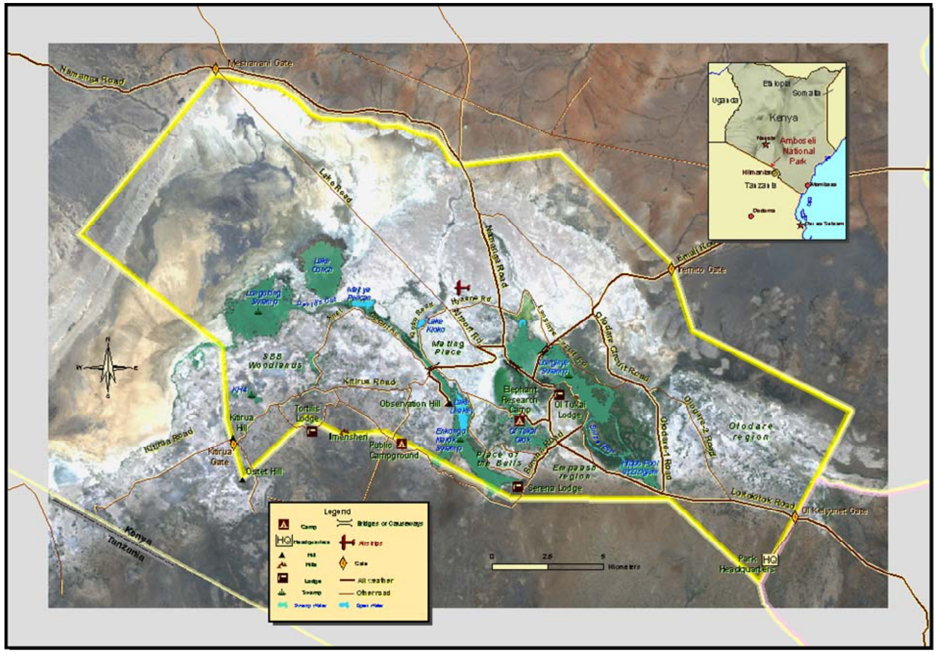
AmboGIS

GIS Activities and Progress



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ELEPHANT TRUST

The application of GIS – Geographic Information System – tools continues to provide new and interesting ways of looking at the long-term data of the Amboseli Elephant Research Project.

Thanks to generous support from ESRI (systems, software and data model development), the National Geographic Society Committee for Research and Exploration (operational funds), the Vienna Zoological Garden (aerial survey) and the US Geological Survey's Goddard Space Flight Center (satellite data), a sound basis has been built for mapping, analyzing and planning for elephant and ecosystem conservation at the Amboseli ecosystem in southern Kenya.

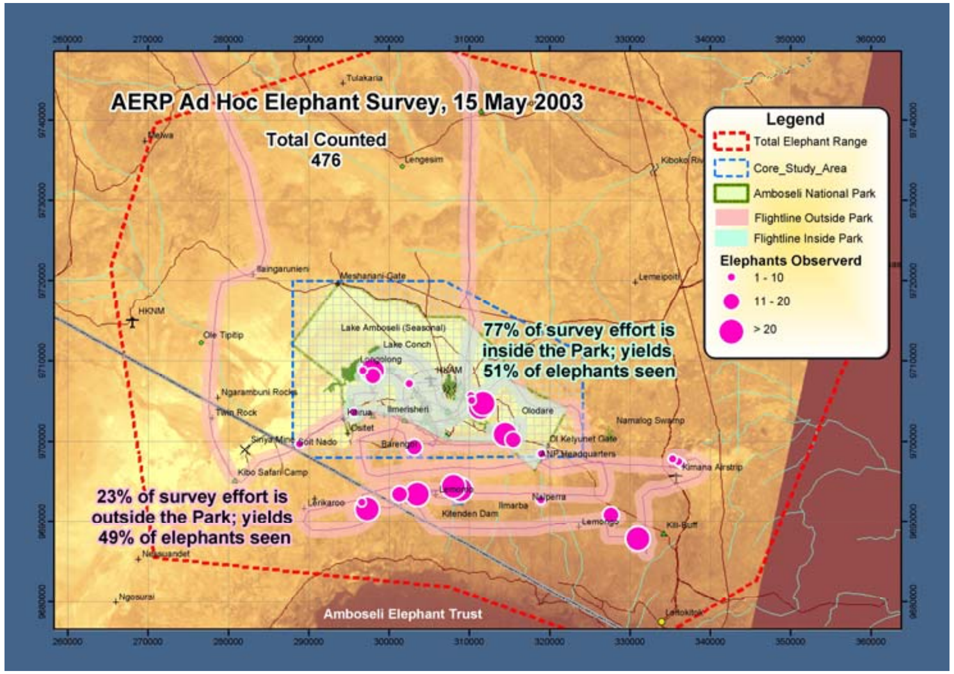
GIS analysis continues to support a number of work areas, for example: aerial survey, time-series of changes in elephant distribution with ecological conditions and social status, ecosystem data collection and landuse planning, and vegetation change mapping.

