



**GEOLOGICAL SURVEY OF NEW SOUTH WALES
DEPARTMENT OF MINERAL RESOURCES**

**LAND USE PLANNING IN NEW SOUTH WALES
ROLE OF THE DEPARTMENT OF MINERAL RESOURCES**

BY

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ABSTRACT

The Department has used a system of subjective mineral prospectivity ratings in its responses to proposals for changes in land use. The responses are necessary under environmental planning legislation and relate mainly to regional and Shire-wide planning instruments. The responses are based on the extensive, though incomplete data bank on geology and mineral resources held by the Department.

The Department in its responses differentiates the knowledge base of the different commodity groups by the description of variously 2, 3 and 4 or more, prospectivity ratings. This report covers land use advisings for "minerals" including construction materials, but not coal resources.

The major constraint on the quality of the Departmental advisings is the need to rely on previously gathered information because of time and manpower constraints. This means the responses value is affected in part by the extent, reliability and completeness of historical records, previous company exploration reportage, and to a lesser extent by the level of understanding of the regional geology, and by the personal knowledge of the area by the Department's staff geologist undertaking the compilation.

CONTENTS	Page
SUMMARY	4
INTRODUCTION	5
DEPARTMENTS ROLE IN LANDUSE PLANNING	5
TYPES/STYLES OF LANDUSE PLANNING ENCOMPASSED BY THE DEPARTMENT	6
PURPOSE IN DEPARTMENTAL ADVISINGS	7
STYLE/NATURE OF DEPARTMENTAL ADVISINGS	7
METHODOLOGY	8
BASIS OF ADVISINGS AND SOURCES OF INFORMATION	9
MINERAL POTENTIAL OR PROSPECTIVITY RATING	10
COMPATIBLE OR DESIRABLE LANDUSE FOR MINERAL DEVELOPMENT	12
DIFFICULTIES CONFRONTING THE DEPARTMENT IN THE PREPARATION OF PROSPECTIVITY RATINGS	12
CONCLUSIONS	13
SELECTED READING	14
SELECTED REFERENCES	15
APPENDIX: Prepared by R. G. Barnes "Factors Governing Mineral Resource Assessment - Check list of questions to be asked"	16

SUMMARY

The Department is required to make input to all significant planning decisions in NSW. This involvement is largely on the prevention of sterilization of mineral resources. It has various advisory, a protective (husbanding), and a concurrence role in decisions. This document outlines the broad principles concerning issues which relate to "minerals". For a specialised discussion on resource planning, the reader is referred elsewhere, eg to M

The methodology flows from the Department's ownership geology and location of known mineral occurrences, and leads to a definition of a mineral development potential or mineral potential "rating".

Various two, three, and four (or more) categories have been utilized at various times and for various purposes. It has been found that "planners" can only readily handle "black" criteria, and the use of "grey" areas of (medium or low) ranking only leads to compromise or conflict. This conflict is not possible to say that any given area has no (future type) for the discovery of (at least some) mineral comm

A major conclusion evident from an assessment of activities in land use planning is that the reliability of response inputs are directly related to both the Department and the comprehensive nature (effectiveness and completeness) of company exploration reportage over the subject area. A high level of understanding of the regional geology and the knowledge of specific areas by individual staff geologists is an implicit value of the response.

It cannot be over-emphasised that a maximum of information should be provided by all explorers in NSW, in order for the mineral resources to be continually updated so as to meet the requirements for realistic land assessment.

INTRODUCTION

The Department of Mineral Resources has an active role in all significant regional planning decisions in NSW.

These planning decisions are reflected in planning instruments ranging from that of regional environmental plans (REP's), to Shire-wide local environmental plans (LEP's), to proposals for large civil or commercial projects, as well as for the development of mines and extractive industry operations.

The Department's input is technical and based largely on its bank of information about the geology of areas and the known existence of mineral occurrences. Together, these factors help to determine a rating for mineral prospectivity.

It is the Department's responsibility to consider all the prescribed minerals and the "unprescribed" commodities, without distinction. The former comprise those of metallic and non-metallic nature, and coal and petroleum/gas resources, while the latter include the bulk industrial minerals (limestone, brickclay), and the low cost construction materials (sand, crushed aggregate, loam). However, its database on some of these commodities is inadequate at present.

