Argyle Diamond Project

Report and Recommendations
by the
Environmental Protection Authority

Department of Conservation and Environment
Western Australia

Bulletin No. 139
January 1983

REPORT AND RECOMMENDATIONS

BY THE

ENVIRONMENTAL PROTECTION AUTHORITY

ARGYLE DIAMOND PROJECT

DEPARTMENT OF CONSERVATION AND ENVIRONMENT

WESTERN AUSTRALIA

BULLETIN NO 139

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1. CONCLUSIONS AND RECOMMENDATIONS

The proposal by Argyle Diamond Mines Pty Ltd to develop an alluvial and Kimberlite diamond mining and recovery project with associated infrastructure in the Eastern Kimberley Region of WA will have extensive and major impacts on the existing environment. However the EPA considers that the Company has shown in its ERMP that with a well planned and fully effective environmental management program these impacts can be controlled and contained to an acceptable level.

The EPA therefore finds that the proposal as described in the ERMP is environmentally acceptable provided the following recommendations are taken into account in the project planning and development.

1.1 Detailed Environmental Management Plans be submitted to the State for consideration in association with the development proposals required in the (Ashton Joint Venture) Agreement Act 1981.

1.2 Should a town development be considered necessary in the future a separate and comprehensive environmental evaluation will be required for EPA consideration.

1.3 The Company have further discussions with the WA Museum on all aspects of Aboriginal Site Protection and Management in areas influenced by the development. Local Aboriginal groups should also be involved in any such discussions.

1.4 The Company closely monitor the social impacts of its development on the town of Kununurra and nearby communities, especially during the construction phase. It should co-operate with private and government agencies as well as other possible developers to control or overcome any adverse impacts which may occur.

1.5 The Company establish a waste dump rehabilitation trial on a suitable site early in the project development to establish a viable and cost effective rehabilitation procedure for later use.

2. BACKGROUND

Diamonds have been known to occur in Australia since the 1850's however they were not of economic significance being found as the result of other mining activities. In the 1960's there were a number of companies exploring for the source rocks of these previously discovered alluvial diamonds.

The Kimberley region of WA received considerable attention because certain rock types known to occur there were very similar to the diamond bearing Kimberlites of overseas diamond mines.

Companies formed joint ventures to fund the extensive exploration programs of the 1970's which followed the discovery of Kimberlites and alluvial diamonds in the Kimberley in the late 60's. It was from one such group that the Ashton Joint Venture was formed in 1976. This venture was successful in locating a number of Kimberlite bodies, some of which had sub-economic diamond values in Central Kimberley culminating in the discovery of the Ellendale Kimberlitessome of which contained near economic grades of gen quality diamonds.

As exploration activity moved east alluvial diamonds were discovered by the Joint Venture in the Smoke Creek drainage and follow-up work soon led to the discovery of the economically significant Upper Smoke Creek Deposits and the AK-1 Kimberlite. A detailed feasibility study commenced in 1980 and has led to the present mining project proposal.

In December 1980 the Joint Venture submitted to the State an Environmental Statement for the mining and recovery of diamonds from the Upper Smoke Creek alluvials. This document was considered by the EPA as a Notice of Intent and the proposal was found to be environmentally acceptable. However the project did not proceed because of the feasibility study on the more major Kimberlite mine and the discovery of further alluvial diamond deposits in the head waters of Limestone Creek in 1981.

A revised alluvial mining proposal which included Limestone Creek and some scree ore was submitted to the State in October 1982 under the provisions of the Diamond (Ashton Joint Venture) Agreement Act 1981. This proposal included environmental management information on the alluvial operation additional to that provided in the ERMP.

In November 1981 the Joint Venture partners entered into an agreement with the State which covers the development and operation of diamond mining at Argyle and Ellendale. This agreement was ratified by the Parliament of WA.

Under the agreement the Joint Venturers (now Argyle Diamond Mines Pty Ltd) have a number of environmental obligations the most important of which are covered by Clauses 7, 11 and 44 of the Agreement Act.