[NB: the map images presented below are copies of working documents. No attempt has been made at this stage to harmonize format or symbology as would be appropriate for a final presentation.]

AERIAL SURVEYS

Aerial surveys continue to provide information on the distribution of the elephant population outside of the core behavioural study area (defined by an x-y reference grid that was established in 1972 covering some 1,000 km^2) as well as outside Amboseli National Park. AERP is devising *post hoc* methods to account for differential occupancy inside and outside of the core study area, and inside and outside of the Amboseli National Park.

One approach is to use GIS tools to partition the survey effort – as measured by GPS tracking during survey flights – into the different regions on the ground and then calculating the ratio of areas surveyed within and outside of the Park and the core study area.



For example, accounting for "search effort" during the May 2003 aerial survey (map to the right), leads to the estimatation that at the time of the survey, 80% of the elephant population was in fact outside of the park.

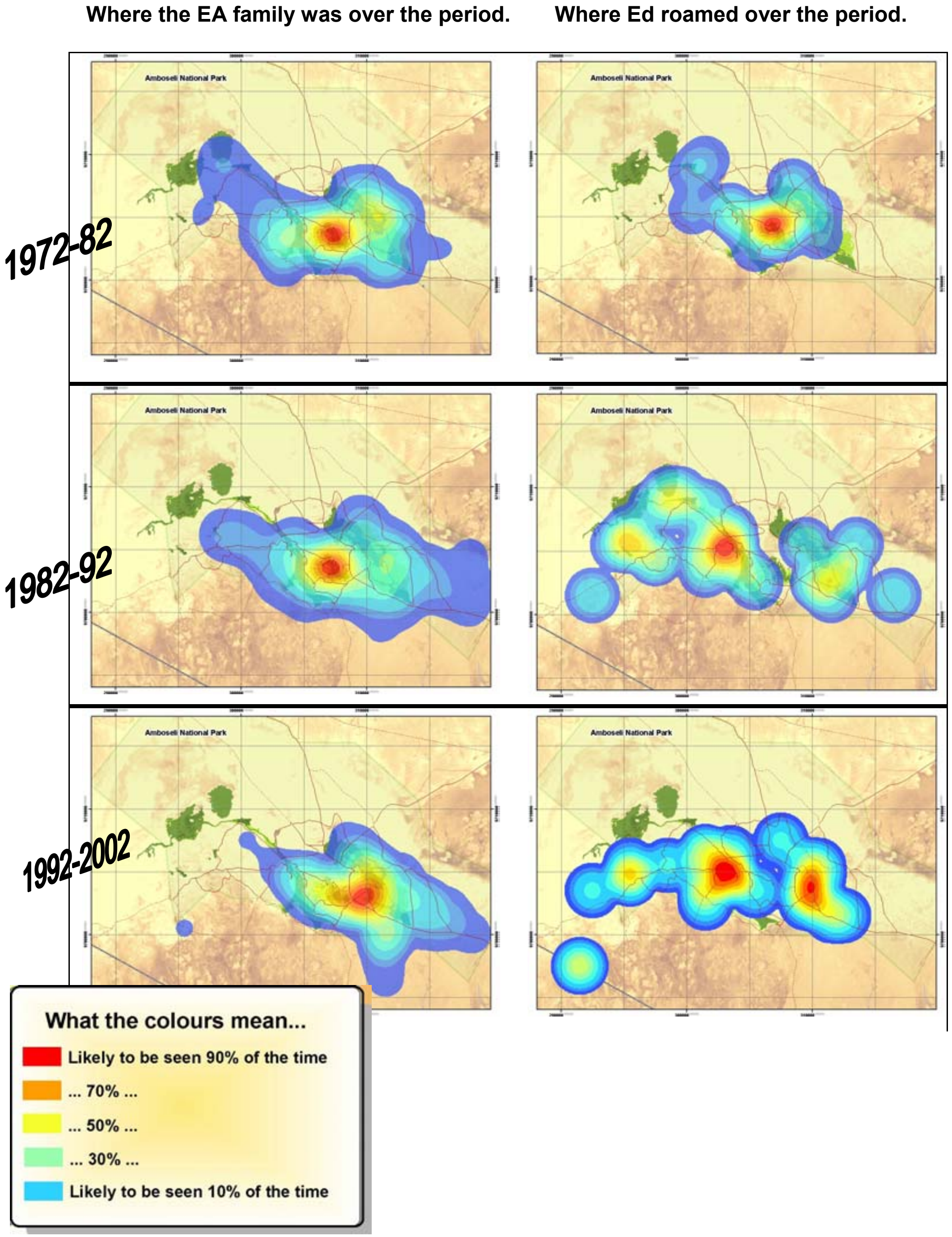
GIS ANALYSIS FOR BOOK

As the book, *Amboseli Elephants: a long term perspective on a long-lived mammal*, enters its final stages of editing, there are growing demands from the past and present AERP researchers for mapping the temporal and spatial distribution of the elephants.

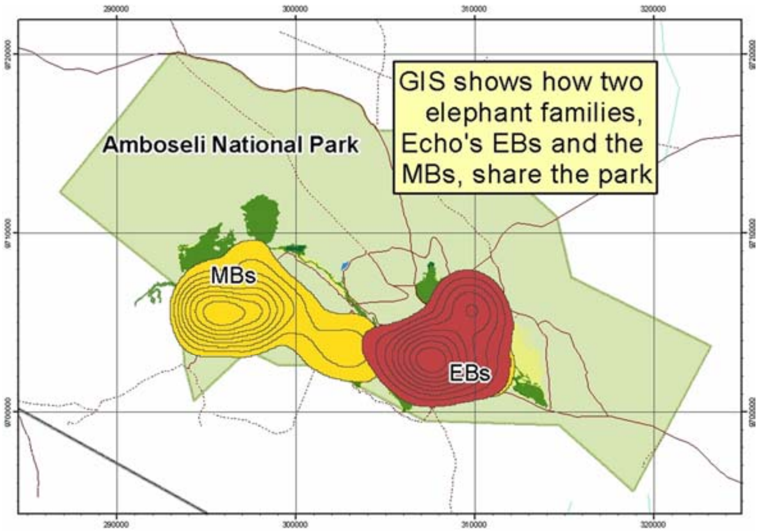
GIS is also providing new ways of analysing the behavioural and life-cycle events in the lives of the Amboseli elephants. One example: although a male elephant may reach sexual maturity at around 14 years, he will not be able to successfully compete for females until he has reached an age commensurate with the size and experience to interest adult females and repell competing males. Does the maturity transition influence where a bull lives?

The bull M-048 was born into the EA family group in the early 1960's. By the time he was first observed by AERP in 1972, he was around 10 years old. He was named Ed. In the following sequence of maps spanning 10-year periods beginning in 1972 it is clear to see that in his early teenage years Ed stuck close to his family (red shows the areas of highest occupancy), but, as he grew older, he began to roam further afield. Each grid-square on the maps is 5x5 km. Ed was first seen in musth in December 1986 by which time he was around 25 years old. He was clearly roaming more widely than his family, with his spatial 'centre of gravity' shifting more and more to the west and north.

But it would not be until the turn of the Millennium that Ed would begin to compete successfully with other mature bulls in their 40s and 50s. By that time, the centres of his occupancy had shifted well away from that of his maternal family and he was roaming more widely that his birth family, even to the Tanzanian boarder (bottom pair of maps, right).



