HARDING DAM PROJECT
PUBLIC WORKS DEPARTMENT

Report and Recommendations by the Environmental Protection Authority

August, 1982

Department of
Conservation and Environment
Western Australia

Bulletin No. 115

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REPORT AND RECOMMENDATIONS

BY THE

ENVIRONMENTAL PROTECTION AUTHORITY

AUGUST, 1982

Department of
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HON MINISTER FOR CONSERVATION
AND THE ENVIRONMENT

Your Ref.
Our Ref. 164/80

My Dear Minister

The Environmental Review and Management Programme prepared by the Public Works Department for its Harding Dam proposal has been considered by the Environmental Protection Authority following submissions by the public and Government departments.

Please find attached the Authority's report and recommendations. Your concurrence is sought for the EPA to publish the report and recommendations.

Yours sincerely

A R MAIN
CHAIRMAN

12 August 1982

CONTENTS

1. INTRODUCTION

This Report is concerned with the proposal by the Public Works Department of Western Australia(PWD) to construct and operate a surface water storage on the Harding River. An Environmental Review and Management Programme(ERMP) was prepared by the PWD and its consultants and has been assessed by the Environmental Protection Authority along with comments received during an eight week public review period.

The Authority also visited the site of the proposal in June 1982 during an inspection of various parts of the Pilbara.

One point that emerged from the public comments was the unsuitability of the proposed Harding River site as a surface water storage. The EPA acknowledges that this site does not have all the characteristics that would make it an ideal site. However, its storage characteristics are more favourable than most other sites in the West Pilbara. The Authority considers that the determination of water resource development strategies should be made by the appropriate water supply authority and that this defined strategy should then be the subject of detailed review. Therefore, the EPA has confined its Report to an assessment of the environmental consequences of the Harding Dam proposal.

The ERMP contains several comments regarding the advantages that the construction of the Harding Dam will have on water quality in the West Pilbara scheme. The effects of high salt levels on human health have recently received wide publicity and with the increasing permanence of the Pilbara population the Authority is concerned that residents may receive a higher than desirable intake of salts through prolonged consumption of water with relatively high salt levels. Every effort should be made by the water supply authorities to manage the water supplies in such a way as to minimise salt loads. This may well require the development of better quality resources in the near future.

The Authority has concluded that the ERMP has addressed most of the major issues associated with the construction and operation of the Harding Dam project in sufficient detail and that the proposed management programmes will assist in minimising the environmental impacts of the project. Some environmental aspects have been identified in the Authority's assessment and from public comments. These are detailed in Section 4.

CONCLUSION

The EPA considers that the project is environmentally acceptable and recommends that approval for it to proceed be subject to the provisions for environmental management contained in the Environmental Review and Management Programme and the recommendations in this Report

2. THE PROJECT

2.1 Pilbara Water Supplies

The current water supply systems in the Pilbara rely exclusively on underground aquifers. The supply arrangements are fragmented, with the West Pilbara and the Port Hedland Water Supply Schemes being the only integrated systems. The West Pilbara scheme provides water to Cape Lambert, Dampier, Karratha, Point Samson and Wickham while Port Hedland, South Hedland and Wedgefield are similarly linked together. Separate arrangements have been made for each of the other towns in the Pilbara. A number of these towns have local sources developed by the Public Works Department, while those towns associated with major iron ore developments are provided with water from company operated bores. In 1980/81, the Public Works Department supplied 14.3 million kilolitres to Pilbara towns, while supplies from company sources were approximately 20 million kilolitres.

2.2 The Project

The existing water supply system for the West Pilbara region, based on the Millstream aquifer, has reached the maximum level which can be obtained on a continuing basis after making appropriate allowance for the local environmental requirements. The current supply is approximately 10 million m^3.

Following engineering, economic, environmental and social investigations into a number of potential surface and groundwater sources located within the West Pilbara, the Public Works Department has selected a surface water storage dam on the Harding River as the next source to be developed.

At Full Supply Level (RL 62.5 m), the dam will impound some 114 million cubic metres (m^3) of water, with a surface area of 23 square kilometres (km^2) and an average depth of 5 metres. The main dam embankment will be a zoned earth and rockfill structure containing approximately 690 000 m^3 of material. An auxilliary embankment is required across a saddle on the southern abutment, and the spillway will be excavated on this side of the river. Water will be withdrawn through a multiple offtake tower located in the reservoir and pumped to the existing pipeline from Millstream.