The Department's role in land use decisions is to provide basic information (e.g. for LEP studies), or to review (and occasionally assess) development proposals (e.g. review of Environmental Impact Statements) (EIS's) for all mining and extractive industry proposals, and most major civil/commercial development projects. In this role, it operates in parallel with the Department of Environment and Planning (DEP), who are responsible for formulating the final recommendations to the Minister for Planning.

Other roles include involvement in more general planning matters such as State Environmental Planning Policies (SEPP's) on mineral resources and extractive resources (with the DEP); in specific local or regional planning matters such as river de-snagging (with local councils and the Department of Water Resources); with Commissions of Enquiry such as for peat; and in attendance at the Land and Environment court, often as "expert" witnesses or objective advisors for one or the other party.

The Department's data bank, while to date largely of an historic nature, is increasingly becoming dependent on company exploration reports for up to date information. Hence the continuation of comprehensive reportage (and thoroughness of these reports) will be one of the factors in the reliability of any prospectivity rating generated during future review processes.

DEPARTMENT'S ROLE IN LANDUSE PLANNING

In land planning and actual landuse changes which are proposed, the Department plays variously, and sometimes simultaneously, an advisory, a protective and a concurrence role, depending on the nature of the enquiry.

The advisory role is exemplified by "identifying" land affected by "mining" for private and public authorities - the existence of mining leases or proclaimed (coal) mine subsidence areas.

In its protective role the Department attempts to prevent alienation of land, sterilization of resources, or retain access to deposits or land for future exploration or mining. This role directly relates to the form of input to regional and local environmental plans and to the declaration of large areas for special (single) purposes, such as nature conservation or defence force requirements.

The concurrence role arises mostly in relation to extractive industry, where a declaration that no "mineral" interests are affected by the proposal, e.g. sand dredging from an estuary, allows the consent authority to make an affirmative decision (assuming that no other concurrence authority raises objections).

Finally there is an ill-defined role in the Department's involvement in the direct resolution of conflicts which arise with proposed changes to landuse. Perhaps the major example here is of submissions to and appearances before Commissions of Enquiry or hearings in the Land and Environment Court.

TYPES/STYLES OF LANDUSE PLANNING ENCOMPASSED BY THE DEPARTMENT

Almost without exception the Department's involvement in Landuse Planning is as part of its strategy to ensure the maximum availability of land for exploration.

Most land planning is initiated, and approved by governmental agencies and almost invariably results in alienation of the land area (subject of the changed landuse) from access for exploration (and mining) under the provisions of the various acts administered by this Department.

The following list is a compendium of the types of landuse changes on which the Department is obliged to comment, in terms of the presence (or otherwise) of mineral resources.

- a) SEPP and related matters (e.g. Wetland Policy, Coastal Zone Management).
- b) Regional Environmental Studies and Plans
- c) Local (especially Shire wide) Environmental Studies and Plans
- d) Proposals for dedication as National Parks, fauna reserves or State recreation areas
- e) Proposals for dedication as wilderness or wild and scenic river areas
- f) Water storages (and their immediate catchments)
- g) Flora Reserves of the Forestry Commission
- h) Crown Lands Office - Management of Crown Lands, sand removal, sand dredging, reclamation in estuarine waters
- i) Title conversions e.g. Crown Leasehold to Freehold
- j) Special Purpose reservations - e.g. Defence Land acquisitions
- k) Review of EIS's for extractive industry
- l) Review and/or Assessment of EIS's for mineral development
- m) Review of EIS's for major civil projects - roads, railways, dams, power stations, smelters, power transmission lines, gas/water pipelines, commercial/tourist developments (of greater than 1ha), and waste disposal sites
- n) Reservations for future quarrying/extraction
- o) Searches for property transfer/purchase e.g. encumbrances.

PURPOSE IN DEPARTMENTAL ADVISINGS

The Department is primarily concerned to prevent the unnecessary alienation of land from access under the various acts it administers and also to minimise the sterilization of known/identified mineral resources. This latter role arises from a perceived need to husband or conserve access to all potential resources, virtually regardless of current strategic or commercial considerations.

The Department is concerned to ensure that any resource which is identified, has due consideration of its intrinsic value taken into account in all proposals for land use changes. This covers both the situations where:

- (a) the proposed development will impact on the ability for extraction of the resource commodity to take place in the future, and
- (b) where the probable future extraction of the resource commodity in the future will impact on the proposed development.

