Appendix I. LUPIS - Extending capabilities to facilitate multi-focussed and multi-stakeholder spatial resource allocation.

Attempts to address complex land use issues can undoubtedly be aided by the application of a decision support system methodology. McClean *et. al* (1995), Land Use Planning: A decision support system, J. Env. Plan. and Man. 38: 77-92.

Background to software product

LUPIS is a functional software product which has been used and distributed over a number of years. The development of the Windows version has provided an opportunity to totally redesign the framework and programming environment of LUPIS. In so doing an attempt has been made to provide a framework which lends itself to efficiently add additional capabilities in the future when the need arises.

What is it?

Basically LUPIS is a microcomputer-based spatial decision support system developed to assist in implementing the SIRO-PLAN and SIRO-MED approaches to spatial resource allocation by facilitating the ranking of competing candidate land uses or management regimes on each of the resource inventoried areas, which jointly comprise a region of study. The ranking reflects the extent to which each land use collectively addresses issue-induced guidelines and the relative importance attached to achieving each guideline. In so doing, LUPIS facilitates a multi-stakeholder driven approach to resource allocation that builds upon resource inventory and evaluation.

LUPIS has been developed in an environment of practical application, with on-going developments coming invariably as a direct result of involvement in or knowledge of exercises in which it has been used. Current adoption of LUPIS for resource allocation studies for the Western Division of New South Wales and the North-east Goldfields Region of Western Australia demand extension to the capabilities already available. Consistent with the design principles the addition of further capabilities is undertaken in a generic form so that capabilities developed for either of the above studies are not only automatically available to the other study but available to any further studies.

The software provides an efficient mechanism for technology transfer. Although the LUPIS software alone is no guarantee of good resource allocation practice, the software provides a vehicle encapsulating an issue-driven approach to spatial resource allocation allowing the relevant stakeholders to systematically explore options for the future. In the case of the Western Division (NSW) and North-east Goldfields (WA) the technology will provide on-going opportunity for stakeholders to explore land use options for the two Regions well beyond the life of the current Projects.

What are the design principles behind LUPIS?

LUPIS has been developed in accordance with a number of design criteria:

1. Low end of the technology spectrum: although the general level of computer literacy is increasing, the range of understanding and adoption by people who are legitimate parties to resource allocation (i.e. stakeholders) is variable. By aiming at the low end of the technology

spectrum there is minimum risk that these parties will be alienated from the planning process by the forbidding nature of the computer technology. It is recognised however that the low end of the computer technology spectrum is continually rising. The evolution and adoption of the Windows environment provided a convenient and timely opportunity to consolidate past LUPIS capabilities and redesign it to accommodate further enhancements for this almost universally accepted platform.

2. Capturing generic capabilities: effort has been made to capture the generic capability that underlies any specific application. In incorporating further capabilities into LUPIS attention has been given to ensuring these capabilities are as generic as possible. As a result LUPIS offers a comprehensive broad- based approach to resource allocation. By comprehensive it is meant that the full spectrum of conventional planning sub activities are recognised and provided for and broad-based means that no limitation is knowingly imposed upon the type of resource using allocands (e.g land uses, management regime etc.) that can be considered.

As a consequence users have successfully used LUPIS in situations in which it was never envisaged by the developers, e.g. planning an environmentally sensitive route for an oil pipeline through a portion of the Amazon Valley.

3. Adoption of a decision support approach to user interface: underpinning this point is the view that one must strive to avoid unduly constraining the way a user may seek to use the package. Rather every attempt should be taken to provide an environment that encourages the user to explore alternatives, options etc., without the expectation that any particular allocation emerging will necessarily be fully implemented- users will however be more aware and wiser of the available options.

4. Avoid duplication of existing software capabilities: rather effort has been taken to provide interfaces to encourage and foster efficient transfer of information between packages so that a user is not constrained in using other complementing packages that allow data import. This approach provides flexibility and opportunities for synergism from the choice and use of both other in-house and commercial software packages. By so doing the risk of users being locked into the approach of a particular software package because of impediments to information transfer between packages is minimised. In some cases seamless interface has been developed to streamline the use of cosmopolitan generic software products.

5. Foster participation: historically to the extent that resource allocation planning was undertaken, it was conducted largely by single agencies with little obligation to consult affected stakeholders. Times have changed, now public participation involves not only scrutiny of candidate allocations but increasingly also involvement in the derivation of the candidate plans. LUPIS explicitly recognises and makes provision for a number of stakeholders to develop individual and/ or collective plans.