The reservoir will be operated conjunctively with the Millstream bore field, allowing an increase in the expected annual system yield from the present 10 million m^3 to 28 million m^3. As proposed in the ERMP, the Harding Dam will provide water to the West Pilbara Scheme until the stored water is insufficient or of poor quality. At this point, the Millstream aquifer will take over, supplying all water requirements of the Scheme until the Dam can again be used.

2.3 Location

The proposed site for the Dam is approximately 25 kilometres south of Roebourne on the Harding River. While the dam embankment and associated structures will be constructed within a gorge on Mt Welcome Station, most of the Reservoir will lie within Cooya Pooya Station, which is now a water reserve vested in the Minister for Works (Figure 1).

2.4 Alternatives

Investigations into water supply options in the West Pilbara have been carried out since the late 1960's. Early detailed studies concentrated on dam sites on the Fortescue River, at Dogger Gorge and Gregory Gorge. As

a result of amended water supply projections, and the environmental and aboriginal importance of the Millstream area, other sources in the region were evaluated. Five reservoir sites and two underground sources were the subject of engineering and environmental investigations. The results of the environmental studies were documented in a Report by consultants to the Public Works Department (1979).

A Report by the PWD (1981) outlines the various alternatives considered and results that have lead to the selection of the Harding River site as the preferred option. In essence, it stated that the Harding site is the lowest cost alternative, with the lowest social impact and having an acceptable environmental impact

2.5 The ERMP

Following referral of the proposal to the EPA by the Minister for Works and Water Resources under Section 55 of the Environmental Protection Act, the Authority recommended that an Environmental Review and Management Programme be prepared. This was undertaken by the Public Works Department and its consultants. The ERMP was made available for public review for 8 weeks from 3 March 1982.

3. EXISTING ENVIRONMENT

3.1 Climate

The Harding Dam site has a semi-arid tropical climate. Temperatures are moderate to high and rainfall is variable and low. The average annual rainfall at Cooya Pooya Station is 306 mm, with a range of monthly averages from 1 mm in October/November to 70 mm in March. Annual evaporation in the Pilbara is substantially higher than rainfall. The annual potential evaporation from the proposed reservoir has been estimated to be 2718 mm, some eight times higher than mean annual rainfall.

3.2 Geology

The majority of the rocks in the project area are basalts, dolerites and tuffs of Proterozoic age, overlying Archaean volcanic rocks of the Warawoona Group. The dolerite and tuffs occur as distinct uplands surrounded by a number of depositional landforms.

A number of soil types mapped in the catchment, such as the solonized and alluvial soils, have been disturbed and are susceptible to accelerated erosion. They represent a significant potential source of sediment to the dam.

3.3 Hydrology

The catchment area of the Harding River above the dam site is relatively small, being 1071 km^2. This is less than Mundaring Weir catchment. The River has a mean annual flow at the dam site of 42.1 million m^3. Flows are intermittent and their quantity is highly variable. Since stream recording at the Dam site commenced in February 1965, the highest observed monthly flow was 86.2 million m^3 in January 1967 while no flows have been reported for periods of up to ten consecutive months. It is likely that there have been longer periods of no flow, such as from mid-1923 to early 1926. The highest recorded flow occurred in April 1966, 1421 cubic metres per second.

3.4 Vegetation

Sixteen vegetation/landform associations, grouped into hills, plains and riverine terrace systems, have been delineated in the reservoir basin. The associations ranged from spinifex grassland and wattle scrub on the plain to cajeput forest and river gums along drainage lines and the River bank. The vegetation formations are typical for the Pilbara, although the cajeput forest in Lockyer Gorge is particularly well developed.

The vegetation of the downstream pools was found to vary, with the zonation around permanent pools being better developed than that associated with the temporary pools.

The mangroves of the Harding and East Harding Rivers were found to represent seven species, all of which are found along the Pilbara coast. Three species were found to be less common to the survey area, Aegialitis annulata,

Aegicera corniculatum and Osbornia octodonta.

One hundred and seventy three flowering plant species were recorded from the reservoir site, and a further seven were recorded around downstream pools during surveys carried out in May 1976, November 1977 and December 1981. Grass species dominate the area, along with the pea and wattle families. Only two of the species collected, Melaleuca linophylla and Euphorbia schultzii, are considered to be poorly collected and none are gazetted as rare.

A further 26 plant species were recorded during a subsequent survey of the reservoir area in April 1982. None have been identified as being rare or poorly collected.

3.5 Fauna

Due to the variety of habitats present in the project area, the diversity of the terrestrial and aquatic communities is reported to be high. During a faunal survey in September 1981 10 species of mammals, 23 species of reptiles, 2 species of frogs and 58 species of birds were identified. Limited earlier field work had been carried out in May 1976 and November 1977.