This is not to say that the Department does not make some attempt to come to terms with the future net value of deposits which are mostly only superficially identified - on the basis of probable urban developments, the geological setting, probable rarity of the occurrence, and etc.

The Department of Mineral Resources is especially concerned about zoning of land for environmental conservation, because dedication of land as National Parks and other reserves severely hinders or precludes mineral exploration, and thereby denies the community access to potentially valuable information, and possibly to mineral resources. The importance and distinction of mineral exploration as a valuable method of land assessment, rather than a land-use, is often overlooked by planning authorities. It is emphasized that commercially exploitable mineral deposits are commonly distributed inconsistently within the earth's crust, and many deposits are discovered only after considerable expenditure of time and money in exploration ventures. Concepts and techniques involved in exploration and mining continually improve and lead exploration companies to investigate both previously unexplored land and land that has been repeatedly explored or even mined in the past.

STYLE/NATURE OF DEPARTMENTAL ADVISINGS

The Department's advisings in relation to mineral resources affected by proposed changes in land use comprise one of two categories. These are:

- a) whether the Department objects or acquiesces to a land alienation proposal, or
- b) whether the Department wishes to have specific resource potential(s) incorporated as a constraint to allowable land uses in land zoning/development proposals.

In the case of (a) it is largely as a black and white (yes/no) advising, based mostly on the known presence or otherwise of mineral resources or resource potential. Usually a "no objection" type of advising is given only in respect of small land parcels, usually where these parcels are in environmentally "strategic" locations, e.g. flora reserves on mountain peaks or ridges, sand dredging in estuaries, etc.

However, in the case of (b) the advising is of a much more subjective nature and includes:

1. a reference to the department's role/function (both regulatory and investigative);
2. a general historic review of the setting of the mining industry in the region;
3. a rating of mineral potential (see later) of the study area, including a listing of known deposits;
4. brief notes on the significance/importance of the identified resources/deposits;
5. Production statistics where relevant e.g. of construction materials.

In addition comment is made where relevant on the presence of declared fossicking areas and sites identified as having mining or geological heritage value.

In some situations comments are also made on aspects of environmental geology which though often the statutory function of other agencies e.g. groundwater, urban capability (e.g. flooding, landslip), river processes (eg river bank stability), or marine processes (dune movement or wave erosion/beachfront recession), or foundation conditions and earthquake risk assessment, if they are considered significant or obvious from an overview geological assessment.

Finally attention is drawn to any potentially hazardous areas arising from the presence of old mining areas e.g. extensive proclaimed subsidence (coal mining) areas, and the possibility of collapse of abandoned shafts, drives and stoped zones, which might affect the suitability of the area for some uses e.g. urban expansion.

METHODOLOGY

When an invitation to comment on a proposal to change landuse is received by the Department, it is subjected to an apparent multi-stage process:

Initially, establishment of time constraints through discussion with the requesting authority is undertaken, followed by:

- a) identification of the geographic position of the study area on the relevant 1:100,000 or 1:25,000 scale map;
- b) identification of any titles, applications or licences (and prior landuse factors) affecting the study area;
- c) an identification of the recorded mineral occurrences in the study area (and any foreseen developments of these), including preparation of a draft prospectivity rating;
- d) an outline of the (simplified) geological setting of the study area is prepared.

Primarily from aspects (c) and (d), a subjective assessment is made of a mineral prospectivity/potential rating (area zoning) is prepared (see later), upon which is based the Department's response to the proposal.

Whilst the above procedure appears to be simple and straightforward, practice in the Department it is an extremely fragmented (and time consuming

process. This fragmentation arises from the need to seek specialist input into each of the above aspects. For example, two or more sections in the Geological Survey Branch alone might be involved in aspects (c) and (d); e.g. a typical assessment could involve each of North East Section, Petroleum Section, Industrial Minerals Section and perhaps Mineral Economics Section and Environment Section.

In addition, Coal Geology Branch might be involved, with one or both of the Mining Engineering Branches also having to make input. The Central Drafting Sub-Branch also plays a major role in both the study area geographic location and titles identification aspects, and in the preparation of the final response.

A simple enquiry e.g. for a straight forward reclamation dredging proposal, can be responded to in a matter of weeks. However, input for a study, preparatory to formulation of a draft local environmental plan for a shire, might take 2 to 3 months, allowing for drafting of plans for inclusion in the report.

