

REFERENCES

- Adam, V.W. 1978. Earthscience Data in Urban and Regional Information System - A Review. In Utgard, R.O., Mckenzie, G.D., and Foley, D. (comps.) Geology in Urban Environment, pp.281-300. Minesota: Publishing.
- Ami, H.M. 1900. On the geology of the principle cities of Canada. Trans. Ray. Soc Canada (2nd Series). quoted in McCall, J., and Marker, B. 1989. Earth Science mapping for Planning, Development and Conservation, pp. 211-230. London: Graham & Trotman.
- Arey Jivoraruk. 1995. Minning Management Information System Project. Proceeding of a conference on Progression and Vision of Geological Resources Development of DMR. Bangkok: DMR. (in Thai)
- Arnould, M., Broquet, J.F., Deveughele, M., and Usseglio Polaterra, J.M. (1979). Cartographie geotechnique de la ville de Paris - premieres realisations (13eme, 19eme and 20 eme Arrondissements). Bull. Int. Assoc. Eng. Geol., 19, pp. 109-115. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Atwater, B. (1978). Central San Mateo County, California Landuse controls arising from eorsion sea cliffs, landsliding and fault movement. In Robinson, G.D., and Spicker, A.M., (eds.), Nature to be Commanded. USGS Prof.Paper. No.950, pp.11-20. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning,

- Development and Conservation, pp.211-230. London: Graham & Trotman.
- Bell, F.G. 1983. Engineering properties of Soils and Rocks. London: Butterworth.
- Bird, E.C.F. 1984. Coast. Oxford: Basil Blackwell.
- Bouma, J., and Bregt, A.K. (eds.) 1988. Land quality in Space and time, Proceeding of a Symposium organized by The International Society of Soil Science (ISSS). Wageningen: The Netherlands: Pudoc Wageningen.
- Brew, D.A. (1974). Environmental Impact Analysis, the Example of the Proposed Trans-Alaska Pipeline. USGS Circular No.695, 16 pp. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Brew, D.A., and Gryc, G. (1974). The analysis fo the impact of oil and gas pipeline systems on the Alaskan environment Internat. Congress Foundation Francais d' Etudes Nordiques : Arctic Oil and Gas - Problems and Possibilities 5eme, Le Havre, May 2-5, 1973 (Proceedings). quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Briggs, R.P. (1977). Environmental Geology, Allegbeny County and Vicity, Pennsylvania : Description of a Program and its Results. USGS Circular, No.747. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp. 211-230. London: Graham & Trotman.
- Cargo, D.N., and Mollory, B.F. 1977. Man and His Geologic Environment, pp.476-479. Manila: Addison-Wesley.

- Cendrero, A. 1975. Environmental Geology of the Santander Bay Area. Journal of Environmental Geology 1, pp.97-114. New York: Springer-Verlag New York Inc.
- Cendrero, A., Nieto, M., Robles, F., and Sanchez, J. (1986). Geoscientific map of the province of Valencia. Diputacion Provincial de Valencia, Servicio de Recursos Geologicos. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Chaiyan Hinthong. 1992. Environmental Geology : A Thematic Map for Land-Use Planning in the Lampang Area, Northern Thailand. In Charoen Piancharoen et al. (eds.), Proceeding of a National Conference on Geologic Resource of Thailand : Potential for Future Development. 17-24 Nov. 92. Bangkok. DMR.
- _____. 1995. The Study of Active fault in Thailand. Proceeding of a Conference on Development and Vision of Geological Resources Development, pp.129-146. Bangkok. DMR.
- Chaiyudh Khantaprab and Niwat Boonop. 1988. Urban Geology of Bangkok Metropolis : A Preliminary Assessment Geology and Urban Development. Atlas of Urban Geology (vol.1). PP.107-136. ESCAP.
- Chandler, P., and McCall, G.J.H. (1986). Stratigraphy and structure of the Plymouth-Plymstock area, a preliminary revision. Proc.Ussber Society. 6, pp.253-257. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp. 211-230. London: Graham & Trotman.
- Chapin, F.S. 1965. Urban Land-Use Planning. 496 p. Illinois Press.: Urban University. quoted in McCall, J., and

- Marker, B. 1989. Earth Science mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Cheerapan Tanapipat et al. 1982. Environmental Geology of Chiang Mai. Proceeding of Symposium on Soil, Geology and Landform - Impact on Land Use Planning in Developing Countries, pp.B15.1-B15.6. Bangkok.
- Christenson, G.E., Pewe, T.L. et al. (1979). Environmental Geology of the McDowell Mountains Area, Maricopa County, Arizona. State of Arizona Bureau of Geology and Mineral Technology, Geologic Investigation Series, Maps G1 series. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Chulalongkorn University. Faculty of science. Remote Sensing and Natural Resources Project. 1986. Map of Tourism Sites of Thailand. Bangkok. Submitted to Tourism Authority of Thailand.
- _____. Faculty of Science. 1989. The Construction of Master Plan for Natural Conservation. Bangkok. Submitted to NRCT. (in Thai)
- Cleaves, E.T., Crowley, W.P., and Kuff, K.R. (1974). Geologic and Environmental Atlas - Towson Quadrangle. Maryland Geologicla Survey. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Cloud, P.E. 1969. Resource and Man : a study and recommendations. p.259. California: W.H.Freeman and Co., San Francisco.

- Coat, D.R. 1985. Geology and Society. New York: Chapman and Hall.
- Coates, D.R. 1981. Environmental Geology, pp.568-572. Toronto: John Wiley & Sons.
- Cook, R.V., and Doornkamp, J.C. 1974. Geomorphology and Environmental Management. Oxford: Clarendon Press.
- Costa, J.E., and Baker, V.R. 1981. Surficial Geology : Building with the Earth. New York: John Wiley & Son.
- Crosby, E.J., Hansen, W.R., and Pendleton, J.A. (1978). Guiding development of gravel deposits and unstable ground. In Robinson, G.D., and Spieker, A.M., (eds.) Nature to be Commanded, USGS Prof. Pap. No.950, pp.30-41. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Davidson, A.D. (ed.). 1986. Land Evaluation. New York: A Hutchison Ross Publication.
- Davidson, E.S., Feth, J.H., and Spieker, A.M. (1978). Tucson Arizona; Controlling hillside development; protecting and conserving mineral and water resources. In Robinson G.D., and Spieker, A.M. (eds.). Nature to Commanded. USGS Prof.Pap.No.950, pp.30-41. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- De Beer, E., Fagnoul, A., Lousberg, E., Nuyens, J., and Macrtens. J. (1980). A reiew of engineering geology mapping in Belgium. Bull. Int. Assoc. Eng. Geol., 21, pp. 91-98. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.

- De Murder, E.F.J., and Bakker, B. 1989. Construction. In McCall, J., and Marker, B. (eds.). Earth Science Mapping for Planning, Development, and Conservation, pp. 175-178. London: Graham & Trotman.
- De Chiara, J., and Koppelman, L.E. 1978. Site Planning Standards. New York. McGraw Hill.
- Dent, D., and Young, A. 1981. Soils Survey and Land Evaluation. Quated in Davidson (ed.). 1986. Land Evaluation. P.197. New York: A Hutchison Ross.
- DLD. (Department of Land Development). 1981. Soil Erosion in Thailand. 37 p. Bangkok: DLD. Ministry of Agriculture.
- _____. Soil Classification Division. 1977. Soil Survey Report of Changwat Prachuap Khiri Khan. Bangkok: Soil Survey Division. DLD.
- _____. 1981. Soil Erosion in Thailand. 37p. Bangkok: DLD. Ministry of Agriculture.
- _____. 1982. Landuse Map of Changwat Prachuap Khiri Khan (Scale 1:100,000). Bangkok. DLD.
- _____. Landuse Planning Division. 1990. Landuse Plan of Changwat Prachuap Khiri Khan. Bangkok: DLD. (in Thai)
- DMR. (Department of Mineral Resource). Geological Survey Division. 1976. Geological map of Hua Hin Area (ND47-15), scale 1:250.000. Bangkok: Geological Division. DMR.
- _____. 1983. Geologic Map of Thailand, Explanation for Western Sheet (Scale 1:500,000). Bangkok: Geologic Survey Division. DMR.
- _____. 1977. Geological Map of Changwat Prachuap Khiri Khan Area (ND 47-3), Scale 1:250,000. Bangkok: Geological Survey Division. DMR.

- _____. 1977. Geological Map of Kraburi Buri Area (ND 47- 7), scale 1:250,000. Bangkok: Geological Survey Division. DMR.
- _____. 1983. Geological Map of Western Thailand, scale 1:500,000. Bangkok: Geological Survey Division. DMR.
- _____. 1987. Geological investigation Report of Hui Yang Area, scale 1:50,000. Bangkok: Geological Survey Division. DMR.
- _____. Groundwater Division. 1976. Geohydrologic Map of Western, Lower and Easter Thailand, scale 1:500,000. Bangkok: Groundwater Division DMR.
- _____. 1978. Geohydrologic Map of Sourthern Thailand, scale 1:500,000. Bangkok: Groundwater Division. DMR.
- _____. 1993. Record of Well : Changwat Prachuap Khiri Khan. 46 p. Bangkok: Groundwater Division. DMR.
- _____. Mineral Resources Development Project. 1992. Mineral and Natural Fuel Resources map of Thailand (Sheet III), scale 1:500,000. Bangkok: DMR.
- _____. Survey Division. 1992. Mineral Concession Map of Changwat Prachuap Khiri Khan, scale 1:250,000. Bangkok: DMR.
- Doornkamp, J.C. (ed.). 1988. Planning and Development : Applied Earth Science Background. Torbay. Geomorphological Services Ltd., UK: Newput Pagnell.
- Doornkamp, J.C. 1989. Hazard. In McCall, J., and Marker, B. (eds.), Earth Science Mapping for Planning, Development, and Conservation, pp.157-172. London: Graham & Trotman.
- Doornkamp, J.C. et al. 1985. The GSL Report on Environmental Geology Mapping. Geomorphological services Ltd, (2 vols., Department of the Environment London, Open File Report. quoted in McCall, J., and Marker, B. 1989.

- Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Dubrovolny, E., and Schmall, H.R. 1968. Geology as applied to urban planning : an example from the Greater Anchorage Area Borough. Alaska. Proc. 23 International Geological Congress 12, pp.39-56. quoted in Frederick, B.JR. (ed.). 1975. Environmental Geology. Pennsylvania: Dowden, Hutchinson & Ross, Inc.
- Dune, T., and Leopold, L.B. 1978. WATER in Environmental Planing, pp.491-710. San Francisco: W.H. Freeman.
- Echevarria, C.M.R. 1967. Geotecnied y mopas geotecnicos. Not y com. del Instituto Geologico y Minero Espana. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp. 211-230. London: Graham & Trotman.
- Eelaart, A.L. 1972. Climate and Crops in Thailand, Report SSR-96. Bangkok: Soil Survey Division. DLD.
- El-Sabh, M.I., and Murty, T.S. (eds.). 1988. Natural and Man-Made Hazards. Boston: D. Reidel Pub.
- ESCAP Secrariat. 1988. Geological Information for PLanning in Bangkok, Thailand. Geology and Urban Development, Atlas of Urban Geology (vol.1), pp.24-60. ESCAP.
- Fagan, J.J. 1974. The Earth Environment. New Jersey: Prantice-Hall, Inc.
- Fairbridge, R.W. 1971. Society and Geomorphology in. Coat, D.R. (ed.). Environmental Geomorphology, pp.215-220. quoted in Federick, B.JR. 1975. Environmental Geology.
- Flawn, P.T. 1970. Environmental Geology-Conservaton, Landuse Planning and Resource Management, p.313. New York: Harper and Row.