In general, the species trapped during the survey were representative of the Pilbara. However, the trapping of the skink Notoscincus butleri represented only the second location where it has been observed. Several of the birds are sedentary, relying on food and shelter provided by the area, while most are migratory. The proposed reservoir area will become an important refuge for a number of migratory and nomadic bird species.

A further survey in April 1982 added an additional 11 birds to the previous list. Most of these are nomadic or migratory and hence their presence and abundance related to seasonal circumstances. Six mammal, 13 reptile and 1 frog species were added to the September survey data. The capture of a Troughton's Sminthopsis (Sminthopsis ooldea) in the reservoir area represents a north-western extension of its range.

The pools downstream of the Dam site represent a diversity of habitats, ranging from the permanent pools to the temporary pools resulting from River flows. Four of the permanent pools were surveyed and were found to have rich plankton communities and to support six fish species. Several of these fish are restricted to freshwater habitats.

3.6 Human Environment

The nearest population centre is Roebourne, approximately 25 km to the north. Over 14 000 people live within the immediate region, mainly in the coastal towns of Roebourne, Wickham, Dampier and Karratha.

While there is little recreational or tourist use of the Harding River near the dam site, Lockyer Gorge is frequently visited. Both areas are scenically appealing, and the cajeput forest and pool at Lockyer Gorge are outstanding, although vehicle access within the Gorge has caused some degradation of the area.

3.7 Archaeology

A survey of the area to be inundated identified 92 archaeological sites, comprising 'hunting hides; petroglyphs and artifact scatters. One ethnographic site is located downstream of the proposed Dam. Protection has been provided to this site.

4. ENVIRONMENTAL ASSESSMENT

In assessing the environmental impact of the Harding Dam Project, the Authority took into consideration public and Government departments' submissions. The Department of Conservation and Environment held discussions with officers of the PWD on various aspects of the project, and the results of these discussions have also been taken into account by the Authority.

4.1 Adequacy of the ERMP

The Authority considered that although the ERMP had some shortcomings, it contained sufficient information for the public and government agencies to make an assessment of the proposal.

One shortcoming of the ERMP is that the field data on the flora and fauna of the area to be inundated is incomplete due to the short duration and timing of the field investigations. This has been acknowledged in the ERMP in a number of places and a monitoring programme is proposed to supplement present information on the area's fauna. (See Recommendations 6 & 7).

Another shortcoming is the limited information in the ERMP concerning the effects of the conjunctive use scheme on the Millstream environment. The PWD has acknowledged this inadequacy and has proposed that a management programme be prepared which will address some aspects of the water resources and management of the Millstream area. (See Recommendation 5).

4.2 Material Requirements

A total of 780 000 m^3 of materials will be required for construction of the embankments and other works. Most of this will be obtained from either the spillway excavation or sources upstream of the main embankment. However, two sources are located below the dam site, one for coarse filter material and the other for the impervious core.

The coarse filter material site is located in the bed of the Harding River. The ERMP indicates that this source may not be required. If this source is to be used considerable care should be taken to ensure that erosion does not occur. Account should be taken of the potential for river channel erosion due to removal of the bedload.

Impervious core material is proposed to be obtained from an area on the south side of the River. This site will be adjacent to the proposed recreation facilities and be visible from the main embankment, the spillway, and recreation area.

The ERMP outlines procedures to be followed in rehabilitating the resultant quarry. The primary rehabilitation species proposed are buffel grass (Cenchrus ciliaris) and Acacia species. As the report indicates, buffel grass is an introduced species that is ubiquitous in the Pilbara. The Authority considers that the use of exotics for

rehabilitation purposes should not be encouraged.

Recommendation 1

Use of quarry areas downstream of the main embankment should be avoided. The Authority noted that the ERMP states that alternative sources are available for each category of embankment fill.

Recommendation 2

Native plant species prevalent in the local area should be used instead of buffel grass in any seed mix to be applied during rehabilitation of the disturbed areas below the dam. Except for the proposed use of buffel grass, the Authority agrees with the rehabilitation procedures outlined in the ERMP.

4.3 Exposure of Reservoir Bed

There is considerable potential for dust generation and water erosion in the reservoir basin due to the presence of extensive areas of soils with moderate to very high erodibility.

The ERMP indicates that inspections of the reservoir foreshore, to assess the effect of wave action, and the exposed reservoir bed will occur. Control measures will be implemented where practicable to minimise soil movement into the reservoir.