From over three decades of on-the-ground observations, AERP staff have known that the elephants use their range in different ways: there are 'western families', 'eastern families', families that trek south during the rains onto the slopes of Kilimanjaro in Tanzania, and families that head north. Using GIS on the 30-year sightings database (which fortunately was designed in the early '70s to be spatially explicit), it is now possible to quantify and map elephant occupancy.



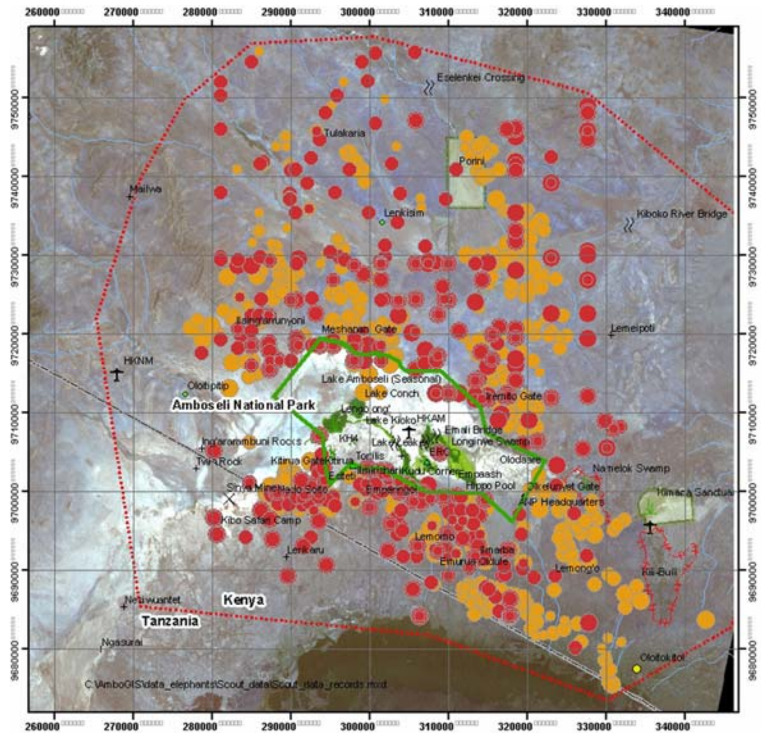
ECOSYSTEM DATA: THE MAASAI SCOUTS

AERP has engaged ten young men from the local Maasai community to collect data on elephant presence in the ecosystem surrounding Amboseli National Park. Armed with GPS receivers and notebooks, in addition to their traditional spears and swords, the scouts walk over hundreds of square kilometres of Acacia bushland. As they wander, they record signs of elephant presence: tracks, dung piles, broken venegation, and of course, elephants themselves.

Patrick Papatiti, with GPS and data-sheet, recording an elephant dung pile.

David Sitonik, one of the local Amboseli Maasai who has recently received his Bachelor's decree with support from ATE, is analysing the scouts' data in order to improve the picture of elephant occupancy of the ecosystem beyond the AERP core study area in the National Park.

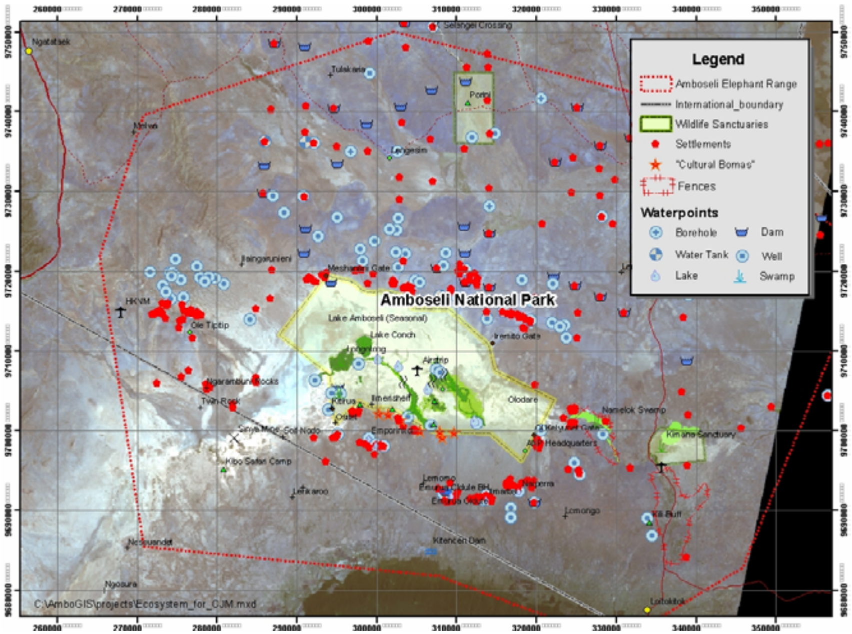
Since 2000, the accumulation of scouts' data records (right) has improved our knowledge of the range of the Amboseli elephants beyond the park boundaries, based on actual sightings (red dots) and elephant signs (tracks, dung, broken branches: yellow dots).