Obviously any specific field work requirement by geologists can substantially increase these time estimates, but can be of great benefit in making more meaningful recommendations.

BASIS OF ADVISINGS AND SOURCES OF INFORMATION

All advisings are of a technical nature and relate to either:

- a) existing titles (or applications or licences) as supplied by Central Drafting sub Branch; or
- b) known, inferred (postulated/potential) presence of mineral or construction material resources, or of petroleum, and coal resources.

As can be appreciated (a) is factual, if of an only essentially short term nature (viz 21 year period of grant of a mining lease), whilst (b) has to date been subjective and a function of the level of completeness of the Departments data base (and, to an often significant extent, on the local knowledge and perceptions of the assessing geologist). It is difficult to foresee any systematic methodology arising which would overcome the subjective nature of the assessment of "mineral potential". Obviously with the passage of time, the data bank on which assessments are made will increase both in quantity and quality, and so impose less emphasis on the subjective aspects.

In some cases where it is perceived that decisions with far reaching consequences are involved, new original data may have to be acquired by direct field studies (e.g. Macleay-Apsley Resources Study, Penrith-Camden clayshale drilling programme).

The data bank held by the Department (mostly available on public access) comprises:

1. The published metallogenic maps, mine data sheets and metallogenic studies.
2. The published and unpublished geological report and map systems.
3. Field programs in progress in the technical branches.
4. Company PEL, EL, PL, and ML reports (in the GS System)

5. The Mine Records System
6. Lease plan system
7. The cores held at the Core Library
8. Any other sources (internal files, inspection reports, DIR records & etc).

From these data sources it is usually possible to prepare an outline of the resources present in an area, their status/value/merit etc, as data points.

The point source data have then to be synthesized with an appreciation of the regions geological setting, by a geologist, to reach a mineral prospectivity rating (see later).

Obviously, the reliability of such a subjective methodology is dependent on the completeness of the Departments knowledge of the presence of mineral deposits and of the degree of reliability of the "as known" geological setting.

This latter aspect can be realistically assessed (albeit also subjectively) where outcrop is present. But what of the situation in respect of basement potential where soft rock cover is present (e.g. are there more Eluras', or Roxby Downs'?). This is one of the many "guesstimate" situations which the Department routinely encounters in response preparation.

MINERAL POTENTIAL OR PROSPECTIVITY RATING

Depending on the particular situation (which Shire, the types of resources present, and the level of knowledge), variously 2, 3, or 4-(or more) fold classifications of potential or prospectivity are currently used by the Department for the separate "mineral" commodity groups.

The simplest one, where the range of resources is small and the reliability of present geological understanding is low, comprises a two-fold classification as below:

Mineral Resource Planning Category A: Includes all known mines and quarries and all known deposits with potential for economic development and areas with old and/or abandoned mineral deposits known or considered to be highly prospective.

Mineral Resource Planning Category B: Comprises areas containing some known and/or abandoned deposits, in which geological resource data is less reliable. The geology as known would indicate that these areas have moderate potential for economic mineralization.

It should be noted that in this scheme, no category "C" (low or "no mineral prospectivity") is nominated. However, a "rider" is usually applied in the response to Council to the effect that:

"In all other areas, planning should be sufficiently flexible so as to not preclude mining and exploration, as an activity".

The above scheme has been widely adopted in preference to earlier classifications (eg McIlveen 1976), which proved largely unworkable for

planners who really need a simple "black/white" classification with no "grey" areas.

The Department is extremely conscious of the fact that any classification of potential (or prospectivity) is very subjective and primitive. A further problem which is difficult to incorporate in planning instruments is that any classification of areas necessitates virtually continuous updating in the light of new exploration techniques, newly identified resources (eg zeolites), new uses for mineral commodities and new knowledge/understanding of models of occurrence of resources.

It is obviously not feasible (or practicable) to classify all areas as prospective, even though in the ultimate this is so. Most "non-classified" areas contain odd scattered mineral occurrences and almost invariably actual or potential construction material resources (the details of which are not known). Hence, resort is often made to other classification schemes, which incorporate additional categories. Whilst these additional categories (see below) are of help to the Department in its internal assessment, they involve concepts which are difficult for a planner to utilize.