Sedimentation of the reservoir will not be the only problem caused by these erodible soils. They will also be susceptible to wind erosion. Inspections of the reservoir bed should also investigate this potential problem, and appropriate control measures should be introduced.

Recommendation 3

The reservoir inspection commitment in the ERMP is endorsed. However, the Authority considers that measures aimed at minimising sediment build-up in the reservoir will not address the associated problem of dust creation. This aspect should also be investigated and, where necessary, control measures should be instigated.

4.4 Conjunctive Use with Millstream Aquifer

The West Pilbara Water Supply Scheme depends to a significant extent on the continued use of the Millstream aquifer. The Millstream area, and the Fortescue Pools in particular, have been recognised as a unique and outstanding area, both biologically and scenically. Any proposal that will affect it needs to be carefully considered.

The ERMP presents a discussion on the Millstream area and has a brief description of how the Millstream portion of the conjunctive use scheme will operate. Most of the description of the conjunctive use scheme is, however, contained in the Report titled 'Hydrologic Investigations for the Harding Dam' (PWD, 1982b).

One important topic addressed in this PWD Report is the effect that various levels of water supplementation in the Millstream area will have on overall system yield. The estimated annual water usage in the Millstream area (Livistonia Pool to Deep Reach Pool) is estimated in the Report to be 11.91 million m^3. By artificially supplementing spring flow in this area to achieve this rate, the conjunctive system yield is 21.8 million m^3, whereas it increases to 28.1 million m^3 if the rate is reduced to 5.95 million m^3. The level of supplementation is one of the topics to be considered by a proposed management group.

The Public Works Department intends to undertake the development of a management programme for the water resources of the Millstream area. The programme would address the following topics.

- Formation of a management group including representatives of the Public Works Department, Department of Conservation and Environment and National Parks Authority.
- Procedures for fixing the level of environmental supplementation.
- Monitoring procedures including
  - i) stream gauging
  - ii) ground water level monitoring
  - iii) pool level monitoring
  - iv) topographic survey
  - v) aerial photography
  - vi) vegetation monitoring
- Outline proposals for supplying water to the various portions of the environment
- Outline procedures for modifying the programme in the light of operational experience
- Provision of regular reviews

The proposed conjunctive use scheme will relieve the Millstream aquifer as the sole water source for the West Pilbara region. The Harding Dam is expected to reduce the average annual water supply demands on Millstream, even when demand reaches 28 million m^3 per year. However, as rainfall is extremely variable in the Pilbara, there will be periods when water stored by the Harding Dam would be quickly utilized and complete reliance would fall on the Millstream aquifer. Unless water conservation measures are successful in curbing demand, the draw on the aquifer during these periods will be beyond that which is currently considered to be the maximum safe yield, after making due allowance for local environmental demands. Based on computer projections by PWD, the Millstream aquifer will be required up to one third of the time when the system yield is 28 million m^3 per year.

Water supply potential in the Pilbara is limited by the erratic rainfall and extremely high rate of evaporation experienced in the region. The Authority is aware of various water supply schemes that have been implemented or are being considered for semi-arid portions of Western Australia. Considerable interest has been generated by the Mt. Newman Mining Co. Pty. Ltd. Ophthalmia Dam project as a means of storing water in areas of variable rainfall and high evaporation. This project utilises the principle of surface water collection and aquifer recharge via selected infiltration locations. Other possibilities are available. For example, there may be potential for the conjunctive use approach to be extended to the major coastal communities by linking the Port Hedland and West Pilbara Water Supply Schemes.

Recommendation 4

The composition of the proposed management group and the general topics to be addressed in the proposed management programme for the Millstream area are endorsed. However, several of the topics need to be clarified. The Authority considers that:

i. the Millstream area should include all of the Fortescue pools and the southern tributaries within the Millstream lease that are dependent on aquifer derived water.

ii) the level of environmental supplementation should be determined after a detailed evaluation of the relationship between the Millstream environment and the underlying aquifer, and the effect of reduced aquifer levels on natural spring flow.

iii) the proposed management programme should consider the effects of high demands on the aquifer in the event of lengthy dry periods occurring during the currency of this conjunctive use scheme.

iv) the management programme should be agreed to by the EPA

v) the regular reviews should occur annually and consequent reports should be forwarded to the EPA for information.

Recommendation 5

The Authority believes that the investigation of various options, including aquifer recharge schemes, as a means of maximising water resource conservation should be encouraged.