- Floyd, J.D. et al. (1982). Environmental geology mapping, South East Edinburgh. British Geological Survey, Edinburgh, Open File Report. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Forster, A., Hobbs, P.R.N., Wyatt, R.J., and Entwisle, D.C. (1986). An Environmental geology study of parts of West Willshire and Southeast Avon. British Geological Survey, Keyworth, Open File report. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Foster, H.D. 1980. Disater Planning. New York: Springer-Verlag.
- Frederick, B.JR. (ed.). 1975. Environmental Geology. Pennsylvania: Dowden, Hutchinson & Ross, Inc.
- Freeman, Fox Ltd. (1987). Investigation of ground characteristics in the area around Chacewater and St.Day in the county of Cornwall (5 vols). Dept.of the Environment, London, Open File Report. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Froelich, A.J., Garnaas, A.D., and Van Driel, J.N. (1978). Franconia Area, Fairfax County, Vierginia, planning a new community in an urban setting-Lehigh. In Robinson, G.D., and Spieker, A.M. (eds.). Nature to be Commanded, USGS Prof. Pap. No. 950, pp. 69-89. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for

- Planning, Development and Conservation, pp.211-230.
London: Graham & Trotman.
- Gandner, M.E., and Johnson, C.G. 1978. Engineering Geological Map for Regional Planning. In Utgard, R.O., Mckenzie, G.d., and Foley. D. (comps.). Geology in Urban Environment, pp.256-264. Minesota: Burgess Publishing.
- Genderen, J.L.V., and other. 1992. Environmental Information Systems for Coastal Zone Management in Developing Countries. Proceeding of the First Thematic Conference Remote Sensing for Maine and Coastal Environments, pp. 647-656. Louisiana: Environmental Research Institute of Michigan.
- Geomorphological Services Ltd. (1988). Earth Science Mapping for Planning and Development, Torbay. Department of the Environment Open File Report. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Gilsanz, J. de P. et al. (1985). Mapafisiografico de Madrid. Escale 1:200000. Comunidad de Madrid. Consejeria de Agricultura y Granaderia. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Glaser, J.D. (1976). An Arundel County : Geology, Mineral Resources, Land Modifications and Structural Conditions. Maryland Geological Survey, County Atlas No.1. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp. 211-230. London: Graham & Trotman.

- Godfrey, A.E. 1977. A Physiographic Approach to Land Use Planning. Journal of Environmental Geology 2, pp.43-50. New York: Springer-Verlag New York Inc.
- Gold, P.D. 1980. Structural Geology. In Siegal, S.B., and Gillespie, R.A. (eds.). Remote Sensing in Geology. New York: John Wiley & Son.
- Gonzalez de Vallejo (1977). Engineering Geology for Urban Planning and Development with an example from Tenerife, Canary Islands. Bull. Int. Assoc. Eng. Geol. 15, pp. 37-43. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Goodal, B., and Kirby, A. (eds.). 1978. Resource and Planning. 367 p. Oxford: Pergamon Press.
- Gostelow, T.P., and Browne, M.A.E. (1986). Engineering Geology of the Upper Forth Estuary. British Geological Survey Report 16, No.8, HMSO, London. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Grant, K. 1986. The PUCE Programme for Terrain Evaluation for Engineering Purposes.I.Principles. In Davidaon, A.D., (ed.). Land Evaluation, pp.115-144. New York: Hutchinson Ross Pub.
- Griggs, G.B., and Gildrist, J.A. 1977. The Earth and Land Use Planning. Massachusetts: Duxbury Press.
- Hackett, J.E. 1967. Geology and Physical Planning. Water, Geology and the Future, pp.83-90. Indiana University, Water Resource Research Center. quoted in Frederick, B.JR. (ed.). 1975. Environmental Geology. Pennsylvania: Dowden, Hutchinson & Ross, Inc.

- Hay, W.C., and Viney, J.D. 1969. Environmental Geology in Town and country. Missouri Geol. Surv. and Water Resource Educ. Ser.2. quoted in Frederick, B.JR. (ed.). 1975. Environmental Geology. Pennsylvania: Dowden, Hutchinson & Ross, Inc.
- Helley, E.S., and Lajoie, K.R. et al. (1979). Flatland Deposits : their Geology and Engineering Properties and their Importance to Comprehensive Planning. USGS Prof.Pap.943. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Hill, C.L., and other. 1991. Our Changing Landscape. US Geological Survey Circular 1085. Toronto: John Wiley & Sons.
- Hopkin, L.D. 1977. Method for Generating Land Suitability Maps Accomparative Evaluation. Jounal of the American Institute of Planners 43, pp.386-400. New York.
- Howard, A.D., and Remson, I. 1978. Geology in Environmental Planning, pp.381-414. New York: McGraw-Hill.
- Huxhole, W.E. 1991. An Introduction to Urban Geographic Information System. Oxford: Oxford University Press.
- IGU (International Geographic Union. (undate). Commission. on Geomorphological Survey and Mapping. quated in Zuidam, R.A. 1985. Aerial Photo-Interpretation in Terrain Analysis and Geomorphologic Mapping, p.38. Ehschede: Smits Pub.
- Jacobs, A.M. (1971). Geology and planning in St.Clair County, Illinois. Illinois State Geological Survey Circular No. 165. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.

- Johnson, R.B. 1972: The Role of State Government in Coastal Management Mapping. Proceeding of A Symposium on Coastal Mapping, pp.39-53. Virginia: American Society of Photogrammetry.
- Johnson, R.B., and De Graff, J.V. 1988. Principle of Engineering Geology, pp.57-64. New York: John Wiley & Son.
- Kasem Kullapradith. 1994. Ecological Vocabulary. In Journal of Ecology vol.21, no.3, p.90-91. Bangkok: Faculty of Environmental and Resource Studies. Mahidol University.
- Keller, E.A. 1976. Environmental Geology, (2nd ed.). Ohio: Abell & Howell Company. quoted in Surachai Sompadung. 1992. Environmental Geology of Changwat Sara Buri. Master's Thesis. Chulalongkorn University.
- Kinsley, C. 1987. Town Geology. London daldy, Isbister and Co.
- Langer, W.H., and Johnson, L.H. (1978). East Granby : A plan for development of a rural community. In Robinson, G.D., and Spieker, A.M., (eds.). Nature to be Commanded, USGS Prof. Pap. No.950, pp.47-51. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Legget, R.F. 1973. Cities and Geology. New York: McGraw Hill.
- Legget, R.F., and Kanou R.F. 1983. Geology in Civil Engineering. New York: McGraw-Hill.
- Lewis, A.M. 1989. Water. In McCall and Marker (eds.). Earth Science Mapping for Planning, Development and Conservation, pp.53-76. London: Graham & Trotman.
- Livingston and Blagney. 1971. Environmetal design study - open space VS. development, final report to the city of

- Palo alto. quoted in spangle et al. 1978. Earthscience Information in Land-Use Planning-Guidelines for Earthscientise and Planners. In Utgard et al. (comps.) Geology in Urban Environment, p.319. Minesota: Bungess Publishing.
- Loelkes, G.L., and other. 1993. Landuse/Landcover and Environmental Photointerpretation keys. US. Geological Survey Bullatin 1600, pp.4. New York: Longman Scientific & Technical.
- Lozinska-Stipien, H. (1979). Engineering geology maps at a scale 1:25,000 for regional planning purposes. Bull. Int. Assoc. Eng. Geol., 19, pp.69-72. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Luksamee Jeawetchasin. 1992. Preliminary Environmental Geology Assessment of Ratchaburi Province. Senior Project. Department of Geology, Chulalongkorn University.
- Luttig, G. 1971. Die Bodensohatze des Nordsu-Kustm-raumes and lhre Bedeutung for Landues planning and Raumordnung. N. Arch.f. Nieders., 21 pp.1:13-25. Gottingen. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation. London: Graham & Trotman.
- _____. 1989. Potential and Future Prospects - Earth Science Mapping for Rational Management of National Resources and the Environment. In McCall and Marker (eds.). Earth Science Mapping for Planning Development and Conservation, pp.237-248. London: Graham and Trotman.

- Manuwadi Hungspreugs et al. 1992. Environmental Site Appraisal Block B5/27 Gulf of Thailand. Bangkok: Submitted to British Gas Thailand. (unpublish)
- Marker, B., and McCall, J. 1989. Environmental Geology Mapping. In McCall, J., and Marker, B. (eds.). Earth Science Mapping for Planninf, Development, and Conservation, pp.204. London: Graham & Trotman.
- Marsh, W.M. 1978. Environmental Analysis for Land Use and Site Planning. New York: McGraw Hill.
- Matula, M. 1965. Regional engineering geological characteristics of the Zvalen Basin. Acta Geo. et. Geograph. UC Geologica, 10. Bratislava. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation. London: Graham & Trotman.
- Matula, M., and Letko, Vl. (1980). Engineering geology in planning the Metropolitan Region of Bratislava. Bull. Int. Assoc. Eng. Geol., 22, pp.139-145. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Mazeas, H., and du Mouza, J. (1979). Cartographic geotechnique des formations superficielles et zones non-urbanisees. Bull. Int. Assoc. Eng. Geol., 19, pp.47-52. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- McCall, G.J.H. et al. (1985). Environmental Geology Study of The Area around Plymouth and Plymstock. Department of the Environment, London, Open File Report, 2 vols and maps. quoted in McCall, J., and Marker, B. 1989.

- Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development, and Conservation. London: Graham & Trotman.
- McHarg. 1969. Design with Nature. New York: National History Press.
- McLoughlin, J.B. 1973. Urban and Regional Planning : A System Approach. (3rd edition). New York: Praeger.
- Mcdonic, G.F. 1987. Planning and Geology. In Cielshow; M.G. et al (eds.). Planning and Engineering Geology, Geol. Soc. London Eng. Geo. Spec. Publ. no. 4. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation. London: Graham & Trotman.
- Mckenzie, G.D., and Utgard, R.O. (comps). 1972. Man and His Physical Environment (2nd edition). Minnessota: Burgess Publishing.
- Merla, A., Merlo, G., and Olivieri, F. (1976). Detailed engineering geology mapping in selected Italian mountain areas : methodology and examples. Bull. Int. Assoc. Eng. Geol., 14, pp.129-135. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Mitchell, B. 1979. Geography and Resource analysis, pp.1-16. London: Longman Scientific & Technical.
- Mitchell, C.W. 1991. Terrain Evaluation, pp.4. New York: Longman Scientific & Technical.
- Montgomery, C.W. 1986. Environmental Geology (2nd edition). Dubuque: Web Pububligher.