Under Clause 7 the Company is required to submit detailed proposals to the Minister for Resources Development, for his approval. The proposals will cover the mining, marketing, infrastructure, services and environmental management of the project. While the ERMP has provided the basis for the environmental management proposal many of the project components are still conceptual and additional detail will be required in the environmental management proposal to be submitted to the State. (Recommendation 1). The areas requiring further study are discussed later in this report.

Clause 11 of the Act requires the Company to submit to the Minister for Resources Development annual reports on environmental investigations and research carried out by the Company. Every 3 years a detailed report and review of environmental matters is to be submitted to the Minister together with proposals for future environmental work.

Clause 44 of the Act requires the Company to comply with all State and Local Government environmental requirements which currently exist or may exist in the future.

In March 1982 the EPA considered a proposal from the Company for a temporary water supply scheme to enable water to be pumped to the project area from Lake Argyle. This scheme was necessary to augment the existing ground-water supplies. The scheme was found to be environmentally acceptable provided certain conditions were agreed to by the Company. This occurred and the water supply was installed late in 1982. This scheme will form the basis of the final project water supply as described in the ERMP.

The ERMP was formally submitted to the EPA on September 8 1982 and a six weeks public review period was held from September 13 to October 22 1982.

3. THE PROPOSAL

The Joint Venturers through their operating Company (Argyle Diamond Mines Pty. Limited) are planning to develop a small short term alluvial mining and diamond recovery operation and a large long term open pit Kimberlite mine and associated milling and recovery plant. The developments will be on the headwaters of Smoke and Limestone Creeks 35 km south of Lake Argyle in the East Kimberley Region of WA. (See Fig 1 for location details).

In addition to the mining and recovery facilities the development will also require support facilities and infrastructure including a power supply, water supply, on site worker accommodation, an airport, construction camp, caravan park, light industrial area, staff housing in Kununurra and diamond sorting facilities in Perth.

The alluvial mining operation will commence before the main Kimberlite mine development and will use a plant based on the existing trial plant used for the feasability study. Approximately 2.5 million tonnes could be mined (this is somewhat more than the 1.2 million tonnes estimate given in the ERMP). The mining operation should be completed within 3 years. Areas not required for the Kimberlite mine or facilities will be rehabilitated with suitable vegetation following the construction of erosion control systems.

The alluvial plant will either be dismantled and moved to another site or used for future test work. Tailings generated by the plant will be used in construction work or dumped in tailings dams and revegetated.

The Kimberlite ore body contains some 80 million tonnes of material accessible to open cut mining. Initially this will be mined at a rate of 2.9 million tonnes per annum (Mtpa) with provision to expand to 4.3 Mtpa later in the project. Prior to productive mining approximately 20 million tonnes of waste rock will need to be removed and over the life of

the open cut over 300 million tonnes of waste rock will be removed and placed in waste dumps.

Following the open cut mining phase there will be additional ore accessible to underground mining. The economics of underground mining are unknown at this stage.

The waste rock will form 3 large waste dumps with a combined area of 410 ha. Rehabilitation of these dumps will not occur until very late in the open pit's life because of their active faces. Sediment retention structures will be built to prevent material eroding from them into the adjacent drainage system.

The Kimberlite ore will be transported from the mine to a treatment plant to be constructed nearby on the headwaters of Limestone Creek. Treatment is relatively simple, the ore is crushed to a suitable size in primary and secondary crushers and slurried with water before it is split into various size fractions.

The diamonds are then removed along with other heavy minerals by passing the material through heavy media separation units operating in each size range. The diamonds are then separated from the heavy media concentrate by using X-Ray sorters, magnetic separators and other specialized equipment usually operating on dry material.

The fine (clay and silt sized) material generated in the plant will be collected in a thickener for partial dewatering prior to it being pumped to a disposal dam where further water will be recovered and returned via a settling dam to the plant.

The coarser-sized reject material will be dewatered and taken by conveyer to a coarse reject dump adjacent to the fine tailings dam north-east of the plant site.

Both disposal areas will have erosion control features and run-off will be collected for return to the plant. They will be progressively rehabilitated as they are filled, using selected plant species based on trials to be carried

out early in the project.