A typical example of a 3 - 4 class scheme is that for Kyogle Shire (LEP) as under:

Mineral Resource Planning Category 1: All operating and proposed mines and quarries and deposits with established potential for commercial development.

Mineral Resource Planning Category 2: Important areas of past mining or quarrying activity, areas immediately surrounding current mining/extraction sites, and geologically favourable areas considered highly prospective for the discovery of commercially exploitable mineral resources.

Mineral Resource Planning Category 3: Comprises areas of scattered mineral deposits or abandoned small mines and some areas of favourable geology, rated as moderately prospective for the discovery of commercially exploitable mineral resources.

Other Areas: The remaining areas lack identified mineral resources and are currently considered to have a low prospectivity for the discovery of resources. However, geological understanding and resource assessment are generally inadequate in these areas and do not preclude the future discovery of commercially exploitable "mineral" or important construction material deposits.

In some cases a full 4-fold classification is adopted using high moderate and low prospectivity, and a fourth category "Indeterminate Mineral Resource Potential" - areas where there has been little effective exploration and the geological setting and mineral resource potential are poorly understood (usually rugged, forested, and essentially uninhabited country).

In all the above schemes, the one primary objective is to avoid any reference to areas with no "mineral potential". This is because the areas defined (by omission) as having low potential, would almost invariably contain at least some operating(?) (even if only intermittently) construction material extraction sites for low cost construction materials such as unprocessed fill and road sub-base. However, these pits operate at too small

a scale to be recorded in a regional inventory, though they might be significant (certainly in number) in an exhaustive Shire inventory.

In addition, these areas would undoubtedly contain a variety of potential construction material resources (which will only become of value when the area is subjected to an increased level of development).

It can be appreciated from the foregoing that the land categories in which it is most likely that new deposits will be discovered are those of moderate to low or unrated prospectivity - because the areas of high prospectivity are closely confined only to existing deposits in most schemes. However, the inability to predict discoveries (in either a resource type or time frame) or to justify such an argument, precludes the obvious approach of why not just class the entire area as "prospective" - without any sub-classification.

COMPATIBLE OR DESIRABLE LANDUSE FOR MINERAL DEVELOPMENT

Under the recent past and present rigid planning schemes used by Local Government Authorities to control and direct development intensity, most development zones have virtual (or implied if not stated) exclusion constraints on any mining or extractive industry eg most sub categories of zones 2, 3, 5, 6, 7, 8, and 9.

Rarely is a specific zone 4 (extractive industry sub zone) incorporated in the final planning instrument, and as yet, resort to the old practice of consecutive use of land (eg initially for extraction and subsequently for housing), is virtually unknown in zone 2.

For the above reasons the preferred zoning for land to accommodate and allow for ease of current and future mineral development are the various sub categories of zone 1 (rural).

It is to be hoped that increasing use of the newly proposed zoning model provisions (with more inbuilt flexibility involving consent following advertising of intent) will enhance use of the concept of multiple and or sequential use by land use planners.

However, it is important to realize that widespread access for exploration is as a rule more critically essential than is local access for mining or extraction (on the grounds that once a deposit is identified, reasonable argument can be formulated for the acceptance of mining). For this reason the Department is especially concerned at the extent of possible broad brush zonings of the 7 (and 8 and 9) type. As yet some lack of success is apparent when it comes to acceptance of this fact by planning authorities

DIFFICULTIES CONFRONTING THE DEPARTMENT IN THE PREPARATION OF PROSPECTIVITY RATINGS

In preparing responses aimed at providing input to proposals for major landuse changes, the Department is confronted with a number of constraints which together render the advisings of mineral prospectivity as less than objective and of varying, though unquestionably limited, reliability.

Some of these constraints are normal to the operations of a geologist, such as: incomplete data base on resource occurrence and nature; very sketchy or superficial geological data base, and almost invariably, insufficient time to undertake the level of investigation necessary to frame a reliable response. Hence the nature of the response is dictated very largely by a subjective appraisal of the data available to the assessing officer(s) of the Department.