- Montgomery, H.B. 1969. Environmental Analysis in Local Development Planning. In Frederick, B.J.R. (ed.). Environmental Geology, pp.324-334. Stroudsburg: Dowden, Hutchinson & Ross, Inc.
- Montri Choowong. 1992. Preliminary Environmental Geological Assessment for Regional Planning in Changwat Saraburi, Central Thailand. Senior Project, Department of Geology, Chulalongkorn University.
- Naiyana Kullapavit. 1995. Mining Environment Master Plan. In Proceeding of a conference on Progression and Vision of Geological Resources Development of DMR, pp.27-36. Bangkok: DMR. (in Thai)
- Nickless, E.F.P. et al. (1982). Environmental Geology of the Glenrothes District. Fife Region. Description of 1:25,000 sheet No.20. Report of the Institute of Geologica Sciences. HMSO. London. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Nieto Salvatierra, M., and Obarti Segreera, J. (1988). Environmental Cartography and Management of Natural Resources. Service of Geological Resources, Provincial Diputation of Valencia. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Nijkamp, P. 1984. Information systems. A General Introduction. In Nijkamp, P., and Rietveld (eds.). Information Systems for Integrated Regional Planning, pp.3-33. North-Holland: Elsevier Science Publishers.

- Nilson et al. 1979. Categories of Slope Stability. quoted in Ortalano L. 1984. Environmental Planning and Decision Making. New York: John Wiley and Son.
- Nikorn Mungkung. 1992. Preliminary Environmental Geological Assessment for Regional Planning in Changwat Chacheangsao, Eastern Thailand. Senior Project, Department of Geology, Chulalongkorn University.
- Noppadon Kornsilpa. 1991. Engineering Geology Investigation and Thematic Mapping of The Lower Rayong Area, Thailand. Master Thesis, AIT.
- Ortalano, L. 1984. Environmental Planning and Decision Making. New York: John Wiley & Son.
- Panichapong, P. 1986. Role of Geology and Geomorphology in Land use Planning. In Narong Thiramongkol (ed.). Proceedings of The Workshop on Economic Geology, Tectonics Sedimentary Process and Enviroment of Quaternay in Southeast Asia, pp.265-270. HaadYai, Thailand: IGCP.
- Pesek, J. and Rybar, J. 1961. An illustration of engineering-geological condition in the map 1:25,000. Geol. Exploration, 3, pp.45-47. Prague. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation. London: Graham & Trotman.
- Pisidhi Karasudhi, Prinya Nutalaya, and Chiu, A.N.L. (eds.). 1987. Proceeding of US-ASIA Conference on Engineering Mitigating Natural Hazards Damage. Bangkok: AIT.
- Pitman, J.I. 1985. Thailand. In Bird, E.C., and Schwartz, M.H. (eds.). The World's Coastline, pp.771-787. New York: D. Van Nostrand Company.

- Prasit Tongyingsiri. 1994. Environmental Impact Assessment of Projects. Institute of Social Technology Journal (Rompruk), June-Oct. 1994. Bangkok: Mind Publishing. (in Thai)
- Prinya Nutalaya, et al. (eds.). 1982. Soil, Geology and Landforms : Impact on land use planning in Developing countries, Proceeding of the 1st International Symposium. Bangkok: AIT.
- Radbruch - Hall D.H., Edwards, K., Batson, R.M. 1987. Experimental Engineering-Geology and Environmental-Geologic Maps of the Conterminous United States. U.S. Geological Survey Bulletin 1610.
- Radbruch-Hall, D.H. 1979. Environmental aspects of engineering geological mapping in the United States. Bull. Int. Assoc. Eng. Geol., 19, pp.351-358. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Rijks Geologische Dienst and Stichting voor Bodemkartering/Dienst Grondwater verkenning TNO. (undated). Sub-soil Uncovered. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Ronai, A. 1979. Fundamentals of engineering geology maps. Bull. Int. Assoc. Eng. Geol., 19, pp.62-68. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Sang-Arthit Chuaviroj. 1995. The relation of fault in Thailand and adjacent area. In Proceeding of a

- Conference on Progression and Vision of Geological Resource Development, pp.119-128. Bangkok.
- Santhad Rojanasoonthon. 1964. Interim reports in the great soil group survey II : Pran Buri Study Area. Mobility Environmental Research Study in THAILAND, No.31. Bangkok: DLD., and Kasetsart University.
- Sasin Chalermklarp. 1990. Geology for the Use in Conservation and Sustainable Development of Khao Sam Roi Yord National Park and Adjacent Area. Senior Project. Department of Geology, Chulalongkorn University.
- Scholten, J., and Chamlong Siriphant. 1973. Soils and Landforms of Thailand. Report SSR-97. Bangkok: Soil Survey Division. DLD.
- Somsak Tachirichitpaisan. 1990. Analysis of the geotechnical land use of the Songkla area. Master's Thesis, AIT.
- Spangle, W. et al. 1978. Earth-Science Information in Land-Use Planning-Grid lines for Earth Scientist and Planners. In Utgard, R.O., Mckensie, G.D., and Foley (comps.). Geology in the Urban Environment, pp.302-324. Minnessota: Burgess Publishing.
- St-Onge, D.A, Kugler, M., and Scott, J.S. 1975. Geoscience and Planning the Future. In Feduic, B.JR. (ed.). Environmental Geology. Pennsylvania: Dowden, Hutchinson & Ron, Inc.
- Strahler, A.N., and Strahler, A.H. 1973. Environmental Geoscience : Interaction between Natural Systems and Man, pp.511. California: Hamilton Publishing Co. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, London: Graham & Trotman.

- Sunya Sarapirome. 1981. Environment geology of area along the Eastern Coast Upper Gulf of Thailand, Master's thesis, Chulalongkorn University.
- _____. 1992. A Terrain Evaluation System and GIS for road corridor selection applicable to intermontane basin in Northern Thailand. Doctor's Thesis. McGill University. Montreal.
- Sonthaya Choksattakig. 1992. Relation of Lineaments from Thematic Mapper with Mineral Deposits in Nam Ngat and Nam Mae Wang Areas, Changwat Chiang Mai, Chiang Rai and Lampang. Senior Project. Department of Geology, Chulalongkorn University.
- Supat Wongwiset et al. 1990. The Investigation of Coastal Erosion on The West of Gulf of Thailand. Bangkok: NRCT. (in Thai)
- Surachai Sompadung. 1992. Environmental Geology of Changwat Saraburi. Master's thesis, Chulalongkorn University.
- Surapol Sudara. 1990. "Coast" The Neglected Area. In Surapol Sudara (ed.). Proceeding of Conference on The Conservation of Natural Resources and Environment (1st), pp.42-44. Bangkok: Organization of Environmental Conference' 90. (in Thai)
- Suwit Pradittan et al. 1989. Preliminary Study on Geology and Petroleum Potential of Khao Sam Roi Yord National Park and Amphoe Muang Prachuap Khiri Khan. Bangkok: Natural Fuel Division, DMR. (unpublish, in Thai)
- Tanapipat, C., Ramingwong, T., and Lerdthusnee, S. 1982. Environmental Geology of Chiang Mai. In Prinya Nutalaya et al. (eds.). Proceeding of Symposium on soil, Geology and Landform : Impact on Land Use Planning in Developing Countries, pp.B15.1-B15.6. Bangkok: AIT.

- Tanawat Jarupongsakul. 1995. Environmental Geoscientific Assessment of Two Potential Sites for Proposed Satellite Cities of the Bangkok Metropolis. Final Report. Bangkok: The Toray Science Foundation Research Affairs Division, Chulalongkorn University.
- Tank, R.W. 1976. Focus on Environmental Geology, (2nd edition). New York: Oxford University Press.
- Thailand Institute of Science and Technology. 1983. Master Plan for Coastal Land Development, Prachuap Khiri Khan Province. Bangkok: Submitted to DLD. (in Thai)
- _____. 1987. Master Plan of Tourism Development Changwat Prachuap Khiri Khan. Bangkok: Submitted to Tourism Authority of Thailand. (in Thai)
- Thiva Supajanya, Sasin Chalermklarp, and Veerrot Daorerk. 1991. Geomorphological Investigation by SPOT Image Interpretation for Conservation and Sustainable Development of Khao Sam Roi Yord National Park. Proceeding of Conference "Dr. Sathit Watcharakitti" (2nd). Bangkok: NRCT. (in Thai)
- Tinnakorn Ta-thong. 1994. Environmental Geology of Map sheet Amphoe Had Yai (5023 II) and Map Sheet Ban Na Si Thong (5023 III). Technical Annual Meeting 1994 Geological Survey Division. Bangkok: DMR.
- Tonnies, G. (1987). Spatial arrangement and regional planning in the Federal German Republic. In Arndt, P., and Luttig, G., (eds.). Mineral Resources Extraction, Environmental Protection and Land Use Planning in Industrial and Developing Countries. E. Schweitzerbart, Stuttgart, pp.73-82. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning,

- Development and Conservation, pp.211-230. London: Graham & Trotman.
- Toy, T.J., and Hadley, R.F. 1987. Geomorphology and Reclamation of Disturbedland. New York: Academic Press, Inc.
- U.S. Geological Survey and Department of Housing and Development. 1971. Program design, 1971 : San Francisco Bay Region Environment and Resource Planning Study. quote in Adam V.W. 1978. Earthscience Data in Urban and Regional Information Systems - A Review. In Utgard, R.O., McKenzie, G.D., and Foley, D. (comps.). Geology in Urban Environment, pp.284-285,294. Minnesota: Burgess Publishing.
- UNESCO. 1976. Engineering Geological Maps : A Guide to their Preparation. Paris: UNESCO.
- Utgard, R.O., McKenzie, G.D., and Foley, D. (comps.). 1978. Geology in Urban Environment, pp.240-242. Minnesota: Burgess Publishing.
- Valdiya, K.S. 1987. Environmental Geology. New Delhi: TATA McGraw-Hill.
- Van Dorsser, H.J., and Salome, A.I. 1982. Example of 1:50,000 scale Geomorphological maps of part of the Ardennes. In Morenson, W.V.H. (eds.), Z. Geomorphology.N.F., December 1982, pp.479-487. Berlin: Gebruder Borntraeger.
- Van Zuidam, R.V. 1982. Considerations on Systematic Medium Scale Geomorphological Mapping. In Morenson, W.V.H. (eds.), Z. Geomorphology.N.F., December 1982, pp.473-479. Berlin: Gebruder Borntraeger.

- _____. 1985. Aerial Photo-Interpretation in Terrain Analysis and Geomorphologic Mapping. Netherland: Smits Publishers.
- Vitton Perawat. 1986. Master Plan of Khao Sam Roi Yord National Park. Bangkok: National Park Division. Department of Forest. (in Thai)
- Vorawut Tantiwanich. 1994. Preliminary Report of Environmental Geology of Changwat Chiang Mai. Technical Annual Meeting 1994. Geological Survey Division. Bangkok: DMR.
- Watkins, J.S. et. al. 1975. Our Geologic Environment. London: W.B. Scandero Company.
- Way, D.S. 1973. Terrain Analysis. Pennsylvania: Dowder, Hutchison & Ross, Inc.
- Wayne, W.J. 1968. Urban Geology - A Need and a Challenge Indiana. Acad. Sci. Proc, pp.49-64. Comm. Sci. Soc., Publ.3.
- Wermund, E.G. et al. 1974. Environmental Geologic Mapping, Southern Edwards Palteau, Southwest Texas. In Davidson, A.D. (ed). Land Evaluation. New York: A Hutchinson Ross Publication.
- William, J.S., and other. 1990. Coast in Crisis. US. Geological Survey Circular 1075, pp.1-27. Toronto: John Wiley & Sons.
- Williams, I. (1983). Geological Reports for DOI : Land Use Planning : the South Humber side Project. Department of the Environment. London. Open File Reports. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.

