Methods for studying and assessing a Karst area

The following list is an **outline** of the stages in a typical systematic karst hydrological study. Most studies would not require **all** these steps.

1 **STAGE 1: Preliminary Work**

- 1.1 Identify the purpose of the study. What information is needed?
- 1.2 Identify the area involved
  Use a geological map for the limestone extent; a topographic map to determine the surface drainage basins.
- 1.3 Literature review (collect and assess existing information)
  - 1.3.1 Reports & maps (published & unpublished (especially government departments, caving clubs))
  - 1.3.2 Cave maps and related information. (Local clubs, ASF database, ...)
  - 1.3.3 Climate, Geology, Soil, Vegetation, and other background info,
  - 1.3.4 Historic data on land-uses, water-usage, ...
  - 1.3.5 Present land usage & ownership (and proposed future usages)
  - 1.3.6 Existing Management plans (are they being implemented?)
- 1.4 Air-photo interpretation, other remote sensing, lineaments, ...etc
- 1.5 Initial site reconnaissance:
  - 1.5.1 Check access (& permits, keys etc),
  - 1.5.2 Locate major features & confirm accuracy of published maps,
  - 1.5.3 Talk to (and make friends with) the locals.
    They can provide history of flood events, location & history of springs, sinks, caves etc.
- 1.6 Determine the requirements and appropriate methods for the main study (ie Stage 2-3). Is there sufficient funding, equipment, personnel, ...? What will be the impacts of the study methods? Do the ends justify the means?
- 1.7 Set up a Computer Database, or a GIS (Geographical Info System).
  Note: Data entry requires Time & Money !
- 1.8 Locate & co-ordinate any specialist personnel
  (e.g. biologists, geo-technicians, cavers, ...)

2 **STAGE 2 Field Mapping and Karst Inventory**

- 2.1 Surface Mapping & Inventory of karst features
  - 2.1.1 Start at regional scale, then move into local detail.
  - 2.1.2 Geology, soils, landforms, vegetation, ...
  - 2.1.3 Map springs, sinks, other recharge areas.
  - 2.1.4 Estimate stream flows (surface & subsurface) & spring flows
  - 2.1.5 Ground-truthing of any Remote Sensing interpretations.
- 2.2 Water sampling
- 2.3 Cave inventory.
- 2.4 Pilot studies to test & calibrate geophysics techniques, tracing tests, etc.

3 **STAGE 3 Specific tasks required for the purpose of the study**. (examples follow...)

- 3.1 Indirect subsurface studies (geophysics, modelling)
  Geophysics: consider cost, relevance? suitability to site?
- 3.2 Direct subsurface studies
  Drill data (lithology, cavities, water levels, pump tests). Consider costs & likelihood of intersecting any features of interest.
  Cave studies - map active conduits & flood overflows)

3.3 Trace conduit & diffuse flows from sinks to springs. Artificial & environmental tracers, ...
3.4 Spring hydrographs - dynamic storage, flow character etc.
3.5 Map the watertable surface - if it exists (from well & cave data)
3.6 Water budgets (input, output, storage)
3.7 Laboratory testing & analysis of materials and data from above ...
3.8 Specialists studies (biology, geotechnical, geophysics, cavers, surveyors, ...)
3.9 Models: design, test and compare to reality - redesign and try again ...
3.10 .... and so on ...

4 ANALYSIS & CONSOLIDATION

4.1 This is where you work out what it all means (a rule of thumb is "one day in the field = one weeks work at the office", so allow time for this in your overall plan)
4.2 Tidy-up field work (the bits you forgot, or collecting additional data to test new hypotheses)

5 REPORTING

5.1 First, make sure you have worked out what is really happening!
5.2 Second, make sure you know your audience.
Their level of understanding, expectations, level of *real* interest, etc. Can you get away with technical jargon, or will you have to spell it all out? How long can you go on before they fall asleep? Will you need appendixes to discuss complex concepts & terms?
5.3 Write text & draw diagrams - at level(s) appropriate to the audience.
5.3.1 Executive Summary
(This is for the Boss (and perhaps the politicians & newspapers) who may not read any further. Write this last of all, and try to keep it to one page and in "dot-point" form)
An Abstract is an alternative where no executive action is required. i.e. for purely scientific studies etc.
5.3.2 Introduction (why, where, how, who, ... & background info from the literature review - eg climate, geol, soil,)
If needs be, the "how" (Methods) and Background data can be expanded into separate sections.
5.3.3 The Data (What you found. Large tables etc might be better as Appendixes?)
5.3.4 The Interpretation (What it all means, how it all works, what the problems are, ...)
5.3.5 Conclusions (Problems and solutions, possible actions)
5.3.6 Recommendations (enlarge on the Executive Summary)
5.3.7 Bibliography (all publications referred to in the text, or which the reader should know about)
5.3.8 Acknowledgements (who helped, who paid for it, Landowners, Cavers, ...Reviewers)
5.3.9 Appendixes of detailed data, charts, maps etc...)
Supply a "Glossary of Karst Terms" for non-karst readers as one of the Appendixes.
5.4 Drafting maps and diagrams.

6 LOCAL FEEDBACK

6.1 Tell the landowners, cavers etc what you found out - this is always appreciated. Give them at least a summary - if not the full report.

7 Some Resources:

7.1 AGPS: 1994 (or later edition) ***Style manual for Authors, Editors and Printers.*** Aust Govt Publishing Service. 468pp.
7.2 Sanders, L.L. 1998: ***A Manual of Field Hydrogeology***. Prentice Hall. 380pp.