4.5 Reservoir Ecosystem

The existing ecosystem of the reservoir is discussed in the ERMP, and an indication of possible and likely changes are given. However, it is said in the ERMP that the data upon which these conclusions are reached is limited. The following reasons are given:

- the flora surveys were not carried out at the most floristically favourable times of the year
- the fauna survey only represents a single limited period (September 1981)
- there is very little data on the ecology of vertebrates in this area

To overcome some of these limitations, the PWD intends to implement a fauna monitoring programme during and after construction of the dam. The proposed programme is endorsed by the Authority.

While the faunal deficiencies will be corrected by this programme, no similar commitment has been made to complete the survey of vegetation that will be inundated by the dam. However, the April 1982 surveys did include further vegetational field work. It is important to ensure that the flora of the reservoir area and its ecological relationships is understood.

Recommendation 6

Prior to completion of the dam, further information on the flora of the reservoir area should be collected.

4.6 Downstream Ecosystem

The Harding Dam will inevitably alter the hydrologic regime of the Harding River downstream of the main embankment. The extent to which this occurs will depend on rainfall frequency and intensity in the River's catchment. The ERMP indicates that the reservoir will fill, on average, once in every three to five years.

Information obtained from the Public Works Department suggests that flows from the dam, either through over-topping of the spillway or scour requirements, will be infrequent. Based on computer simulations, the dam will fill beyond the Full Supply Level less than 2 per cent of the time while scouring of water from the reservoir will be required approximately 3 per cent of the time. These figures are based on a system yield of 15 million m^3 per year, and will be lower when 28.1 million m^3 is reached.

The mean annual stream flow of the Harding Dam site is estimated to be 42.1 million m^3. While much of this water is lost to the sea, a portion is retained by the numerous pools located in the River downstream of the dam while some infiltrates into the groundwater. The pools will be deprived of regular flows of water and have to rely on the catchment downstream of the dam and contributions from downstream aquifers.

Approximately 30 per cent or 400 km^2 of the Harding River catchment is downstream of the dam. Therefore, it is likely that some replenishment of the pools will occur from this source. However, stream flows are likely to be small and infrequent.

The aquifers adjacent to the River rely to a significant extent on river flows to replenish them. With these flows being dramatically reduced, the aquifer contribution to the pools may diminish.

The flora and fauna surveys indicated that the River pools are important components of the ecosystem of the area. Because the reservoir and fringing vegetation will be different to that of the pools, their important ecological role is likely to remain provided the pools are maintained. The ERMP provides an indication of the likely effects of the Dam on the pools and their associated flora and fauna. It is likely that vegetation species composition and abundance around them will change, which may effect faunal (particularly bird) utilisation of the pools. The manner and extent to which the pools are affected needs to be monitored in order that compensating action can be undertaken should this become necessary. The pools are already subject to disturbance from stock and quarrying activities.

An evaluation of the mangroves in the Harding River and East Harding River estuaries was made, and the conclusion presented in the ERMP was that it is unlikely that they will be affected by the dam. The mangroves are crucial to the marine fauna of the region, upon which various commercial fisheries are based. Any change in the mangrove community may affect this industry. It is therefore important that any effects that the damming of the Harding River might have on the mangroves are identified.

Recommendation 7

A monitoring programme should be implemented to determine the effect of the altered river regime on the ecology of the downstream Harding River pools. The programme should be developed in consultation with the Department of Conservation and Environment.

Recommendation 8

The Authority recommends that vertical colour aerial photography of the mangroves should occur at three year intervals to identify any broad changes that could be attributed to the altered fresh water and sediment contributions of the River.

4.7 Public Health

The potential that the project has for introducing exotic disease to the region and also enhancing the spread of existing disease is clearly addressed in the ERMP. This is an area that requires particular attention and this is acknowledged by the PWD.

The Authority endorses the proposed control and monitoring programme outlined in the ERMP.

4.8 Aboriginal Sites

A large number of archaeological sites will be inundated by the proposed reservoir. The ERMP contains a proposed programme of recording of all sites and selected removal of some examples, undertaken in accordance with the Aboriginal Heritage Act.

4.9 Water Conservation

Water consumption in the new West Pilbara towns is very high, some 60 per cent higher than the old established northern towns. For example, average annual domestic consumption in 1980/81 for Karratha and Wickham was 933 and 1341 kilolitres (kL) per service respectively, while Roebourne was 688 kL and Derby 675 kL. A number of reasons for this disparity are outlined in the ERMP. Water restrictions have been in operation in the West Pilbara Water Supply area since September 1974.

Due to the high consumption levels, any measures which will reduce demand will be of considerable benefit to the community. Not only would consumers save by reducing demand, but there is the potential for deferring significant new capital expenditure. High water demand affects the environment as well, necessitating environmental management at the source. Further, soil salinity problems have emerged in some residential areas due to excessive water use.

The ERMP contains the following measures that have been suggested as being part of a public education and awareness programme:

- Holding public seminars on domestic water conservation
- Further active publicity of the permanent water controls
- Promoting the proven concept of low water usage gardens, with extensive use of local native plants
- Publication of a brochure to emphasize the need for, and means of achieving water conservation.

Recommendation 9

An active water conservation programme should be initiated in the Pilbara, incorporating the education programme outlined in the report. This programme should include the active participation of the major mining companies.

4.10 Recreation Facilities

To compensate for the inundation of Lockyer Gorge, the PWD has undertaken to maintain the pool below the dam embankment, and develop its surroundings for recreation purposes. A concept plan has been developed for the areas, covering passive and active recreation and camping facilities. One aspect of the plan that suggests some problems is the potential for erosion occurring on the northern shoreline opposite the spillway outlet into the pool.

The Authority understands that this is currently the subject of investigation.

Another aspect is one of public health. The dam pool may facilitate contact with various waterborne diseases, such as amoebic meningitis. Attention should be drawn to the risk associated with recreating in the pool.

4.11 CRRIA Railway

The Authority noted that the CRRIA railway is located within proposed Full Supply Level of the reservoir and that negotiations on various alternatives to minimise the possible effects are currently being undertaken. The adopted alternative should ensure that water will not be impounded on the western side of the railway embankment.

4.12 Reporting

As part of the ERMP, the Public Works Department has undertaken to carry out further field studies and monitoring programmes covering reservoir fauna, reservoir soil conditions, public health aspects and the Millstream component of the conjunctive use scheme. Further studies are recommended in this Report.

Recommendation 10

Regular reports on the various components of the management programme should be provided to the Authority for review. In general, three yearly reports are considered to be sufficient. With regard to the Millstream programme however, it is considered that annual reports should initially be provided.

5. SUMMARY OF RECOMMENDATIONS

1. Use of quarry areas downstream of the main embankment should be avoided. The Authority noted that the ERMP states that alternative sources are available for each category of embankment fill.

2. Native plant species prevalent in the local area should be used instead of buffel grass in any seed mix to be applied during rehabilitation of the disturbed areas below the dam. Except for the proposed use of buffel grass, the Authority agrees with the rehabilitation procedures outlined in the ERMP.

3. The reservoir inspection commitment in the ERMP is endorsed. However, the Authority considers that measures aimed at minimising sediment build-up in the reservoir will not address the associated problem of dust creation. This aspect should also be investigated, and, where necessary, control measures should be instigated.

4. The composition of the proposed management group and the general topics to be addressed in the proposed management programme for the Millstream area are endorsed. However, several of the topics need to be clarified. The Authority considers that:

   i) the Millstream area should include all of the Fortescue pools and the southern tributaries within the Millstream lease that are dependent on aquifer derived water.

   ii) the level of environmental supplementation should be determined after a detailed evaluation of the relationship between the Millstream environment and the underlying aquifer, and the effect of reduced aquifer levels on natural spring flow.

   iii) the proposed management programme should consider the effects of high demands on the aquifer in the event of lengthy dry periods occurring during the currency of this conjunctive use scheme.

   iv) the management programme should be agreed to by the EPA

   v) the regular reviews should occur annually and consequent reports should be forwarded to the EPA for information.

5. The Authority believes that the investigation of various options, including aquifer recharge schemes, as a means of maximising water resource conservation should be encouraged.

6. Prior to completion of the dam, further information on the flora of the reservoir area should be collected.

7. A monitoring programme should be implemented to determine the effect of the altered river regime on the ecology of the downstream Harding River pools. The programme should be developed in consultation with the Department of Conservation and Environment.

8. The Authority recommends that vertical colour aerial photography of the mangroves should occur at three year intervals to identify any broad changes that could be attributed to the altered fresh water and sediment contributions of the River.

9. An active water conservation programme should be initiated in the Pilbara, incorporating the education programme outlined in the report. This programme should include the active participation of the major mining companies.

10. Regular reports on the various components of the management programme should be provided to the Authority for review. In general, three yearly reports are considered to be sufficient. With regard to the Millstream programme however, it is considered that annual reports should initially be provided.

6. REFERENCES

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Dames & Moore (1982). Fauna and Flora Survey (April 1982), Harding Dam Project.

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APPENDIX SUBMISSIONS ON ERMP

1. PUBLIC SUBMISSIONS

Submissions were received from the following members of the public:

Conservation Council of WA Inc	Perth
Mr P Dowding, MLC	Karratha
Mrs P Glennon	Karratha
Mr R W Hart	Roebourne
Pastoralists & Graziers Assn of WA	Roebourne, Port Hedland
Mrs B J Reimers	Pyramid Station

The major points raised in their correspondence is covered in the following sections.

1.1 Alternative Water Sources

The WA Conservation Council in a detailed submission recommended abandoning the Harding Dam project in favour of progressive developments of bore fields to cover short term increases in water demand in the West Pilbara. It further suggested that dam sites should be investigated on the Upper Kumina Creek and Upper Robe River. Also the possibility of importing bulk freshwater supplies in iron ore carrier ballast tanks was discussed.

P Dowding suggested that desalination and linking of the East and West Pilbara water supply systems should be considered.

1.2 Water Conservation

Several submissions discussed the need for an active water conservation programme involving use of low water demand gardens, collection of stormwater runoff and reduction of water wastage.

1.3 Millstream Environment

Mr P Dowding and the WA Conservation Council expressed concern for the Millstrean environment because of continuing draws on the Millstream aquifer, both before and after construction of the Harding Dam. It was recommended by the W A Conservation Council that annual reporting on the Millstream environment including aquifer details should be undertaken.

1.4 National Parks

The WA Conservation Council recommended that the Chichester Range National Park be extended northwards to include parts of the Cooya Pooya Water Reserve.

1.5 Recreation

Detrimental effects of the project on recreation at the Harding Dam site and Roebourne were raised by a number of people. The WA Conservation Council's submission suggested that if the project was not undertaken, consideration should still be given to upgrading roads serving the Harding Dam project area to improve recreation access. Mr D Hart requested that non-polluting boating be allowed on the Harding Dam Reservoir to increase recreational opportunities in the region.

1.6 Public Health

The potential for an increase in arbovirus diseases and concern about waterborne disease agents resulting from construction of the Harding Dam were raised in a number of the submissions.

1.7 Rehabilitation

Mrs P Glennon questioned the use of Buffel Grass during rehabilitation of land disturbed during construction of the dam. She believes that native vegetation should be utilized instead.

1.8 Dingos

Mrs B J Reimers and the Pastoralists and Graziers Association of Western Australia were both concerned that the dingo population would increase as a direct result of the dam, with the resulting possibility of higher sheep losses on the neighbouring stations.

2. GOVERNMENT DEPARTMENT SUBMISSIONS

Summaries of the various Government submissions are provided below

2.1 National Parks Authority

The proposed dam will not have any significant impact on the Chichester Range National Park although destocking of Cooya Pooya Station will be of advantage to the Park.

Current action by the PWD to provide supplementary water to a number of the major pools at Millstream is commendable.

The commitment to environmental supplementation does not indicate whether it is for the Millstream National Park area or for all that portion of the Fortesque dependant on the Millstream aquifer. Earlier studies have stressed the environmental significance of the "southern tributaries", particularly Palm Springs.

It was recommended that a qualified person be employed by the PWD for environmental assessment and monitoring of the Harding Dam project, including the effects on the Millstream environment.

2.2 Department of Lands and Surveys

A summary of the freehold and Crown land and trigonometric stations to be affected by the proposal was provided. In particular the possible re-location of the CRRIA railway and access road was mentioned.

The overall effects of the proposed dam on Mount Welcome Station was expected to be minimal as river flow reductions due to the dam should be offset by downstream catchment inputs.

2.3 Public Health Department

No objections to the ERMP contents

2.4 Department of Agriculture

The dam will attract Rufous Night Herons, one the most prolific carriers of mosquito borne arbovirus diseases. The dam could be a useful monitoring site for bovine disease vectors and pathogens.

Toxic cyanophyta (algae) are present in the survey area and it is desirable that nutrient data be collected to predict harmful blooms.

2.5 Mines Department

Concluded that the geology sections of the ERMP suffered from a lack of recent geological information. This was provided as an attachment.

No potential mineral deposits within the catchment area are known. The last mineral claim in the dam site area was withdrawn in June 1981.

2.6 Department for Youth Sport and Recreation

The Department believes that more pressure will be placed on the few isolated recreation sites in the West Pilbara as a result of the project. The Harding development will cater for a different group of people. More funds will be required to manage the isolated sites to minimise environmental degradations.

2.7 Town Planning Department

Scour from overspill and siltration around the reservoir shoreline may present problems but overall the project is regarded favourably, particularly as it is to be used to reduce the draw on Millstream.

2.8 Museum

The Management proposals for ethnological and archeological sites outlined in the ERMP appear to be satisfactory.

The faunal aspects of the ERMP suffer considerably by having been documented from a short period of time in just one season.

2.9 Main Roads Department

The Roebourne to Cooya Pooya Stations road access route is preferred as it will in the long term provide for an extension to Wittenoom.

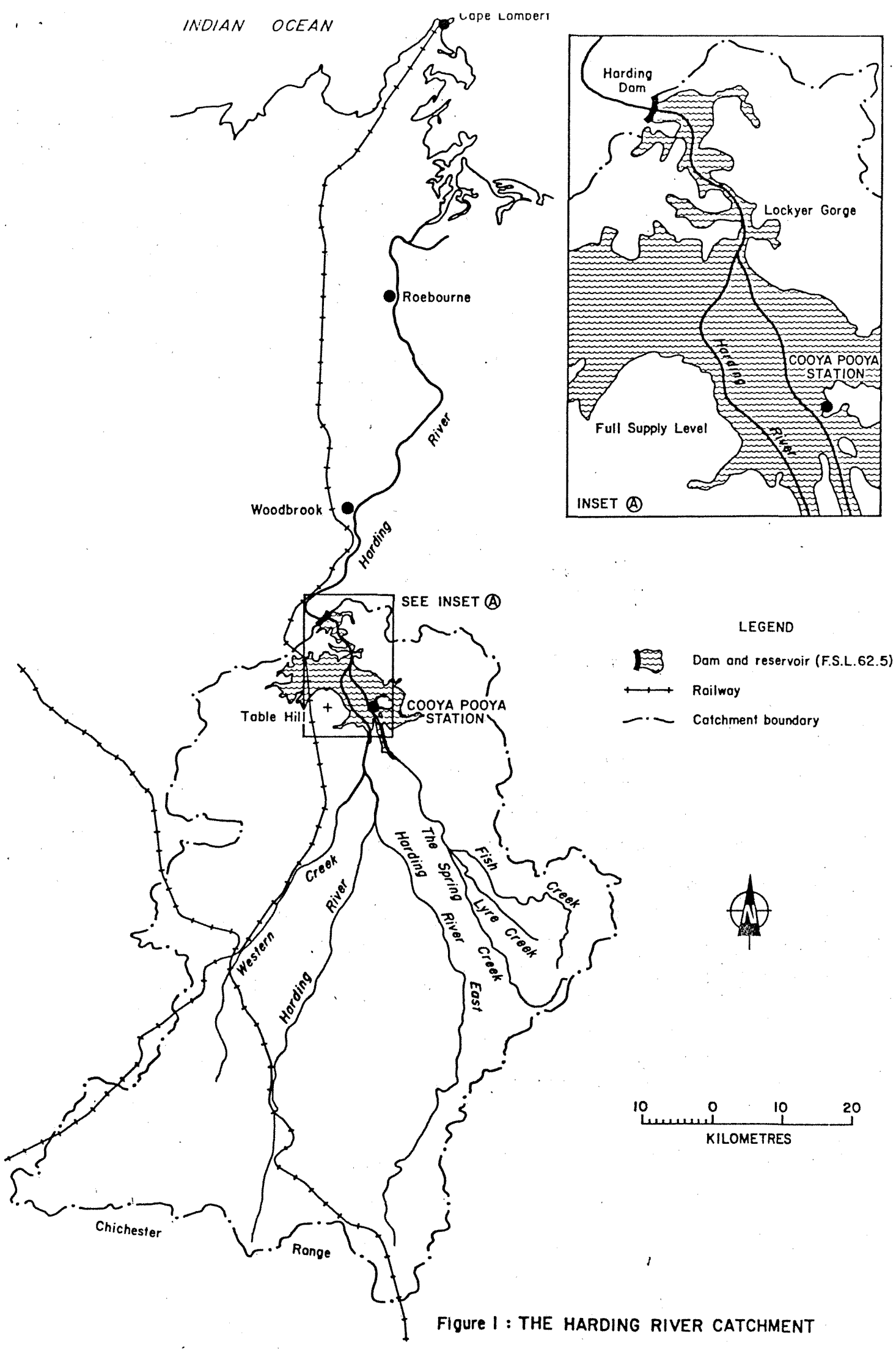

Figure I : THE HARDING RIVER CATCHMENT