- Williams, J.W. 1978. Geologic Mapping for Coastal Zone Planning in California-Background and Example. Journal of Environmental Geology, Vol.2, No.3, pp.121-163. New York: Springer-Verlag New York Inc.
- Wilson, D., and Smith, M. (1985). Thematic Geology Maps : Bridgend Area. British Geological Survey Open File Report. quoted in McCall, J., and Marker, B. 1989. Earth Science Mapping for Planning, Development and Conservation, pp.211-230. London: Graham & Trotman.
- Wongwises-Somjai et al. 1989. Coastal Morphology with Empasts on Coastal Erosion and Coastal Deposition. NRCT's Research Report. Bangkok: NRCT.
- Zaw Zaw Aye. 1991. Urban Geology in Land Use Planning of Ban Na San Southern Thailand. Master's thesis, AIT.

APPENDIXES

Appendix A

The collection file of GILM works, collected from various source of data which have been discussed in Chapter II

NOTE

Sources of data

¹ Studied from Marker and McCall(1989), ² ; from rewrite papers, ³ ;from absolute report, ⁴ ; from proposed idea

Diagnosis features of individual maps

Sca-Function of scale : s=Small (<1:100,000), m=Medium (1:25,000-1:100,000), l=Large (1:10,000-1:25,000),

Sit-Situation of information : c=Classic, a=Applied geoscience, o=Non geoscience map, d=Data distribution

Hab-Habit of information : t=Thematic, n=Non thematic

Deg-Degree of inference : l=Low, m=Medium, h=High

Dignosis features of series of maps

1=Aim of works : Specific purposes, Multi-purposes

2=Grouping of map topics : Grouped by subjects, Grouped by degree of inference, Grouped by both of subjects and Degree Inference, or non-significant of grouping of maps

3=Relationship of information : 2 , 3 , 4 stages of relationship, non significant of relationship of maps.

4=Updating of information : Low, Medium, or High updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Arnould et al., 1979 ¹ Paris, France Metropolitan area	Landforms Thickness of deposits Depth to formation tops Erosion Foundation conditions Limestone workings Karst Geotechnical characteristics (zoned)	D to L	a/c a a a a a a	n t t t/n t/n t/n t/n	l l m m l l m/h	1) multi-purposes 2) non significant of grouping of maps' topics 3) non significant of relationship of maps (2 stages, by expected) 4) low updatable
Atwater, B., 1978 ¹ San Mateo County, California Phase 1, 1979 County	Basic geology Flood prone areas Physical character (flatland, hillside) Landslide (incidence, susceptibility) Slope Active faults Earthquake epicenters Tsunamis Sewerage Water supply Pollution Waste disposal Groundwater chemistry	m m m m m m m m m m m m m	c a a a a/c a/c a a a a a a a	n t n t/n t t t t t t t t t	l m l m l l l/m l l l l l l	1) multi-purposes 2) non significant of grouping of maps' topics 3) non significant of relationship of maps (2 stages?, by expected) 4) low updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Atwater, B., 1978 ¹ San Mateo County, California Phase 2 County	Maps cover: Basic geology Bedding dip/slope steepness Hillside materials/ Engineering character Stability during earthquakes Liquefaction susceptibility Predicted seismic shaking intensities Accumulated damage potential/ground shaking Potential earthquake damage to buildings	m m m m m m m	c a a a a a a	n n n t t n n	l l m m m m m	1)specific purpose on earthquake hazard planning 2)non significant of grouping of maps'topics 3)non significant of relationship of maps 4)low updatable
Briggs, 1977 ¹ Allegheny County, Pennsylvania, USA County	Earth disturbance inventory: (a) Land modified by man: Mining Mining related subsidence Mine fires Refuse banks Quarries, pits Slag dumps Urban development Pre-development modification Land modified for transportation Earth and rock fill Near-vertical cuts and cliffs Water impoundments (b) Areas affected by Natural Hazards: Landsliding	m m m m m m m m m m m m s	a a a a a a a a a a a a a	t t t t t t t t t t t t t	l l l l l l l l l m/l l l l	1)specific purpose on hazard planning 2)grouped by subjects 3)non significant of relationship of maps (2 stages?, by expected) 4) low updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
	Mineral deposits Hydrology Amount and location of water Quality of water Precipitation Process Areas of erosion Areas of deposition Geological formation Ages Distribution and outcrops		a/c	t/n	l/m	
Cendrello, 1975 ² Santander Bay, Spain Region of coastal zone	Environmental geologic systems and environmental units General feature of the environmental units Physical properties and active process Assessment of capability Land use units map		a a a o	t/n n n/t t	l l m/n l	1)mult-purposes 2)grouped by degree of inference of maps 3)3 stages of relationship? 4)low to medium updatable
Cendrero et al., 1987 ¹ Valencia, Spain Province	Preliminary geological mapping Geoenvironmental units Vulnerability of water to pollution and Risk flooding Land slide Subsidence Collapse	s s s s s s	c a a a	n n/t n t t t	l m/h m m m m	1)mult-purposes 2)non significant of grouping of maps' topics 3)non significant of relationship of maps (2 stages?, by expected) 4)medium updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
	Seismic risk Risk of potential erosion Conservation capacity Orientation and limitation on land use	s s s s	a a a a	t t t t	m m m/h h	
Chaiyan Hinthong 1992 ² Lampang area, Northern Thailand Province	Land-use and Land-cover map General geological map Groundwater resource map Potential shallow groundwater contamination risk map Mineral resource map Engineering geological risks and hazards map Potential and unfavorable areas for waste disposal sites Land suitability recommendation map	s s s s s s s s s	o c a a a a a a a	t n t t t t t/n t/n t	l l m m m m m/h m/h h	1) multi-purposes 2) non significant of grouping of maps' topics 3) non significant of relationship of maps (2 stages, by expected) 4) low-medium updatable
Chaiyudh Khantaprab and Niwat Boonnop, 1988 ² Bangkok The metropolitan area	Topographic and Landform Hypsographic map Ground elevation Geomorphological map Soil and Land suitability Soil map Land suitability map Land use and land cover map	s s s s s s s	a/c a/c c c a o	t t n t t/n t/n l	l l l l h l	1) ? 2) grouped by subjects of maps 3) non significant of relationship of maps 4) low updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Cheerapan Tanapipat et al 1982 ² Changwat Chieng Mai, Thailand Province	Basic environmental geology Geology and landform Climate and drainage Surface and subsurface water resource Construction material resource Potential hazard and problem Seismic hazard Waste disposal		c a c a a a	n n n t t t	l l l/m m/l m m	1) ? 2) grouped by degree of inference of maps 3) non significant of relationship of maps 4) low updatable
Cleaves, Cronley and Kuff, 1974 ¹ Towson Quadrangle, USA Quadrangle	Geology Landforms: (a) Upland (b) Lowland (c) Floodplain (d) Steepness of slope (e) Relief Estimated thickness of overburden Geological factors affecting land modification Mineral resources/mined land inventory	l l l l l l l l l	c a a a a a a a a	n t t t t t t/n n	l l l l l l m l/m	1) specific purpose on mine planning 2) non significant of grouping of maps' topics 3) non significant of relationship of maps 4) medium updatable
Crosby et al., 1978 ¹ Front Range Urban County	Hillside development and slope stability Resources and their development (minerals; sand and gravel; Water; shrink and swell in soils and rocks) Subsidence due to coal mining	s s s	a a a	n n/t t	l/m m m	1) ? 2) non significant of grouping of maps' topics 3) non significant of rela. 4) low updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Davidson et al., 1978 ¹ Tucson, Arizona County	Hillside development Resource conservation (minerals, water) Control of waste from mining Hazards from old mine workings	m and s	a a a	t t t	l d/h d/h d/h	1)specific purpose on mine effect urban study 2)non significant of grouping of maps'topics 3)non significant of
De Beer et al., 1980 ¹ Liege, Brunels, Mons, Ghent Charleroi, Belgium Cities and Large town	Topography Site locations Thickness of geological formations Depths to tops of specific formations Hydrogeology Engineering geology zones Geological profile (supported by geotechnical properties of the mapped formations)	d to l	c d a a c a -	n t t t n t -	l l l l l m l	1)mult-purposes 2)non significant of grouping of maps'topics 3)non significant of relationship of maps (2 stages?, by expected) 4) low updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Dubrovolmy and Sehmall, 1968 ¹	Topography		c	n	l	1) multi-purposes
	Geology		c	n	l	2) non significant of
	Slopes		a/c	t	l	grouping of maps' topics
Greater Androrage, Alaska, USA	Construction materials		a	t	l	3) non significant of
	Foundation and excavation conditions		a	t	l	relationship of maps
	Stability of natural slopes		a	t	l	4) low updatable
Borough and City area within it (1,730 miles ²)	Recreation areas	s	o	t	l	
	Gravel and surface water (areas of potential development)	and l	a	t	l	
	Groundwater availability		a	t	m	
	Depth of unconfined aquifers		a	t	l	
	Water-table contours		a	t	l	
	Piezometric surface		a	t	l	
	Saturated thickness		a	t	l	
	Principal recharge areas		a	t	l	
	Chemical quality of water		a	t	l	
ESCAP Secretariat, 1988 ²	Regional setting					1) ?
Bangkok	Topography	-	c	n	l	2) grouped by subjects
	Regional structure	s	c	n	l	of maps
	Stratigraphy	s	c/a	t	l	3) non significant of
Metropolitan area	Structure	s	c/a	n	l	relationship of maps
	Geotechnical characteristic of surficial deposit	s	a	t/n	m	4) low updatable
	Earthquake hazard	s*	a	t	m/l	
	Man-induce erosional and depositional process		a	n	m/l	