Amboseli National Park at 390 km^2 is less than 10% of the area that the elephants (and wildebeeste and zebra) range over the ecosystem. The map on the left shows the extent of the elephant population's range (red dotted line) surrounding the park, an area of around 6,000 km^2.

ECOSYSTEM PLANNING: ELEPHANT "CORRIDORS"

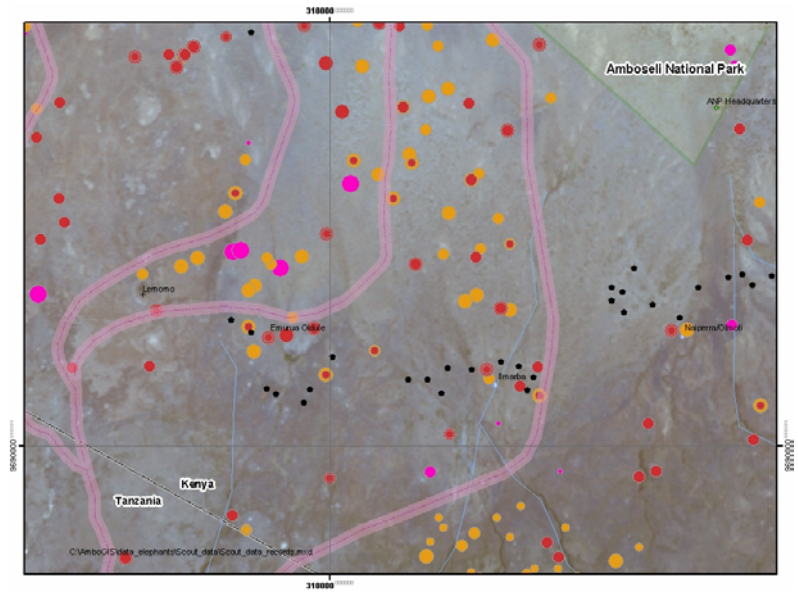
As the elephants move in and out of the park in their seasonal quest for an adequate and varied diet, they increasing encounter a growing human presense: watering points (blue symbols) and settlements (red symbols).



Sub-division the large, communally-held Maasai group ranches surrounding the naitonal park into individual holdings is happening now. It is imperative that AERP provides the necessary spatial data for planners and the new landowners to accommodate the passage of elephants without conflict. Negotiated "elephant corridors" will provide a rational and sustainable basis for landowners to participate in wildlife-viewing enterprizes to augment their near-subsistence incomes.

By combining aerial survey with Maasai scouts' data, AERP is providing vital information for the planning process that hopefully will allow the best location of corridors for both elephants and people.

The draft corridors (pink) in the map below attempt to optimize passages through areas of heavy elephant occupance (red and orange dots) while avoiding Maasai settlements (black dots).