However, of more concern is that related to the present situation of lack of legislative influence on extractive industry. Currently the provisions of the mining act do not apply to the extraction of construction materials. This group, ranging from garden loam, to sand, to crushed and re-constituted road base and crushed aggregates, are extracted under a variety of tenures, but with no central controlling agency. As a consequence, knowledge of the location of extraction sites is largely undocumented, as is the actual size of many pits and the extent of the market which is supplied from local sources. The Australian Bureau of Statistics attempts to collect yearly production/sales figures, but these are often incomplete as they rely on voluntary compliance (for the returns).

This situation has the effect of making prediction of future needs even more subjective than is desirable; yet these are the very group of resources which generate the major landuse conflicts in local and regional planning.

Only in rare instances is the Department able to make reliable input into local planning in relation to construction materials. These instances occur without exception in the major urbanised areas of the greater Wollongong-Sydney-Newcastle region, where Departmental activities over the last 20 years have been primarily in relation to extractive resources (and coal) and accordingly a reasonable data base on these commodities is available.

Elsewhere, the Department has to rely on the personal knowledge of the study area by the assessing officer to make any worthwhile input into future planning for construction materials availability.

CONCLUSIONS

- (a) The basic aims of the Departments input are to:
- avoid unnecessary sterilization of resources
 - maximise access to land for exploration and mining
 - ensure that planning allows for adequate future supplies
- (especially of extractive resources) to be available.
- (b) The Department is keenly aware of its role in maintaining access to a maximum of the area of the State for exploration and mining.
- (c) Mining and extractive industry has been singled out by the Planning & Environment Legislation as always requiring an EIS and the determination of a development consent.
- (d) The Department must have some basis (viz mineral prospectivity) to support any objections it raises to changes in landuse.
- (e) There is generally insufficient opportunity for the Department to undertake specific investigations to assess prospectivity of areas subject to

proposals for changes in landuse (there are some 250 shires or equivalents in NSW).

(f) The Department is reliant on its data base on mineral resources and a currently poorly documented data base on construction material resources, in order to reach some measure of prospectivity ranking.

(g) In order for the Department to improve the quality of its advisings, and hence of the value of its inputs to landuse planning, a conscious effort will be required to both improve the usability of the existing data bank and increase the quantity and quality of incoming information on mineral resource prospectivity.

(h) The importance of reliable and complete EL (& PL & ML) reportage to the above process cannot be over-emphasized. The Department needs an outline of the thinking/concepts that were being tested by the explorers, and why results were considered discouraging, when licences are relinquished.

(i) One obvious shortcoming evident to current Departmental staff compiling mineral resource data is the lack of historic compilations of all lease plans onto standardised maps, throughout the State but especially in areas of continuing landuse conflicts.

(j) To respond to the ever increasing demands for input into landuse planning studies, provision needs to be made for sufficient staff to continue new data collection, so continuing the highly visible input by the Department on the aspect of mineral resource prospectivity.

SELECTED READING

The following list comprises a representative selection from the major landuse studies carried out by the Department over the last 10-15 years. Even prior to this, the Department had been involved in the identification of mining and geological constraints to planned regional development, though the nature of the advisings were in general less geared to the defining of (resource) prospectiveness. This will be apparent to those who read a selection starting at the earliest and working through to more recent studies.

Year of Study	Region	(Main Author)	GS report number
1971	Coffs Harbour Shire	(Crawford E.A.)	GS1971/275
1971	Campbelltown Sub Region	Study (Chesnut W.S., et al)	GS1971/463
1971	Gosford-Wyong Sub Region	Study (Wallace I., et al)	GS1971/463
1972	Tweed Shire	Study (Chesnut W.S.)	GS1972/396
1974	Albury-Wodonga Region	(Chesnut W.S.)	GS1974/021
1974	Gosford-Wyong Region;	factors affecting Development (Chesnut W.S.)	GS1974/411
1975	Newcastle-Cessnock Region	(Gobert V.D., et al)	GS1975/159
1976	Bathurst-Orange Region	(McIlveen G.R., et al)	GS1976/394
1985	Inverell Shire	(Cameron R.G.)	GS1985/148
1985	Macleay-Apsley Study	(Barnes R.G., et al)	GS1985/055
1985	Manilla Shire	(Henley H.)	GS1985/149
1986	Drake Project	(Mt Carrington Mines)	EIA

1986	Gidginbung Project	(Paragon Resources)	EIA
1986	REP 9 (Sydney Region Extractive Industries)		(DEP)
1986	Macarthur REP	(DEP)	
1975	Rural Land Evaluation Manual	(DEP) 1st Edition	
1987	Rural Land Evaluation Manual	(DEP) 2nd Edition	
1987	Kyogle Shire	(Brownlow J.W., et al)	GS1987/191

Note that the hiatus between 1976 and 1985 is only an apparent feature, in part due to a change to a "user-pays" system by the Department in the provision of services and in part by the only gradual realization by Councils of the extent of the input required for local environmental plans.