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
	Distribution, worked ground Water resource Distribution, aquifer Engineering geology Availability of geotechnical test deta Engineering geology of solid deposits Engineering geology of surficial deposits Slope stability Distribution of slope angle and land slip Landfill and waste disposal Distribution of madeground Data distribution Distribution of boreholes Other Site of specific interest	l m m m m m m l l m	a a a a a a a a d a	t n t/n t/n t/n t/n t t t/n	l l l/m m m m l l l l	
Ekkapol Siribhomprasam, 1993 ³ Changwat Suphanburi Province	Environmental Geology Distribution of population map Surface water map Hypsometric map Geomorphological map Slope map Present land use map Geological map Geological resource potential map Hydrological map	s s s s s s s s s	o a a a a o c a c	t n/t t n t t n t n	l l l l l l l m l	1)multi-purposes 2)non significant of grouping of maps'topics? 3)2 stages of relationship 4)low to medium updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Forster et al., 1986, 1987 ¹ West Willshire and South East Avon, England A Small area around the city of Bath	Element and Derived maps: Topography and drainage Solid lithostratigraphy Drift deposits (extent, lithogy, thickness) Made ground/infilled land Distribution of Great Oolite freestone Groundwater Ground conditions related to groundwater Landslipped and cambered strata Slope angle distribution Geotechnical properties (bedrock, superficials) Mining (extent, location of shafts) Location of geotechnical data sources	1 1 1 1 1 1 1 1 1 1 1 1	c c c a a c a a a a a d	n t n t t t n/t n t t/n t t	l l l l l l l l l l l l	1) multi-purposes 2) non significant of grouping of maps' topics 3) non significant of relationship of maps 4) low to medium updatable
Freeman, Fox Ltd., 1987 ¹ Chaeewater, Gruwall, England A small area in whicle there had been intensive copper mining	Element maps: Topography and drainage Drift and outcrop geology Bedrock geology Underground mining Hydrogeology Surface hydrology Mine property boundaries Mineral mining consultation area Derelict land	1 1 1 1 1 1 1 1 1	c c c a c c a d a	n n n t/n n n t/n t t	l l l l l l l l l	1) multi-purposes 2) grouped by degree of inference of maps 3) 2 stages of relationship 4) medium updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
	Derived maps: Underground storage potential Existing and proposed development sites Nature conservation sites Critical and non-critical areas of mine-related hazards	l	a	t	m	
		l	a	n	m	
		l	a	t	m	
		l	a	t	m	
Froelich et al., 1978 ¹ Franconia Area, Fairfax County, Virginia, USA Urban Community	Topography Landforms Geology Hydrology (including drainage, floodprone areas) Surface materials Outcrop (gravel, sand, clay, bedrock) Slope stability Capability for planned housing development	l	c	n	l	1) specific purpose on housing development planning 2) non significant of grouping of maps' topics 3) non significant of relationship of maps 4) low updatable
		l	c	n	l	
		l	c	n	l	
		l	c	n	l	
		l	a	t	l	
		l	a	t	l	
		l	a	t	m	
		l	a	t	h	
Gonsalez de Vallejo, 1977 ¹ Tenife, Canary Island Entire Island, Spain	Geology Geomorphology Engineering geology Urban suitability (hazards, constraints and hydrogeology included)	m	c	n	l	1) specific purpose on urban suitability 2) non significant of grouping of maps' topics 3) non significant of relationship of maps (2 stages?, by expected) 4) low updatable
		m	c	n	l	
		m	a	n	m	
		m	a	n	h	

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Gardner and Johnson, 1978 ⁴ Boulder, Colorado, USA Subdivision of a small hillside	Engineering geologic map Structure and thickness Topographic expansion and surface relief Weathering and ancient soil profiles Workability Excavation Compaction Drilling Surface drainage, and erosion runoff rate erosion susceptibility Groundwater Permeability of rock Water table depth & character Yield to well quality use Suitability for waste disposal Soil absorption septic tanks Sanitary-landfill sites Foundation stability Expansive clay Collapsible silt Subsidence Slope stability Possible failure types Hazardous situations Trench-wall stability		a a c/a a a a a a 1 a a a a a a a a a a a a	n/t n n n t t t t t t t t t t t t t t t t t t t t t	m l l l m m m m m m m m m m m m m m m m m m m m m	1)specific purpose on engineering work? 2)grouped by both of subjects and degree of inference 3)non significant of relationship of maps 4)low to medium updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
	Probable earthquake stability Most hazard potential Use Building & construction material	l	a	t	m	
Geomorphological Services Ltd., 1988 ¹ Torbay, Devon, England The borough of Torbay: a large coastal residential and tounis area	Element maps: Bedrock geology Superficial geology Geomorphology Slope steepness Soils Geotechnical conditions Site geotechnical investigations Sites of mineral working Land use planning provisions Planning map: Ground characteristics for planning and development	m m m m m m m m m m	c c c a c a a a a a	n n n t t n/t t t t t	l l l l l m l l l l	1) multi-purposes 2) grouped by degree of inference of maps 3) 2-3? stages of relationship 4) medium updatable
Gilsanz et al., 1985 ¹ Madrid, Spain Metropolitan area	Physiographic divisions (colour) Superficial deposits (stipple) * Bedrock geology * Bioclimatic divisions * Altitude * Land use	s s s s	a c o a	t n t t	l l l l	1) multi-purposes 2) non significant of grouping of maps' topics 3) non significant of relationship of maps 4) low updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Glaser, 1976 ¹ Ann Arundel County Many, USA	Geology Mineral resources/inventory of mined land Geological factors affecting land modification (combination of environmental hazard variables) (a) Steep slopes (b) Rock ledges (c) Sand and gravel distribution (d) Clay distribution (e) Fine clay/sand/silt distribution (f) Flood plains Shoreline protection structures/beach distribution/ historical erosion rates	m m m m m m m m m	c a a a a a a a	n n t t t t t t n	l l l l l l l l	1)multi-purposes 2)non significant of grouping of maps'topics 3)non significant of relationship of maps 4)low to medium updatable
Gostelow and Browne, 1986 ¹ Upper Forth Estury, An area of 35 x 20 km. ² Scotland	Element maps: Drift thickness/depth to rockhead Contours on the upper surface of glacial deposits Drift geology Distribution of mine workings Derived maps: Engineering geology of solid rocks Engineering geology classification of soft sediments Geotechnical cross-section	m m m m m m m	a a c d a a a	t t n t t/n t/n -	l l l l m m -	1)specific purpose on heavy structures planning 2)grouped by degree of inference of maps 3)3 stages of relationship 4)medium to high updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
County	Resources and minerals (a) limestone (b) sand and gravel (c) clay and shale (d) coal, petroleum water Geological conditions affecting construction: (a) topography (b) surface materials (c) water-table (d) flooding (e) bedrock (f) soil creep Geological conditions affecting solid waste disposal	1 1 1 1 1 1 1 1 1 1 1	a a a a a a a a a a a	t t t t n/t t t t t t n	l/m l/m l/m l/m l l l l l l l	3) non significant of relationship of maps 4) low to medium updatable
Langer and Johnson, 1978 ¹ Connecticut River Valley, Connecticut East Gramby, USA Rural township	Unconsolidated materials Depth to bedrock Slope steepness Areas with seasonal high water-tables Groundwater potential Floodplains Inland wetlands and water courses Natural land use intensities (suitability for development)	1 1 1 1 1 1 1 1	a a a a a a a a	t t t t t t t t	l l l l m l l l h	1) multi-purposes ? 2) non significant of grouping of maps' topics 3) non significant of relationship of maps (2 stages?, by expected) 4) low updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Livingston and Blayney and other, 1971 ¹ Palo Alto Cities	Slope Fault zone Landslide Natural slope stability Cut-slope stability Soil suitable so fill Soil erosion Soil expansion		a a a a a a a	t t t/n t t t t	l l/m m m m m m	1) multi-purposes 2) non significant of grouping of maps' topics 3) non significant of relationship of maps 4) low updatable
Lozinska-Stepien, 1979 ¹ - Regional	Topography Geomorphology Lithogenesis of deposits Hydrogeology Geodynamic processes: (a) aeolian (b) fluvial (c) ravine erosion (d) landslides Geotechnical properties of soils and rocks Potential maps Favarable area for structure foundation Unfavorable area for structure foundation	m m m m m m m m m m	c c c/a c a a a a a a	n n n/t n t t t t t t	l l l l l l l l h/m h/m	1) specific purpose on structure foundation 2) non significant of grouping of maps' topics 3) 2 stages of relationship 4) low to medium updatable
Luksmee Jeawetchasin, 1992 ³	Physiography Climate Landform	s s	o a	t t	l l	1) multi-purposes ? 2) grouped by degree of inference of maps

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Ratchaburi, Thailand Province	Soil and soil suitability for agriculture Land use and land cover Geology Mineral resource Water resource Potential geological hazard Growth potential Agriculture development potential Industrial development potential Residential and commercial development potential Groundwater potential	s s s s s s s s s s s	a o c a a a a a a a a	n t n t t t t t t t t	m/h l l m m m h h h m	3)2 stages of relationship 4)low to medium updatable
Marker and McCall, 1988 ^a	Basic geological map Applied geological map * Mineral resource * Stability/safety Environmental geology map		c a a a	n t t n/t	l m m m/h	1)multi-purposes 2)grouped by degree of inference of maps 3)3 stages of relationship 4)medium updatable
Matula and Letko, 1980 ¹ Batislava Metropolitan area	Trends in urban development The main engineering problems Geoenvironmental factors: (a) seismicity (b) geodynamic processes (c) hydrogeology (d) foundation conditions	m m m m m	o o/a a a c a	t/n t/n t t n t/n	- m l l l m	1)specific purpose on zone of suitability for development 2)non significant of grouping of maps' topics 3)non significant of relationship of maps (2 stages?, by expected)

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
	(e) geomorphology Protection of resources for development Engineering zones Zones of suitability for development	m m m m	c a a a	n t t t	l h m h	4) low to medium updatable
Mazeas and Mouza, 1979 ¹ Carcassonne, France Urban area	Lithology and facies * Alluvium, Colluvium * Glacial * Screens * Residual Soils * Made Ground Hydrogeology Stability Erosion Thickness of deposits	m m m m m m m m	a a a a a c a a	t t t t t n t t	l l l l l l d d l	1) multi-purposes ? 2) non significant of grouping of maps' topics 3) non significant of relationship of maps 4) medium updatable
McCall et al., 1985 ¹ Plymouth, Devon, England Metropolitan area and its fringes	Element and derived maps: Topography (and contour pluck) Solid geology Superficial geology Scale sections of superficial deposits down to rockhead Hydrology (natural drainage and man-made conduits) Hydrogeology (borehole and well distribution; the Plymouth Limestone; marine incursion)	l l l l l l l	c c c a c a a	n n n t n n n	l l l l l l l	1) multi-purposes 2) non significant of grouping of maps' topics 3) non significant of relationship of maps (2 stages?, by expected) 4) low to medium updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
	Location of quarries, mines and caverns	l	a	t	l	
	Location of mineral workings	l	d	t	l	
	Depth to rockhead	l	a	t	l	
	Thickness of weathered zone below rockhead	l	a	t	l	
	Depth to engineering defined bedrock	l	a	t	m	
	Engineering properties of soils and bedrock	l	a	t	m	
	Made ground, reclaimed land, landscaped and terraced areas	l	a	n	l	
McHarg, 1969 ³ Staten Island, New York Subdivision of Staten Island	Major data Bedrock Geology Surficial Geology Hydrology Soil drainage environment Existing land use Historical land mark Tidal inundation Physiographic feature Geologic feature Slope Existing vegetation Existing wildlife habitats Soil Limitations : Foundation Soil Limitations : water-table Forest : Ecological association Forest : Existing Quality					1)multi-purposes 2)grouped by degree of inference of maps 3)3 stages of relationship 4)medium to high updatable
			c	n	l	
			c	n	l	
			c	n	l	
			a	n/t	l	
			o	t	l	
			o	t	l	
			a	t	l	
			a	t	l	
			a	t/n	l	
			a	t	l	
			o	t	l	
			o	t	l	
			a	t	m	
			a	t	m	
			o	t	l	
			o	t	l	

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
	Soil : most-least erosion Value Map		a	t	l	
	Historic feature value		o	t	m/h	
	Existing forest quality		o	t	m/h	
	Marsh quality		a	t	m/h	
	Beach quality		a	t	m/h	
	Stream quality		a	t	m/h	
	Water wildlife value		o	t	m/h	
	Intertidal habitat value		o	t	m/h	
	Geologic feature value		a	t	m/h	
	Physiographic feature value		a	t	m/h	
	Scenic value (land)		a	t	m/h	
	Scenic value (water)		a	t	m/h	
	Ecological associations value		o	t	m/h	
	Suitable areas maps					
	Conservation area map		a	t	h	
	Recreation area map		a	t	h	
	Active recreation suitability		a	t	h	
	Passive recreation suitability		a	t	h	
	Urbanization area		a	t	h	
	Residential suitability		a	t	h	
	Commercial industrial suitability		a	t	h	
	Composite map					
	Conservation/ Recreation/ Urbanization areas		a	n	h	