6. Transparency: in recognition that with increasing public accountability in resource planning it is necessary to provide the opportunity to allow the reason underpinning any allocation to be seen and reviewed as required by public scrutiny.

7. Reproduceability: as an adjunct to being transparent it is essential that anyone undertaking the same exercise in the same manner is able to reproduce a consistent result.

8. Trace back provisions: provides opportunity for the user to gain insight and understanding of the allocation.

9. Response time: with increasing computing power users expect a quick response to their requirements (red light syndrome). The quicker the response time the more likely a user is to explore the implications and alternatives- thereby contributing to decision support. As an index to response time improvement, a gain of a factor of 1700 has been achieved in the DOS- Windows upgrade (of which x5 has been due to concurrent hardware improvements and x350 with software efficiencies). Translated to practical terms an exercise that once took 19 hr. to conduct can now be undertaken in 40 sec.

10. Continuity with previous versions: ensure users who upgrade their version of LUPIS (over a 100 versions have been distributed) can revisit past exercises automatically and have available the enhancements offered by later versions. In the past this has been the case with DOS versions and is being continued with the DOS- Windows upgrade.

11. Platform transferability: to assist in ensuring maximum opportunity of transfer to alternative platforms, for instance capabilities including file handling operations have been developed as a dynamic link library in Visual C++, the user interface is in Visual BASIC.

What are LUPIS' capabilities?

The value and purpose of the core supporting capabilities can only be gained from a demonstration or using LUPIS, however to assist that process a brief coverage is provided:

Large exercises: the size of an exercise is determined by the number of mapping units, land uses and guidelines. The limit on number of mapping units is in principle constrained only by the size of the hard disc, for formatting purposes the limit set on land uses is 99 and for guidelines 999- values which considerably exceed anything yet undertaken. Individually there can be 9999 commitment, exclusion and preference guidelines and 999 data items held against each mapping unit if required- subject to hard disk capacity.

Multiple stakeholders: earlier versions recognised only one stakeholder, in essence being developed to support single party planning (viz. SIRO-PLAN). The Windows version supports multiple stakeholders (99 provided for) with each stakeholder having access to the common map and data base (viz. SIRO-MED) as the inputs to development of individual stakeholder plans a prelude to the development of a consensus plan.

Hierarchal land use and guideline structure: historically LUPIS has identified a single land use to each mapping unit implying an exclusive allocation not conducive to multiple land use. The introduction of hierarchal land use structure which may recognise a preferred use, permitted uses, conditional uses and proscribed uses fosters a more inclusive approach to resource use. The hierarchal land use structure also recognises that land uses can be described in various levels of detail, for instance pastoralism may be divided into sheep and cattle grazing, sheep grazing in turn into breeding and dry sheep operations. In principle there is no limitation upon the number of levels that may be included in the hierarchy. The different levels of land use capture the diversity of interest and understanding relevant stakeholders express in formulating guidelines which may be directed at any specific level, for instance agencies may direct guideline attention to the highest level (e.g. pastoralism), peak bodies may formulate guidelines at industry levels (e.g. sheep or cattle) and individual

pastoralists at the activity level (e.g. breeding or dry sheep operations). The integrated hierarchal structure of land use and guidelines enables diversity of focus to be captured and utilised in resource allocation- a feature that facilitates a 'think globally, act locally' approach.

Spawning guidelines: guidelines proposed by way of example frequently have numerous analogues which the stakeholder takes for granted. To streamline the development of multiple guidelines to capture the theme of an example, guideline spawning has been developed whereby numerous specific guidelines are automatically spawned for a single exemplary generic statement. The advantage of this capability is that the stakeholder need only identify the single example (conservation of a particular land system type) for the underlying principle to be extended to all relevant cases (i.e. all land systems). Stakeholders retain control over the level of achievement on the individual spawned guidelines.

Multiple plans: each stakeholder can produce multiple plans, each of which can be retained for further refinement or as a component plan for plan blending. Provision is made for each stakeholder to retain 999 plans.

Switches for land uses: to simplify the exploration and development of appropriate land uses, individual land uses can be selectively removed from an exercise by a simple switch, in effect all the guidelines for a switched-off land use are ignored until such time the user switches the land use on again. The switches can be applied at any level within the hierarchy.

Switches for commitment and exclusion guidelines: commitment and exclusion guidelines by their nature can have an enormous impact upon the expression of preference guidelines and the option space of a land use. The switches enable an efficient exploration of this impact with the opportunity for the user to simply switch on and off commitment and/ or exclusion guidelines either individually or collectively.