SELECTED REFERENCES

Coal Resource Planning in the Hunter Region, MINFO 17, October, 1987, p33-36

APPENDIX

Page 3 BARMN:MINVAL

Factors governing mineral resource assessment -

Check list of questions to be asked .

Known mineralization What are the types, numbers, value, production and historic importance of known mineral deposits? What was the largest deposit, what is the average size of worked deposits? How do the deposits in the area of concern compare with similar deposits elsewhere? For example a small copper deposit might be the largest known deposit in the area of concern but be of little significance nationally or globally.

Areas of past mining are important as indicators of metal and commodity concentrations in the Earth's crust. Many mining areas offer potential for further discoveries as well as for re-mining of previously uneconomic zones. Old mining dumps, tailings and slimes might also be retreated.

Commodities What are the known commodities? What are their comparative values? For example, sterilization of one gravel location may be of little importance compared to the sterilization of gold mining area. What is the range of known commodities, including minor commodities? Could any of these be potentially valuable; for example, bismuth deposits later worked for molybdenum, tungsten deposits later explored for topaz, monazite discarded as waste now of value because of contained thorium and rare earth elements. Is there the possibility of small amounts of some valuable commodity being present? e.g. base metal deposits with minor gold might now be worked principally as gold deposits.

Size and grade of deposits Is it possible that known deposits could be assessed as a resource using different criteria to those used in original mining; for example, an area of scattered low tonnage, high-grade veins might later be considered as a large low grade resource. An example of this is the Taronga tin deposit in northern NSW.

Genetic relationship of mineral deposits to host rocks Are the mineral deposits genetically related to the host rocks in which they occur, or is their occurrence governed by other factors such as structures, distance from granitic contact, or in the case of construction materials, distance from transport and markets?

This information provides vital clues to the importance of particular rock types or settings.

Are the host rocks similar to rocks hosting mineral deposits elsewhere in the state/country/world or is there little or no association?

This could be of significance where no deposits are known from the region but where a potentially interesting rock association occurs. This is the way in which most exploration companies undertake project generation.

Page 4 BARMN:MINVAL

Extent of interesting zones Having established that there are rocks with genetic associations to mineralization in the area or known elsewhere by association, what are the controls over these in the area of concern? For example, stratiform massive sulphides may be restricted to felsic volcanic sequences, while gold vein deposits might be associated with specific structural corridors. Tin deposits may be associated with particular granites and their country rocks. Construction materials may be restricted to a variety of rock types within 200 metres of main roads. With these controls established, what is the extent of the rock types, or other zones controlling deposits within the area of concern? Is it possible to comment on areas which are more or less prospective within those which are interesting?

Levels of confidence in current geological understanding What is the level of confidence which we have in current geological understanding in the area of concern? Is the geological mapping accurate or is there the possibility of important sequences being present which have not yet been identified? What is the current status of metallogenic understanding? Have all the lease plans for the area been compiled? Do available metallogenic maps cover the area with sufficient detail?

Exploration What exploration has occurred over the area of concern? How many companies have explored in the area? What exploration models have been used? What range of commodities were sought? What targets were defined? Where any of these drilled? Why did exploration cease? Are there any commodities or geological environments which have not been explored for?

Value of known deposits What is the grade/ tonnage/ value/ export potential of these deposits? Are they currently being mined? What is their value to the community in terms of employment, flow-on effects, reduced costs of materials for construction compared with importing materials from elsewhere into the area, value to government by way of royalties, taxes? What is the strategic value of the materials mined?

Potential value of deposits What types of deposits could occur in the area of concern? Based on exploration models, what could be their grade/ tonnage/ value/ export potential?

Land use pressure What land use pressures are there on the area of concern? Do all land use criteria require absolute answers, or is it possible to leave open categorization of some areas until a pressing landuse conflict arises? Is it possible to suggest sequential landuse such as beach sand mining followed by a golf course or housing development.