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Mckenzie and Utgard, 1975 ⁴	Basic Data Map Depth of bedrock Flood hazard Bedrock geology Surficial geology Depth to water table Ground water quality and quantity Resource Capability Map Sanitary landfill Residential development Park and recreation Liquid waste disposal Ground water supply Surface reservoir Resource Suitability Map Location of potential area Other informations		a a c c c/a a	t t n n t t	l l l l l l	1) multi-purposes 2) grouped by degree of inference of maps 3) 3 stages of relationship 4) medium to high updatable
Merla, Merlo and Oliveri, 1976 ¹ - Regional	Subzones of geological conditions Hydrogeological conditions Geomorphology (soil, land use forestry and pasture maps) Engineering geology zoning		a a c a	t n n n	l l l m	1) multi-purposes ? 2) non significant of grouping of maps' topics 3) non significant of relationship of maps 4) low updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Montgomery, 1969 ⁴	Map of basic data AIR Airshed map WATER Ground water geologic map and hydrologic atlas Topography map showing valleys and stream LAND: SOIL AND TOPOGRAPHY Soil map Topographic map Land form maps Orthophoto maps LAND: ROCK Geophysical map LAND: MINERALS Resource geologic map Interpreted basic data AIR Patterns of pollutant WATER Water-supplying strata Groundwater recharge area Groundwater quality LAND: SOIL AND TOPOGRAPHY Surface water flow Thickness		o	t	l	1)multi-purposes 2)grouped by both of subjects and degree of inference 3)3 stages of relationship 4)high updatable
			c	n	l	
			c	n	l	
			c	t	l	
			c	n	l	
			c	t	l	
			c	n	l	
			a	n	l	
			a	n	l	
			a	t	m	
			a	t	m	
			a	t	m	
			a	t	m	
			a	t	m	

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
	Fertility		a	t	m	
	Engineering quality		a	t	m	
	Degree of slope		a	t	m	
	Flood plain		a	t	m	
	LAND: ROCK					
	Strata engineering quality		a	t/n	m	
	LAND: MINERALS					
	Mineral quality or quantity distribution		a	n	m	
	Depth and type of overlying soil and rock		a	n	m	
	Mineral area		a	t	m	
	Mine refuse area		a	t	m	
	Map used in planning					
	AIR					
	Zones showing ability of areas to torelate air pollution resulting from new activity		a	t	m/h	
	WATER					
	Water yield per well or acre foot		a	t	m/h	
	Cost per 1,000 gallons of water		a	t	m/h	
	LAND: SOIL AND TOPOGRAPHY					
	Agricultural products grown, including productivity per acre and dollar value of land		a	n	m/h	
	Size of area required for septic tanks or sewage disposal facilities		a	t	m/h	
	Liquid waste acceptance capacity and cost		a	n	m/h	

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
	<p>per 1,000 gallons Volume of solid waste which can be accomodated per acre and cost per acre of disposal Ground water level and yield Soils by origin Soil slide zones LAND: ROCK Areas requiring intense rock blasting Rockfall and landslide zones Capacity to accept liquid/solid waste LAND: MINERALS Cost per acre for reclamation Subsidence zones Underground mine fire areas Cost per cubic yard or acre for refuse treatment or for quenching or burial of mine fires SPECIAL SITES Location of historic, aesthetic and archeological sites</p>		a	n	m/h	
Montri Chuwong, 1992 ³ Saraburi, Thailand	Surface water map Hypsometric map Geomorphology map Parent material map	s s s s	a c/a c a	t/n t n t	l l l l	1) multi-purposes 2) grouped by degree of inference of maps 3) 3 stages of relationship

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Province	Slope map Landuse map Landcover map Geologic map Potential Map Geological resource potential map Hydrological map Static water level map Development Recommendation Recommendation for regional Planning map	s	a	t	l	4)medium updatable
Noppadon Kornsilapa, 1991 ³ Lower Rayong area, Thailand Part of province	Thematic map Geomorphologic map Ground elevation map Geologic map Depth of water table map Water table contour map Existing borrow pit map Construction material map Foundation practice map		c c/a a a d a a	n t n t t t t	l l l l l l m	1) 7 2)non significant of grouping of maps'topics 3)2 stages of relationship 4) low to medium updatable
Nickless et al., 1982 ¹ Glennothes Fife, Seatland, UK	Element maps (18): Borehole sites Unconsolidated deposits (a) distribution	m m	d a	t t	l l	1)multi-purposes 2)grouped by degree of inference of maps 3)3 stages of relationship

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
A Single Ordnance Survey Sheet, No 20	(b) lithology	m	a	t	l	4)medium to high updatable
	(c) engineering properties	m	a	t	l	
	(d) thickness	m	a	t	l	
	(e) depth to water-table	m	a	t	l	
	Sand and Gravel thickness	m	a	t	l	
	Bedrock Geology	m	c	n	l	
	Rockhead contours	m	a	t	l	
	Shallow undermining	m	a	t	l	
	Natural landslip potential	m	a	t	l	
	Opencast workings	m	a	t	l	
	Resources					
	(a) Hard rock for aggregate	m	a	t	l	
	(b) Brick and tile clay	m	a	t	l	
	(c) Mudstone for brickmaking	m	a	t	l	
	(d) Limestone	m	a	n	l	
	Hydrogeology	m	a	n	l	
	Derived maps (4):					
	Underground storage Potential within 100 m. of the surface	m	a	t	m	
	Sand and gravel potential	m	a	t	m	
	Foundation conditions	m	a	t	m	
Groundwater resources	m	a	t	m		
Potential maps (5):						
Development potential	m	a	t	h		
Priority areas for on-site investigation	m	a	t	h		
Mineral resources						

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Radbruch-Hall, Edwar, Batson, 1987 ³ Conterminous United States All of United State	Landslide Seismic probability Volcanic hazard Karst Expansive materials Standing water Steep slopes Experiment maps Engineering geologic map Environmental geologic map	s s s s s s s s s s	a a a a a a a a a a	t t t t t t t t t t	m m m l l l l l m m	1)multi-purposes 2)non significant of grouping of maps'topics 3)2 stages of relationship 4)low updatable
Rijks Geologische Dunst et al., undate ¹ Durteu, Netherland Area of flat level former flood basin terrain bordering the river Waal around the town	Element maps include: Industrial minerals Aggregate minerals Derived maps include: Foundation conditions Preparation of building sites Settlement	m m m m m	a a a a a	t t t t t	l/m l/m m h h	1)specific purpose on building site/ settlement 2)grouped by degree of inference of maps 3)2 stages of relationship 4)low updatable
Rodbruch-Hall, 1979 ¹ North Slope Alaska Ammense Area (the	Drift geology Bedrock Mineral resources (coal, metals, construction minerals, vein minerals, industrial minerals)	s s s	c c a	n n n/t	l l l/m	1)multi-purposes 2)non significant of grouping of maps'topics 3)non significant of relationship of maps

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
national Petroleum Reserve) companion study of a large area of the Mekenzie District of Canada	Ecological areas Areas important for arctic foxes, wolf packs etc.	s s	o o	t t	l/m m	4) low updatable
Ronai, 1979 ¹ Part of the great plain, Hungary Province	Climate Hydrology Bedrock Soils Foundation conditions Slope stability Seismic risk	s s s s s s	c c c c a a	n n n t t t	l l l l m m	1) multi-purposes 2) non significant of grouping of maps' topics 3) non significant of relationship of maps (2 stages?, by expected) 4) low to medium updatable
Ronai, 1979 ¹ Budapest, Hungary Metropolitan area	Topography Relief Hydrography Geology	l/m l/m l/m l/m	c c c c	n n n n	l l l l	1) multi-purposes 2) non significant of grouping of maps' topics 3) non significant of rela. 4) low updatable
Sasin Chalermklarp, 1990 ³ Khao Sam Roi Yod National Park The park area and adjacent area	Drainage map Geologic map Soil map Surface geologic map Sinkhole & linearment map Land use map Frora resource map	s s s s s s	a c c c a o	t n t n n t	l l l l l l	1) multi-purposes 2) non significant of grouping of maps' topics 3) non significant of relationship of maps 4) low updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Somsak Tachirichitpaisan, 1990 ³ Songkla area Part of province	Thematic map Surface material map Geomorphologic map Geologic map Hydrological map Flood hazard map Construction material map Existing landuse map Geotechnical landuse map		a c c c a a a	t n n n t t t	l l l l m l/m l m	1)multi-purposes 2)non significant of grouping of maps'topics 3)non significant of relationship of maps 4)low updatable
St-Onge, Kugler and Seat, 1975 ⁴ - aspet to a region	Geoscience Aspect Bedrock-lithology structure distribution Configulation of bedrock surface Surficial deposits character, distribution, thickness Geotechnical aspects, engineering properties of material, terrain capability Geomorphology, landscape from process Geological hazard landslide, erosion susceptibility Construction material potential bedrock & surficial material Hydrology Physical-chemical of groundwater flow aquifer Potential fluid waste disposal Seismic effect bedrock & surficial material		c a c/a a c a a a a	n t n n n n n n n	l l l m l m m m m m/h m	1)multi-purposes 2)grouped by subjects of maps 3)non significant of relationship of maps (2 stages?, by expected) 4) low updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Part of Eastern region of Thailand	Slope Land use and land cover Geologic setting Mineral resource Surficial deposit Water resource Marine geology Development potential Residential potential Heavy industrial potential Agricultural potential	s s s s s s s s s s s	a o a a a a a a a a a	t t t t t t/n t t t t	l l l l l l h h h	3)2 stages of relationship 4)low to medium updatable
Surachai Sompadung, 1992 ³ Changwat Saraburi, Thailand Province	Physiographic setting Climatology Drainage Geomorphology Landuse and landcover Geology Natural resource Mineral and construction material Water resource Touris and recreation resource Floodprone area Development potential Waste disposal area Residential and commercial potential	s s s s s s s s s s s s s s	o a c o c a a a a a a a a a	t t n t n t t t t t t t t t	l l l l l l/m l/m l/m l/m m h h	1)specific purpose on waste disposal area and residential and comercial development 2)grouped by degree of inference of maps 3)2 stages of relationship 4)low to medium updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Tanawat Jarupongskul, 1995 ³	Environmental Geology Assessment					1)multi-purposes 2)grouped by both of subjects and degree of inference 3)2 stages of relationship 4)medium updatable
Changwat Ratchaburi, Changwat Suphanburi Province	Socio-economic Background	s	o	t	l	
	Population density map	s	o	t	l	
	Transportation map	s	o	t	l	
	Land Resource					
	Hypsometric map	s	a	t	l	
	Slope inclination	s	a	t	l	
	Detail soil map	s	c	t	l	
	Geomorphological map	s	c	n	l	
	Land use map	s	o	t	l	
	Water Resource					
	Water resource map	s	a	t	m	
	Hydrological map	s	c	n	l	
	Groundwater resource map	s	a	t	m	
	Geological Resource					
	Geologic map	s	c	n	l	
	Geological resource map	s	a	t	m	
	Forest Resource					
	Forest map	s	o	t	l	
	Environmental Hazard					
Map of earthquake effect of Thailand and adjacent area	s	a	t	d		
Land slide potential map	s	a	t	d		
Flood hazard zoning map	s	a	t	d		
Strategic planning and management						
Potential waste disposal site	s	a	t	h		