Because the diamonds make up a very low percentage of the rock the tailings will total the amount of ore mined and the disposal areas will cover 300 to 350 ha.

The project will also require considerable infrastructure due to its remote location. The main items are as follows:

3.1 Water Supply

The water supply for potable uses, the treatment plant, mine and industrial use will all come from Lake Argyle. The project will use up to 12 000 m^3 per day which will represent an insignificant draw on the Lake storage capacity.

The water will be pumped from a take off point out in the Lake to a shore break tank and pump station from where it will be pumped through a buried pipeline to storage tanks and the distribution system. Potable water will be filtered and chlorinated. The existing Basalt Valley borefield will be retained for emergency use. Special design features will aim to limit the possibility of mosquitoes breeding in the water supply system.

3.2 Power Supply

Initially this will come from on site diesel powered alternators with a combined capacity of 100 MW. The SEC is currently evaluating a hydroelectric facility based on the Ord River Dam site and it is possible that power may be supplied from this source to the project. Should this occur, separate consideration will be given to the environmental consequences of the transmission line route by the EPA. The EPA has already considered the environmental aspects of the hydroelectric project on the Ord River and has reported in Bulletin No 82.

3.3 Transport

The Lissadell road from the Great Northern Highway to the project area will be upgraded for the construction phase. An all weather airstrip will be constructed and used to fly employees to and from the site. A number of access roads and haul roads will be constructed to connect the various site facilities. Where necessary these will be sealed or watered to limit dust generation.

3.4 Sewage and Refuse Disposal

Each major component of the development will have a separate sewage disposal system, the larger units will use package type plants and the smaller will have conventional septic units. Special attention will be given to the design of the sewage disposal systems to prevent mosquito breeding and flooding in the wet season.

Domestic refuse will be disposed of by the sanitary land fill method at a suitably approved site while industrial waste not salvaged will be buried in the waste rock dumps. Waste oil will be burnt as fuel in plant dryers.

Industrial waste water will be collected and fed to a central treatment area where sediment and oil will be removed prior to disposal.

3.5 Accommodation

In addition to the on site accommodation for employees there will be a construction camp and caravan park for contractors during the construction period. These facilities will be removed after the construction is complete. A maximum construction work-force of 1 200 is expected while the operating work-force at 2.9 Mtpa will consist of 370 commuting workers based in Perth and 70 staff and essential service workers based in Kununurra.

The Company will build 70 accommodation units in Kununurra. Because of the commuting arrangements not all the workforce will be on site at any given time as there will always be a significant number on recreational leave.

3.6 Services

A wide range of service facilities will be provided at the site including administration buildings, messes, tourist facilities and visitor accommodation, first aid buildings, sports facilities and shopping and banking arrangements. There will be a light industrial area, warehouses, workshops, fuel storage and comprehensive security arrangements to service the project.

4. THE OPTIONS

As with most large mining projects there are very few real options available to the developer. This is because the project is based on a natural resource which is located by past geological events. It is possible to vary the mining rate but this has very little effect on the final environmental impact. There can be variations in the location and type of infrastructure but even this is usually determined by the location of the ore body and by economic conditions.

One of the options with this project has been the workforce accommodation system. In the past, major new mining projects have either established new towns or dramatically increased the population of existing towns to house their workforce, families and associated service and support workers. However in this case the Company has decided to use a commuting workforce. Workers will live in Perth in their own homes and be flown to the site for work periods of 19 days after which they will be flown back to Perth for a leave period. Staff and key workers will be housed in Company houses in Kununurra and will fly to the site as required. Special arrangements will be made for local Aboriginal people who join the workforce.

Workers will be housed in on-site units similar to motel units. There will be a full range of recreation and service facilities. Private vehicles will be prohibited from the site in the operation phase but will be permitted in the construction period.