Area adjustment: the relative area allocated to each land use in a plan can be adjusted directly and accurately with this capability whilst retaining the integrity of the land use values. The vote profile consistent with the area adjusted allocation is derived and retained. This feature can be used for those occasions when specific areal requirements need to be met either in percentage or real terms. Once an area requirement has been met this can be locked in before turning to the next land use, sound in the knowledge that land uses that have been locked in will not be altered in subsequent area changes. Area adjustment can be applied at any level in the land use hierarchy. However, once an area is locked in for a particular activity all further adjustments whether up or down the hierarchy are constrained to be consistent with activity areas already locked in.

Achievement adjustment: the guideline achievement attained for any preference guideline in a plan can be adjusted directly and accurately with this capability whilst retaining the integrity of other land use values. The vote profile consistent with the area adjusted allocation is derived and retained. This feature can be used for those occasions when specific guideline achievement requirements need to be met either in percentage or real terms. Once a guideline achievement requirement has been met this can be locked in before turning to the next guideline, sound in the knowledge that guidelines that have been locked in will not be altered in subsequent achievement adjustment of other guidelines. Achievement adjustment can be applied at any level in the guideline hierarchy. However, once an achievement is locked in

for a particular guideline all further adjustments whether up or down the hierarchy are constrained to being consistent with the guideline achievements already locked in.

Pragmatic achievement interpretation: guideline achievement is reported in percentage or absolute values where absolute values reflect the idealised area equivalent that an allocation has delivered. The guideline achievement of any preference guideline can be reinterpreted into a number of more pragmatic physical and economic measures (e.g. carrying capacity) to assist in evaluating the environmental, economic, physical and social consequences of any plan.

Temporal considerations: natural resource systems are not static, data reflects a snap shot of conditions currently applying. If dynamic changes in data are known then these can be taken into account and a sequence of plans produced in accordance with the fluctuating values of the dynamic variables. The sequence of plans can then be displayed in relative real time. Any one of this sequence of plans can be used as a seed plan for further change.

Mega units: mapping units having the same data or ratings profile will be allocated to the same land use, by recognising subsets of mapping units with the same profile time can be saved in the allocation phase. In addition mega units offer a sampling frame and an insight into the data and rating diversity for the area. The particular data and/ or ratings on which mega units are formed is under user control.

Proprietary data file structures: the capabilities of other software packages can be used to increase the efficiency with which LUPIS is used or enhance the output from LUPIS. To facilitate this links have been made to allow seamless use of other products both in-house and commercial. To date the two commercial products are Excel and IDRISI. In addition information can be transferred to an ASCII file for importing to other packages.

Plan blending: individual stakeholders can generate a series of plans each of which may have desirable features. Alternatively the preferred land use plans of individual stakeholders need to be reconciled. Plan blending allows these component plans to be combined (several methods are provided) to form a single plan. This single plan can then become the seed plan for subsequent refinement as required.

Mediation: the resolution of differences in the land use preferred by individual stakeholders is gained with a period of interactive mediation of the conflicts. To assist in this phase a number of negotiation aids are available which can be used in a flexible form determined by the user(s) to assist resolving differences and develop a consensus plan.

Relative land value: the relative land value applies to a plan and is the relative value of each mapping unit should the preferred use be implemented. As such it reflects the price that the plan developer would be prepared to pay for adoption of the preferred use should a land market exist for the land. There is a constant adjustment in relative land values as stakeholders progressively refine their plans. Similarly relative land values differ between the allocations preferred by different stakeholders.

Hotspot: while differences in relative land value exist between competing stakeholders there are different degrees of significance. Hotspot analysis allow the stakeholders to collectively

identify at what level the difference between their individual relative land values is of sufficient significance to warrant further analysis and negotiation.

Tradeoff: the allocation of a land use as preferred also identifies what land values have been forgone and therefore the implied tradeoff involved should the preferred use be implemented. In addition the achievement level of each guideline monitonically increases or declines in moving incrementally from one plan to another. Comparing the trace of this change across targeted guidelines gives insight into gains and losses associated with any intermediary plan.

Consensus plan: the objective of a planning exercise where a number of stakeholders are competing for the land resources is to arrive at an efficient allocation which has enabled each stakeholder to maximise their individual objectives mindful of the competing objectives of other stakeholders and their relative political importance. This is the objective of the consensus plan which is arrived at by combining the preferred land use plans of each stakeholder into a single plan which is then adjusted further in light of the insight offered by the negotiation aids. The full capabilities of the package are available for adjusting the plan at the discretion of the stakeholders.

A Stylised layout of LUPIS: