WATER AUTHORITY
of Western Australia

WATER RESOURCES DIRECTORATE

Water Resources Planning Branch

Gracetown Water Supply
Supply From Ellen Brook
Public Environmental Report

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GRACETOWN WATER SUPPLY

SUPPLY FROM ELLEN BROOK

SUMMARY

Gracetown is a small holiday/retirement town on the West Coast of Western Australia. there are 154 dwellings in the town whose only source of water is from rainwater tanks. Early investigations for a source of potable water for a public, reticulated water supply, had shown that Ellen Brook, located 5 kilometres south of the town was the optimum location. Two methods of developing the Brook as a source of supply were considered. These are, to pump water from an existing masonry pipehead dam immediately upstream of the Ellensbrook Homestead, or to construct a new pipehead dam downstream of the Homestead.

Acknowledging public opposition to the use of the existing masonry pipehead dam, the lower site has been selected as the preferred source for Gracetown, despite the greater cost evolved.

Sensitive environmental issues raised by the proposal to use Ellen Brook as a source of water for the Gracetown Water Supply are addressed in this Report. It is concluded that, with sound management, the preferred proposal can be constructed and operated with a minimal and acceptable impact on the environment.

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GRACETOWN WATER SUPPLY

SUPPLY FOR ELLEN BROOK

1. BACKGROUND

Gracetown is a small holiday/retirement town on Cowaramup Bay approximately 40 kilometres south of Cape Naturaliste. The town was opened up in the 1960s.

There are 154 dwelling units in Gracetown at present, making it one of the largest country towns in Western Australia not served by a reticulated water supply. Although it was originally developed as a holiday resort, the number of permanent residents has increased significantly in recent years. There are now 62 permanently occupied houses in the town, with a resident population of approximately 160. Some further increase in the proportion of permanent residents is expected in the future. The provision of a reticulated water supply at Gracetown will give the residents of the town a standard of living which in the Metropolitan Area has become accepted as the right of every individual.

A reticulated water supply will also lessen the severe summer fire hazard as residents are reluctant to clear the natural scrub if they cannot maintain replacement vegetation because of a lack of water.

Investigations for a reticulated water supply commenced in 1971 following representations from the Gracetown Progress Association. Following an unsuccessful search for groundwater, investigations were extended to include all surface water resources in the area. Ellen Brook was identified as the optimum source of water for the town.

The project involves the construction of a small pipehead dam on Ellen Brook from which water will be pumped to a 1 000 m^3 capacity service tank to be located east of the town. Water will gravitate from the service tank to consumer services in the town.

Ellen Brook is located within the Leeuwin-Naturaliste National Park, and the pipeline route traverses the Park.

2. LEGISLATIVE REQUIREMENTS AND APPROVAL PROCESSES

The proposed project is subject to environmental review under provisions of the Environmental Protection Act 1971-1980 (Western Australia). Under this Act the Environmental Protection Authoirty (EPA) is charged with the duties of enhancing the quality of the environment and controlling and wherever practical, preventing acts or omissions capable of causing pollution. Section 55 of the Act requires Ministers of the Crown to refer to the EPA matters which may have a detrimental effect on the environment. The EPA can then require the provision of "aid, information and facilities" to assist it in reporting to the Minister on environmental aspects of the proposal. In

practice, the provision of information is undertaken by the proponent, in this case the Water Authority of Western Australia. The Authority has submitted a Notice of Intent to the EPA which described the proposal, the impact of the proposal on the environment, alternative sources of supply and comparative costs of those alternatives. The EPA has directed the Authority to prepare a Public Environmental Report (PER) for public comment.

As the proposed project site is within an A Class Reserve for National Park, the proposal will need to be endorsed by the National Parks an Nature Conservation Authority, or in the event that such approval is not forthcoming, by a majority in both Houses of Parliament.