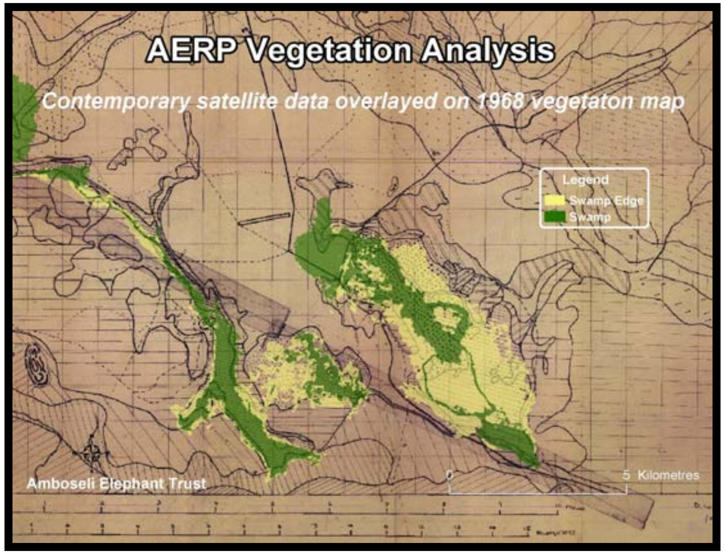


VEGETATION CHANGE MAPPING

AERP collaborates with NASA, EROS Data Center and Goddard Space Flight Center.to describe and quantify historical and current distribution of 'food-on-offer' to the Amboseli elephants to understand better elephant distribution, habitat use, social organisation and reproductive success.

At the ecosystem level, AERP uses data from NOAA's AVHRR weather satellites. Although designed for climate studies , their rather coarse resolution of 1 km is offset by the high frequency of daylight passages and long time series (continuous since the early 1980s). The datea are excellent for monitoring seasonal changes in green biomass, and gross inter-annual changes in vegetation cover.

AERP has analyzed monthly satellite imagery for patterns of green flush in wet season months of November to May and for patterns of desiccation in dry season months of June to October in each year across the bushlands and woodlands in the Amboseli ecosystem. Indices of plant productivity allow comparison between months and years in relation to rainfall records, elephant population demography and ranging patterns. The data also allow measurement of changes in the woodlands and swamps of the Amboseli basin.

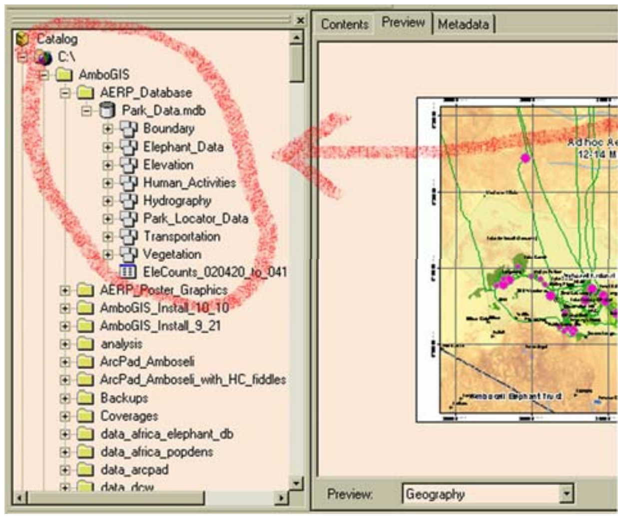


Within the smaller area of the basin – roughly 1,200 km^2 – AERP is using relatively high-resolution Landsat data, with resolutions of 10-30 metres. The aim is to map and quantify changes in the extent of the permanent swamps and the extremely important swamp edge – which provides dry season forage for most of the wild and domestic herbivores in the ecosystem – from the 1970s to the present. In addition, AERP is quantifying the growth of intensive agriculture in the swamps outside of the protected area, some of the key foci of conflict between foraging elephants and local communities.

GEODATABASE

One of the greatest constraints to the efficient generation and use of spatial data is the proliferation of GIS layers as data are collected, spatial descriptions generated, analyses run and hypotheses tested. AmboGIS data files and coverages currently contain over seven gigabytes of data. Fortunately ArcGIS provides data management tools to organize the typically massive amounts of data and information generated by GIS analysis.

Consultant Peter Ndunda, a Kenyan post-grad who has recently completed an MSc at Redlands University (with partial support from ATE), undertook a consultancy to build a geodatabase for AERP. At its most basic level, the geodatabase is a 'container' for storing spatial and attribute data and their inter-relationships. Spatial point, line, and polygon features, tabular data such as spreadsheets, and raster image formats can be linked within an integrated system, using rules, relationships, and topological associations. Apart from the huge benefit of aiding navigation through gigabytes of data and enforcing data intergrity, a geodatabase can also become a manageable if complex data model for representing the real world.



Deceptively simple, the new AERP geodatabase allows quick and efficient access to a large, complex data directory.