This proposal should result in a lower environmental impact than the more traditional mining town approach. This is because large areas are not required for the town and support facilities such as power, water and sewage. There is also a very important secondary effect in that there will be much lower pressure on the surrounding countryside due to the recreational activities of the workforce. The absence of a town should also assist in lowering of adverse impacts on surrounding Aboriginal communities and

pastoral properties.

The EPA considers that there are major environmental advantages in the proposed commuting workforce concept and supports the Company's choice of this option.

The Agreement Act makes provision for a Town Development and it is possible that the commute option may not be acceptable to the Company or workforce especially if production rates increase in the future. Should a town be considered in the future the EPA will require a detailed environmental assessment to be prepared for its consideration and advice (Recommendation 1.2).

5. THE ENVIRONMENTAL ISSUES

A large project of this type raises numerous environmental concerns because of the diverse nature of the development and the lack of knowledge about the environment in the region as a whole. The EPA has examined the major environmental issues, many of which are presently only at a conceptual level, in its consideration. The environmental provisions of the Agreement Act will ensure that there is adequate consideration by government departments of the multitude of more minor environmental matters which a project of this type will require. The environmental matters considered have been:

5.1 The Possible Destruction of Unique or Rare Ecosystems, Flora or Fauna

The project will result in irrevocable changes in the land surface and environment over considerable areas and will modify the environment in many other areas. The Company has spent considerable time, effort and money to study and document the existing environment so that the areas to be subjected to these changes are well known. This work is presented in the Technical Appendices of the ERMP.

This work has demonstrated that the project should not result in the destruction of any unique or rare ecosystems, flora or fauna. Some of the flora located in high impact areas has been poorly recorded but this reflects the poor state of our knowledge about the area rather than any real restriction of the plants involved. The Company has however undertaken to preserve plants of this type wherever possible. Where their destruction is absolutely necessary, such as at the mine site, seed will be collected so that the plants can be propagated and used in rehabilitation work.

Of the more limited environments to be adversely affected by the project the riverine fringing vegetation

is the most important in an overall biological sense and the Company should endeavour to preserve this habitat wherever possible. It should also try to re-establish this unit in suitable areas as part of any rehabilitation work following temporary uses such as alluvial mining or borrow pits.

5.2 Soil Erosion

The Eastern Kimberley region has a major soil erosion problem due to a combination of factors: these include soils with very high erodabilities due to their composition and structure, heavy monsoonal type rainfall leading to large amounts of runoff degradation and vegetation loss caused by past over-stocking and feral animal activity combined with poor or non-existent land management.

In more recent years attempts have been made to correct the situation through projects such as the Ord Catchment Regeneration Scheme.

Rivers and streams entering Lake Argyle in the wet season carry enormous sediment loads causing water turbidity and loss of storage capacity. Soil loss from the catchment lowers the productivity and limits plant cover, leading to ever-increasing soil erosion.

The project will, especially in the early stages, result in the disturbance of the soil and vegetation and hence increased soil erosion. Many of these soil erosion problems can be controlled or prevented by good environmental management and the Company has shown in the ERMP that it is fully aware of the potential problem and has undertaken to instigate a range of erosion control procedures.

In areas where control is not possible, such as waste dump out-slopes, sediment retention structures will be built to trap the eroded material for later recovery

and re-use and to ensure that only clean water leaves the site.

These structures will need to be carefully designed and their effectiveness closely monitored, especially those associated with the waste dumps. The Company should fully brief the Public Works Department on the construction and operation of the larger structures which may need formal PWD approval.

It should however be pointed out that even without any controls the extra sediment deposited in Lake Argyle as a result of the project would not be significant in comparison to the existing inputs from the degraded catchment.

Because of the degraded nature of much of the area the EPA considers that the Company should instigate a positive soil conservation policy as part of the environmental management program and that all topsoil and suitable sub-soils should be recovered, stockpiled for re-spreading, or re-used elsewhere, before any construction undertaking which would bury or result in the loss of the soil. This will apply particularly to borrow pits, tailings disposal areas, waste dumps and plant sites.

5.3 Adverse Environmental Effects on Surrounding Lands

In developments of this type there are always some adverse impacts on the environment outside the project area. These are caused by the activities of the workforce outside working hours and by other people such as tourists attracted to the area by the development. They range from broad scale land degradation brought about by the use of off-road vehicles, to rubbish and litter problems at picnic spots and scenic attractions. Interference with Aboriginal sites can also occur and nearby pastoralists can experience problems due to gate and fence damage and illegal shooting. In this particular case there is the risk

of exotic plants or animals, both terrestrial aquatic, being introduced and spreading and becoming major pests.

The absence of a mine town combined with off-site recreation periods will do much to limit these problems, however the Company will need to monitor the activities of its employees and contractors off-site to ensure this type of environmental damage does not occur. This will be very important in the construction phase when numbers will be greater and private vehicles common.

The EPA endorses the Company undertaking to provide comprehensive employee briefings on these and other environmental matters and its undertaking to prohibit fire arms and the keeping of pets including aquaria. The EPA also believes that the same provisions should be made for all contractors and their employees.

The Company will have control over a very large tract of land outside the immediate project area through its acquisition of part of Lissadell Station. Future environmental management plans should include provisions for the management of this land and ways of overcoming the degradation caused by past management practices.

5.4 Aboriginal Sites

Both archaeological sites and sites of significance to living Aboriginals exist within the project area and in surrounding areas. Surveys have been carried out by the Company and the WA Museum in association with local Aboriginal people to locate and document these sites. The site locations have been kept confidential to respect the wishes of the Aboriginal people and were not reported in the ERMP.

The Company will, where possible, avoid developments which would damage or endanger sites. However, there are a number of both archaeological and currently significant sites which will be destroyed

or endangered by the project.

A site has already been destroyed in the exploration phase. This occurred following negotiations between the Company and a local Aboriginal group and the formal approval of the WA Museum Trustees.

The Company has made a number of undertakings in the ERMP on Aboriginal site protection, continued access to sites by Aboriginal people, consultation with Aboriginal groups on site matters and employee briefings and discipline on Aboriginal matters. While these undertakings are all satisfactory there is still the need for the Company to consult further with the WA Museum on the ways in which these undertakings can be implemented under the provisions of the Aboriginal Heritage Act and on the salvage work to be undertaken prior to site destruction. (Recommendation 1.3).

5.5 Construction Phase Problems

In the construction phase of development projects there is usually a large workforce housed in temporary accommodation. Many of the workers are contractors or sub-contractors and do not receive formal project briefings. Considerable pressures exist to complete work as quickly as possible and single males predominate. All these factors can quickly lead to adverse social impacts on nearby communities and towns and adverse environmental impacts.

Litle was said in the ERMP on the construction phase except in the social impact section which described some of the potential problems.

It will be important for the Company to have a definite plan to cover this period. It should have adequate staff on site to supervise the activities of the contractors in relation to environmental matters and to stop inappropriate activities. The same will apply to the supervision of recreation activities in

the project area and Kununurra. (Recommendation 1.4).

Aboriginal sites will be particularly vulnerable during this period and will need a much greater level of protection. The nearby Aboriginal communities will also come under increased social pressure and the Company's "good neighbour" policy will need to be prepared to cope with these pressures. Regular consultations with the affected groups will be required to control the problems that could arise.

5.6 Waste Dumps and Tailings Disposal

The waste dumps will contain over 300 million tonnes of rock. They will be up to 100 m high with outslopes at angles up to 32^{o}. They will be the major visual impact of the project and represent the largest area of disturbance in the project. The Company should make every effort to blend the dumps into the existing topography where this is possible.

The long-term stability of these dumps is questionable especially under wet season conditions. This is because the dumps will be built by tipping the material from the top and allowing it to scree down the dump face rather than building the dumps in a series of separate lifts with benches to break the slope into smaller units. The Company will need to carry out considerable geotechnical investigations to establish dump construction parameters and to demonstrate that the dumps will remain stable after the mine ceases operation. In addition the dump behaviour will need to be monitored throughout the life of the project and the construction technique modified if problems occur.

An additional adverse feature of the dump construction method is that because the outslopes are constantly active over the entire mine life rehabilitation work cannot be carried out progressively and must wait until the open cut is worked out. This is often a difficult economic period in which to carry out a major rehabilitation

program. It also means that the exposed dump surface is visible throughout the life of the mine and may cause dust and erosion problems.

For these reasons the EPA considers that the Company should establish a suitable trial area to test the proposed dump rehabilitation works as soon as possible in the life of the project. (Recommendation 1.5). This will enable a suitable system to be developed, highlight any problems and provide data so that adequate provisions can be made in the mine planning for the final dump rehabilitation.

The need for further data on the sediment retention structures associated with the dumps was discussed in Section 5.2. The whole area of waste dump design and operation will need to be further documented in the Environmental Management proposals and progress environmental reports required under the Agreement Act.

At least 80 million tons of tailings will be produced over the life of the project and additional quantities may come from the possible underground mining.

The major concern with tailings disposal are the long term stability of the material and possible sediment yields to streams. As the processing does not introduce any toxic chemicals to the tailings or process water there should be no water pollution problems except turbidity.

The ERMP outlines at a somewhat conceptual level a plan to contain the tailings in a stacked coarse tailings dump and a pumped fine tailings dam. No water will be discharged from the system while the plant is operating as all excess water will be returned to the process circuit. There is no discussion of what will occur when the treatment plant is temporarily or permanently closed. However there are proposals to progressively revegetate the tailings to stabilize the surface.

Considerably more information will be required on the design and operation of the tailings disposal system especially its ability to copy with wet season rainfall events and post operational behaviour. This data should be presented in the environmental documentation required under the Agreement Act.

5.7 Social Issues

The project will cause quite large and wide ranging social changes to the East Kimberley. The ERMP included a section on the perceived social impacts both good and bad that can be expected to occur as a result of the project in both the construction and operation phases.

This section received considerable favourable comment in many of the submissions received. The EPA considers it was a very useful and well prepared section of the ERMP and that it made a serious attempt to explain the changes likely to occur to the social environment of the region.

The major adverse impacts are likely to occur in the town of Kununurra during the construction phase. The Company and Government agencies will need to closely monitor the social changes in Kununurra and take quick corrective action to overcome or control adverse impacts (Recommendation 1.4). The problems could be aggravated by other developments which will or could occur at the same time. These include the Ord River Hydro-power project and transmission lines and the proposed Ord sugar industry as well as increased mineral exploration activity.

6. THE ERMP AND COMMENTS

The ERMP prepared by the Company was of a high standard and included the results of the wide ranging studies and research carried out by the Company on environmental matters. The natural history of the area was very poorly known prior to this study and in nearly all areas the Company undertook original surveys and studies. The technical Appendix will be a useful reference work for future researchers for many years to come.

A number of submissions commented on the high standard of the ERMP and its comprehensive nature. There were some minor criticisms of the lack of detail in particular areas of the environmental management section. However, the conceptual nature of the project at the ERMP stage limits the amount of of useful detail which can be provided. There is some value in considering projects in these earlier stages so that environmental recommendations can be used in preparing the final project plans. In this case there is also the additional safeguard of the environmental provisions of the Agreement Act under which the detail can be obtained on those topics which only received conceptual treatment in the ERMP.

There was one criticism of the document that it did not describe the invertebrate fauna of the project area. This is a common criticism of ERMP's in general and one the EPA hopes can be rectified in the future as the invertebrate fauna can be very important to the overall environmental processes and is proving useful in monitoring the success of rehabilitation works. The EPA does not consider it a serious omission in this case but would like to see the company undertake invertebrate studies at some stage in the future.

No public submissions were received on the ERMP but 17 State Government Departments or Agencies made submissions. None of these raised any major objections to the proposals but many pointed to the need for more details on particular aspects of the project especially where these related to

areas under their responsibility or control. These comments have been passed on to the Company so that they can be considered when detailed proposals are being prepared.

The Commonwealth department of Home Affairs and Environment also made a submission which found that the ERMP was, overall, a comprehensive and satisfactory document while pointing out the need for additional detail or consideration in a number of particular areas.

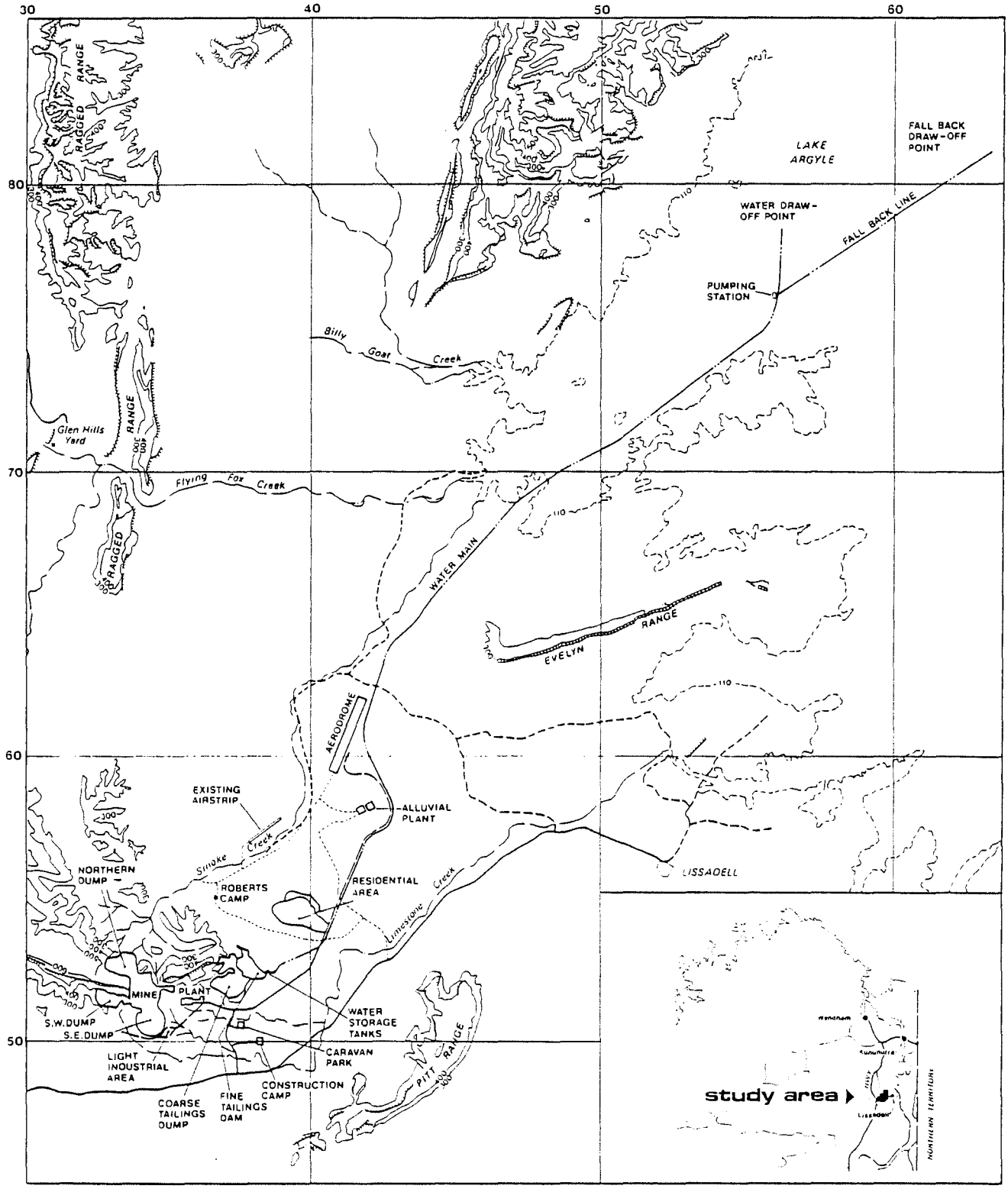

Figure 1

PROJECT INFRASTRUCTURE

ARGYLE DIAMOND PROJECT