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
	Landsuitability for urban development Recommendation for regional planning	s s	a a	t t	h h	
Tinakorn Tathon, 1994 ³ Ban Na Si Thang, Had Yai Full of Map sheet 5023 II, 5023 III	Environmental Geology Geological resource potential Industrial Rock Construction Soil & Sediment Groundwater Potential Specific area of landuse potential Forest Residential and Industrial	m m m m m m m	a a a a a a a	t t t t t/n t t	m m m m m m h/m	1) ? 2) non significant of grouping of maps' topics 3) non significant of relationship of maps (2 stages?, by expected) 4) low updatable
Tonies et al., 1987 ¹ Lower Saxony Bremen, Germany Province (Lander)	Recommendations for land use Groundwater utilization Groundwater and mineral spring Protection areas Recharge areas Large reservoirs for drinking water supply Mineral resource exploitation (areas of near- surface, first priority mineral deposits) Soils (productivity, general yield) Ground unsuitable for construction on account of: a) organic soils liable to subsidence above salt diapirs, sink holes, cavern	s s s s s s s s s s s	a a a a a a a a a a a	n t n t t t n n n n n	h m/h l h l l l l/m l/m l/m	1) multi-purposes 2) non significant of grouping of maps' topics 3) non significant of relationship of maps (2 stages?, by expected) 4) low updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Voravut Tantivanich and Krongkeaw Mikaness, 1994 ²	General geology Construction material resource Hazard geology * Earthquake * Landslide * Flood Waste disposal problem	m m m m m m	c a a a a a	n t t t t t	l l m m m m	1) ? 2) non significant of grouping of maps' topics 3) non significant of relationship of maps 4) low updatable
Wermuna et al., 1974 ⁴ Southern Edward Plateau, Texas	Environmental mapping unit Slope map Landuse map		a a o	n t t	l/m l l	1) ? 2) non significant of grouping of maps' topics 3) non significant of relationship of maps 4) low updatable
Williams, 1983 ¹ South Humber side, England Quite small area of less than county size, much built up	Element maps (7): Topography and drainage Drift and outcrop geology Drift thickness Rockhead contours Opencast workings and mined land Area underlain by the buried Kirmington channel Potential maps (1): Development potential	l l l l l l l l	c c a a a a a a	n n t t t t t t	l l l l l l l l	1) multi-purposes 2) grouped by degree of inference of maps 3) 2 stages of relationship 4) low to medium updatable

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
Williams, 1978 ⁴ Medorins; Gualala, California, USA City	Map of geologic units Map of geologic factors Land use map		a a o	n n t	l/m m/l l	1) ? 2) non significant of grouping of maps' topics 3) non significant of relationship of maps 4) low updatable
Wilson and Smith, 1985 ¹ Bridgend South Glamorgan, Small urban area	Element maps: Topography and drainage Drift and outcrop geology (stratigraphy, lithology) Bedrock geology and structure Rockhead contours/borehole locations Derived maps: Foundation conditions Mineral resource potential (a) Limestone (b) Sand and gravel Potential for coast erosion	l l l l	e e e	n n n t/n	l l l l	1) multi-purposes 2) grouped by degree of inference of maps 3) 2 stages of relationship 4) medium to high updatable
Zaw Zaw Aye, 1989 ³ Ban Na San, Surathani Amphoe (District)	Thematic Map Geomorphology Geology Water supply Construction material Waste disposal		c c a a a	n n t t t	l l m/l m/l m	1) ? 2) non significant of grouping of maps' topics 3) non significant of relationship of maps (2 stages?, by expected)

Source/location/coverage	GILM Topics & Themes	Sca	Sit	Hab	Deg	Dianosis of a Series of Maps
	Flood prone area Existing landuse Slope and aspect map Geotechnical landuse zoning map		a	t	m	4) low updatable
			o	t	l	
			a	n	m	
			a	t	m/h	

Appendix B

List of Map in collected from previous works, by alphabetic order.

Accumulated damage potential/ ground shaking	Areas of shallow workings (subsidence prone)
Active fault	Areas requiring intense rock blasting
Active recreation suitability	Areas with seasonal high water- tables
Ages	Assessment of capability
Aggregate minerals	Availability of geotechnical test data
Agricultural potential	Availability of ground-water
Agricultural products grown, including productivity per acre and dollar value of land	Basic geological map
Agriculture development potential	Basic geology
Airshed map	Basic geology (Pleistocene and recent mainly unconsoli- dated, superficial deposits)
Altitude above m.s.l. map	Bay map
Amount and location of water	Beach quality
Applied geological map	Bedding dip/slope steepness
* Mineral resource	Bedrock geology
* Stability/safety	Bedrock geology and structure
Area flood of hericane potential	Bedrock-lithology structure distribution
Area for water resource development	Borehole locations
Area underlain by the buried	Borehole sites
Areas for which the British Geological Survey holds site investigation reports	Bridges
Areas important for arctic foxes, wolf packs	Building
Areas of deposition	Building & construction material CBR
Areas of erosion	Capability for planned housing development
Areas of potential development of groundwater and surface water	Capacity to accept liquid/solid waste
	Chemical quality of water
	Chemical quality of water
	Clay distribution

Cleaning and gubbing	Depth and type of overlying soil and rock
Climate	Depth of bedrock
Climate and drainage	Depth of unconfined aquifers
Climatology	Depth of water table map
Coastal geologic processes	Depth to confined artesian aquifers
Collapse	Depth to engineering defined bedrock
Collapsible silt	Depth to formation tops
Commercial industrial suitability	Depth to rockhead
Compaction	Depth to unconfined aquifers
Conditions of excavation	Depths to tops of specific formations
Configulation of bedrock surface	Derelict land
Conservation area map	Detail soil map
Conservation capacity	Development potential
Conservation/ Recreation/ Urbanization areas	Difficulty of excavation
Construction Soil & Sediment	Distribution and outcrops
Construction material map	Distribution of Great Oolite freestone
Construction material resource	Distribution of boreholes
Construction material potential bedrock & surficial material	Distribution of madeground
Contours on the upper surface of glacial deposits	Distribution of mine workings
Control of waste from mining	Distribution of population map
Cost per 1,000 gallons of water	Distribution of slope angle and land slip
Cost per acre for reclamation	Distribution, aquifer
Cost per cubic yard or acre for refuse treatment or for quenching or burial of mine fires	Distribution, worked ground
Courbanization land	Drainage classification
Critical area of drop of peizometric level	Drainage map
Critical area of subsidence in Bangkok	Drainage treatment cost surface
Critical and non-critical areas of mine-related hazards	Drift and outcrop geology (stratigraphy, lithology)
Cut and fill height	Drift and outcrop geology
Cut-slope stability	Drift deposits (extent, lithogy, thickness)
Degree of slope	Drift geology
	Drift thickness
	Drilling

Earth disturbance inventory:

- (a) Land modified by man:
 - Mining
 - Mining related subsidence
 - Mine fires
 - Refuse banks
 - Quarries, pits
 - Slag dumps
 - Urban development
 - Pre-development modification
 - Land modified for transportation
 - Earth and rock fill
 - Near-vertical cuts and cliffs
 - Water impoundments
- (b) Areas affected by Natural Hazards:
 - Landsliding
 - Flooding
 - Heavy storm precipitation and related mass movement
 - Natural subsidence
- Earthquake epicenters
- Earthquake hazard
- Earthquake location
- Earthquake problems
 - (a) Response
 - (b) Amplification
 - (c) Liquefaction potential
- Earthquake risk
- Ecological areas
- Ecological associations value
- Embankment cost surface
- Engineering geologic map
- Engineering geology of solid rocks
- Engineering geology of surficial deposits
- Engineering geology zoning
- Engineering geology classification of soft sediments
- Engineering properties of soils and bedrock
- Engineering quality
- Engineering zones
- Environmental geologic systems and environmental units
- Environmental geology map
- Environmental geologic map
- Environmental mapping unit
- Erosion
- Erosion and sediment studies
- Estimated thickness of overburden
- Evaporation data map
- Excavation
- Existing and proposed development sites
- Existing borrow pit map
- Existing forest quality
- Existing landuse map
- Existing vegetation
- Existing wildlife habitats
- Expansive clay
- Expansive materials
- Fault zone
- Favorable area for structure foundation
- Fertility
- Flood & depth of flood water map
- Flood area map
- Flood hazard map
- Flood hazard zoning map
- Flood prone area

Flood-prone area and landuse implication	Geological factors affecting land
Floodplains	Geological factors affecting land modification (combination of environmental hazard variables)
Folded rocks, fault, joints	(a) Steep slopes
Forest : Ecological association	(b) Rock ledges
Forest : Existing Quality	
Forest map	
Foundation and excavation condition	(c) Sand and gravel distribution
Foundation conditions	(d) Clay distribution
Foundation practice map	(e) Fine clay/sand/silt distribution
Freedom from natural hazard	(f) Flood plains
Frora resource map	Geological hazard landslide, erosion susceptibility
General feature of the environmental units	Geological regions
General geology	Geological resource map
Geodynamic processes:	Geological resource potential map
(a) aeolian	Geological conditions affecting solid waste disposal
(b) fluvial	Geological profile (supported by geotechnical properties of the mapped formations)
(c) ravine erosion	Geology
(d) landslides	Geology and landform
Geoenvironmental factors:	Geology, landforms, Caliche
(a) seismicity	Geomorphological map
(b) geodynamic processes	Geomorphology, landscape from process
(c) hydrogeology	Geophysical map
(d) foundation conditions	Geotechnical aspects, engineering properties of material, terrain capability
(e) geomorphology	Geotechnical characteristics (zoned)
Geoenvironmental units	Geotechnical characteristic of surficial deposite
Geologic feature	Geotechnical conditions
Geologic feature value	Geotechnical cross-section
Geologic map	
Geological Resource	
Geological conditions affecting construction:	
(a) topography	
(b) surface materials	
(c) water-table	
(d) flooding	
(e) bedrock	
(f) soil creep	

Geotechnical landuse map	Groundwater studies
Geotechnical landuse zoning map	Groundwater utilization
Geotechnical planning for heavy structures	Ground characteristics for planning and development
Geotechnical properties (bedrock, superficials)	Hazard geology
Gravel and surface water (areas of potential development)	Hazardous areas (unstable slopes, flooding)
Ground conditions related to groundwater	Hazardous situations
Ground elevation map	Hazards from old mine workings
Ground unsuitable for construction on account of:	Heavy industrial potential
a) organic soils liable to subsidence above salt diapirs, sink holes, cavern fields, solution mining, underground repositories for radioactive and toxic wastes	Hillside development
b) sites with geoscience protection value	Hillside development and slope stability
Ground water	Hillside materials/ Engineering character
Ground water geologic map and hydrologic atlas	Hillside materials - inferred engineering behaviour and landuse implication
Ground water level and yield	Historic Shorelines of the Bay
Ground water quality and quantity	Historic feature value
Ground water supply	Historic flood data
Groundwater (depths, quality)	Historical land mark
Groundwater and mineral spring	Hydrogeological conditions
Groundwater availability	Hydrogeology
Groundwater chemistry	Hydrogeology (borehole and well distribution; the Plymouth Limestone; marine incursion)
Groundwater condition	Hydrography
Groundwater potential map	Hydrological map
Groundwater quality	Hydrology (including drainage, floodprone areas)
Groundwater recharge area	Hydrology (natural drainage and man-made conduits)
Groundwater resource map	Hypsometric map
	Industrial development potential
	Industrial Rock
	Industrial minerals
	Industrial or housing development
	Inland wetlands and water courses
	Intertidal habitat value

Karst
 Kirmington channel
 Land cover
 Land for industrial
 Land for watershed conservation
 Landform maps
 Land pollution susceptibility
 Land slide
 Land slide potential map
 Land subsidence
 Land suitability for housing
 area map
 Land suitability map
 Land supporting forest
 Land use and land cover map
 Land use implication region of
 bay mud
 Land use planning provisions
 Land use units map
 Landcover map
 Landform
 Landforms:
 (a) Upland
 (b) Lowland
 (c) Floodplain
 (d) Steepness of slope
 (e) Relief
 Landslide
 Landslide (incidence,
 susceptibility)
 Landslide and unstable slopes
 Landslide susceptibility
 Landslipped and cambered strata
 Landsuitability for urban
 development
 Large reservoirs for drinking
 water supply
 Levelling height
 Limestone workings
 Liquifaction susceptibility
 Liquid waste acceptance capacity
 and cost per 1,000 gallons
 Liquid waste disposal
 Lithogenesis of deposits
 Lithology and facies
 * Alluvium, Colluvium
 * Glacial
 * Screes
 * Residual Soils
 * Made Ground
 Location of geotechnical data
 sources
 Location of mineral workings
 Location of potential area
 Location of quarries, mines
 and caverns
 Location of historic, aesthetic
 and archeological sites
 Made ground/infilled land
 Made ground, reclaimed land,
 landscaped and terraced areas
 Major structure element
 Man-induced erosional and
 depositional process
 Map of geologic factors
 Map of geologic units
 Map of subsidence bdvl.
 Map of earthquake effect of
 Thailand and adjacent area
 Marine geology
 Marsh quality
 Materials resource development
 Mine property boundaries
 Mine refuse area
 Mineral and construction
 material
 Mineral area
 Mineral commodities
 Mineral deposits
 Mineral mining consultation area

Mineral quality or quantity distribution	Patterns of pollutant
Mineral resource	Peizometric surface
Mineral resource exploitation (areas of nearsurface, first priority mineral deposits)	Permeability of rock
Mineral resource potential (a) Limestone (b) Sand and gravel	Physical character (flatland, hillside)
Mineral resource potential	Physical properties and active process
Mineral resources (a) near-surface (b) buried (opencast) (c) buried (pumping, mining)	Physical properties of unconsolidated deposits and land use implications
Mineral resources (coal, metals, construction minerals, vein minerals, industrial minerals)	Physical-chemical of groundwater flow aquifer
Mineral resources/inventory of mined land	Physiographic divisions (colour)
Mining (extent, location of shafts)	Physiographic feature value
Most hazard potential	Physiographic feature
Natural land use intensities (suitability for development)	Piezometric surface
Natural landslip potential	Planning map
Natural resource	Preliminary recommendation for regional
Natural slope stability	Pollution
Nature conservation sites	Population density map
Opencast workings	Possibility of floodprone area map
Opencast workings and mined land	Possible failure types
Opencast workings/landfill sites	Potential earthquake damage to buildings
Orientation and limitation on land use	Potential fluid waste disposal
Orthophoto maps	Potential for coast erosion
Outcrop (gravel, sand, clay, bedrock)	Potential geological hazard
Parent material map	Potential waste disposal site
Park and recreation	Precipitation
Passive recreation suitability	Predicted foundation conditions
	Predicted seismic shaking intensities
	Prediction map of area below sea level in the year submergence
	Preliminary geological mapping
	Preparation of building sites
	Present land use map
	Principal recharge areas

- Priority areas for on-site investigation
- Protection areas
- Protection of resources for development
- Quality of water
- Rainfall (isohyetal map)
- Recharge areas
- Recommendation map for primary landuse
- Recommendation for regional
- Recommendation for regional planning
- Recommendations for land use
- Recreation area map
- Regional structure
- Relief
- Residential and Industrial
- Residential and commercial potential
- Residential and commercial development potential
- Residential development
- Residential potential
- Residential suitability
- Resource conservation (minerals, water)
- Resource geologic map
- Resource location map
- Resource potential
- (a) Water
- (b) Soil
- (c) Minerals: sand and gravel, clay, salines, shale, peat
- Resources
- (a) Hard rock for aggregate
- (b) Brick and tile clay
- (c) Mudstone for brickmaking
- (d) Limestone
- Resources and minerals
- (a) limestone
- (b) sand and gravel
- (c) clay and shale
- (d) coal, petroleum water
- Resources and their development (minerals; sand and gravel; Water; shrink and swell in soils and rocks)
- Risk flooding
- Risk of potential erosion
- River mouth siltation and port problem
- Rock type of bedrock distribution
- Rockfall and landslide zones
- Rockhead contours
- Rockhead contours/borehole locations
- Sand and Gravel thickness
- Sand and gravel potential
- Sand distribution
- Sanitary-landfill sites
- Saturated thickness
- Scale sections of superficial deposits down to rockhead
- Seismic effect bedrock & surficial material
- Seismic hazard
- Seismic probability
- Seismic response map
- Seismic risk
- Seismic value (land)
- Seismic value (water)
- Selected road corridors with least cost of construction
- Settlement
- Sewerage
- Shallow undermining

Shoreline protection structures/ beach distribution/historical erosion rates	Solid geology
Silt distribution	Solid lithostratigraphy
Sinkhole & linearment map	Solid waste disposal
Site geotechnical investigations	Specific area of landuse potential
Site locations	Stability
Site of specific interest	Stability during earthquakes
Site of waste disposal	Stability of ground for foundation structure
Sites of mineral working	Stability of natural slopes
Size of area required for septic tanks or sewage disposal facilities	Stability of natural slope
Slope map	Standing water
Slope and aspect map	Static water level map
Slope angle distribution	Steep slopes
Slope inclination	Strata engineering quality
Slope stability	Stratigraphy
Slope steepness	Stream quality
Slopes elevations	Strength of material
Socio-economic Background	Structure
Soil map	Structure and thickness
Soil : most-least erosion	Subsidence
Soil Limitations : Foundation	Subsidence
Soil Limitations : water-table	Subsidence area
Soil absorption septic tanks	Subsidence due to coal mining
Soil and Gravel	Subsidence potential
Soil and soil suitability for agriculture	Subsidence zones
Soil drainage environment	Subzones of geological conditions
Soil erosion	Suitability for agricultural
Soil expansion	Summary of geological constraints
Soil permeability map	Superficial deposits (stipple)
Soil slide zones	* Bedrock geology
Soil suitable so fill	* Bioclimatic divisions
Soils (productivity, general yield)	* Altitude
Soils by origin	* Land use
Soils susceptible to frost	Superficial geology
Solid geology	Surface and subsurface water resource
	Surface geologic map
	Surface hydrology
	Surface material map

Surface reservoir
 Surface water flow
 Surface water map
 Surface drainage, and erosion
 runoff rate, erosion
 susceptibility
 Surficial deposit
 Surficial deposits character,
 distribution, thickness
 Terrain cost surface for road
 construction
 The main engineering problems
 Thickness of deposits
 Thickness of geological formations
 Thickness of superficial deposits
 Thickness of weathered zone
 below rockhead
 Tidal inundation
 Topographic expansion and
 surface relief
 Topographic map
 Topography (and contour pluck)
 Topography and drainage
 Topography map showing valleys
 and stream
 Topography of bedrock surface
 Topsoil removal
 Topsoil thickness
 Touris and recreation resource
 Transport network
 Transportation map
 Transportation on soft clay
 Trench-wall stability
 Trends in urban development
 Tsunamis
 Unconsolidated deposits
 Unconsolidated deposits
 (a) distribution
 (b) lithology
 (c) engineering properties
 (d) thickness
 (e) depth to water-table
 Unconsolidated materials
 Underground mine fire areas
 Underground mining
 Underground mining (coal)
 Underground storage potential
 Underground storage Potential
 within 100 m. of the surface
 Unfavorable area for structure
 foundation
 Urban drainage system
 Urbanization area
 Urban suitability (hazards,
 constraints and hydrogeology
 included)
 Vegetation
 Volcanic hazard
 Volume of solid waste which can
 be accomodated per acre and
 cost per acre of disposal
 Vulnerability of water to
 pollution and Waste disposal
 Waste disposal area
 Waste disposal problem
 Waste water treatment
 Water bodies
 Water quality and suspended
 sediment
 Water resource map
 Water supply
 Water table contour map
 Water table depth & character
 Water wildlife value
 Water yield per well or acre foot
 Water-related problems
 (a) Flooding
 (b) Channel change
 (c) Salt water intrusion
 (d) Subsidence

(e) Settlement
(f) Shrink and swell
Water-supplying strata
Water-table contours
Water-table contours
Weathering and ancient soil
profiles
Yield to well quality use
Zone of bigger natural hazard
Zone of exploitation natural
resource
Zones of suitability for
development
Zones showing ability of areas
to tolerate air pollution
resulting from new activity
pasture map

Appendix C

List of Groups of Map Topics, selected from Appendix A

Briggs	Land modified by man Areas affected by Natural Hazards
Cargo and Mollory	Topography Hazard Evaluation maps Engineering geology Earth materials Hydrology Process Geological formation
Chaiyudh Khantaprab & Niwat Boonnop	Topographic and Landform Soil and Land suitability geology Surface water and Drainage Groundwater Flooding Subsidence
Cherapan Tanapipat et al. ESCAP Secretariat	Basic environmental geology Potential hazard and problem Regional setting Environmental concern Engineering problem Flooding Subsidence

Edwards et al.	Geology Mineral resource Water resource Engineering geology Slope stability Landfill and waste disposal Data distribution Other
Ekkapol S.	Environmental Geology Recommendation map
Floyd, et al.	Element maps:
Gostelow & Brown	Derived maps: Potential maps:
Freeman, Fox Ltd.	Element maps: Derived maps: Workability Groundwater
Gardner and Johnson	Suitability for waste disposal Foundation stability Slope stability Probable earthquake stability Use
Geomorphological Serv.	Element maps: Planning map:
Luksmee Jeawetchasin	Physiography Growth potential
Marker and McCall	Basic geological Applied geological Environmental geology

BIOGRAPHY

Mr.Sasin Chalermmlarp was born in Bangkok on December 20, 1968. He graduated with a B.Sc. degree in Geology from Chulalongkorn University in 1991. He then was on leave for higher degree study at Chulalongkorn University from 1991-1996.

During his study at graduate school, he was a research assistant involving a study of Ancient Settlement from aerial photograph. He was also employed as editor's team of commemorative book "Geomorphology of Thailand from Space", which being organized by the NRCT committee to serve the idea of Her Majesty Princess Maha Chakri Sirinthorn.

He has been worked as a lecturer in Department of Civil Engineering and Environment, Faculty of Engineering, Rangsit University since 1991 to present.