3. WATER DEMAND

There are 152 building lots in the present development of Gracetown of which 149 have been built on. There are 154 dwelling units in the town. Allowing for services to public facilities (tennis courts, beach front ablutions etc) and assuming some minor further development, a total of 160 services can be expected by the time a reticulated water supply is commissioned.

The Department of Lands and Surveys advised that subdivision of an additional 60 blocks could be provided within the townsite, but any further development would be hindered by topographic constraints. There is no pressure at present for the release of additional urban blocks at Gracetown. The implications of future regional development are examined in paragraph 6.2 of this Report.

For planning purposes it is assumed that ultimately there could be 220 potential services at Gracetown.

As shown in Appendix 1, the average day of peak week demand of towns similar to Gracetown and which have established water supplies, approximate 2.5 cubic metres per service. This figure has been rising over the past 15 to 20 years as the general standard of living and consumer expectations have risen. A continuing increase to 3.0 cubic metres per service must be anticipated. In the case of new schemes, experience has shown that normal water demands usually take some years to become established. The initial demand at Gracetown is estimated to be 2.0 cubic metres per service.

Thus the average day of peak week water demand at Gracetown is estimated to be 320 cubic metres when the reticulated water supply is commissioned, and rising to a maximum of 660 cubic metres per day, in about 20 years.

4. ALTERNATIVE SUPPLY PROPOSALS

4.1 Cowaramup Brook

The first resource considered as a source for Gracetown water supply was Cowaramup Brook, which enters the ocean at Cowaramup Bay immediately north of Gracetown as shown on Figure 1.

Consideration of this resource was discontinued as the stream is ephemeral, and the water is of marginal quality.

4.2 Underground Water

Between 1974 and 1978, 14 exploratory bores were drilled at Gracetown in an attempt to locate a source of underground water to supply the town. These bores were drilled at sites selected by qualified hydrogeologists of the Mines Department and also on the basis of drilling experience by Departmental officers in other similar localities.

All bores were unsuccessful, except for Bore 1/74 located within the townsite. Pump testing of this bore showed that it was capable of producing 400 cubic metres of water per day, but the annual supply from this source is only quite small due to the limited areal extent of the aquifer. This bore cannot be used as the main source for Gracetown water supply, but it can be used to supplement another source to supply peak demands during summer.

The bore was equipped as a carting supply in 1978. The available production records are:

Year	Annual Pumping	Peak Week
1982/83	1 099 m^3	84 m^3
1983/84	1 634 m^3	100 m^3
1984/85	1 171 m^3	166 m^3

It is anticipated that the bore will supply up to 10 000 cubic metres over summer if it is operated as a supplementary source.

4.3 Ellen Brook Springs

Two separate springs on locations 673 (private property) and 202 (now incorporated into the Leeuwin-Naturaliste National Park) were first gauged in 1974/75 and again since 1978/79. Neither spring has sufficient flow to supply the existing development at Gracetown. Utilisation of the spring on location 202 would be unacceptable because of the undesirable impact of the proposal on Meekadaribee waterfall and cave.

4.4 Wilyabrup Brook

Wilyabrup Brook, located 8 kilometres north of the town, was considered as a source for Gracetown water supply. It would avoid encroachment on the National Park. Wilyabrup Brook stops flowing during summer and a storage of approximately 60 000 m^3 would be required to supply the demand during this period. Without any of the necessary site investigations, a preliminary estimate of the cost of this proposal is of the order of $1 400 000 to $1 500 000 depending on the location of the diversion structure on Wilyabrup Brook.

4.5 Excavated Dam and Bitumen Catchment

Supply from an excavated dam and bitumen paved catchment area has been suggested as a means of avoiding encroachment on the National Park. If a suitable site could be located within 3 kilometres of Gracetown, this option would cost in the order of $1 600 000.

4.6 Margaret River

A pipeline extension to supply Gracetown from the existing water supply headworks at Margaret River would minimise encroachment on the National Park (only about one kilometre of pipeline would be within the National Park). As set out in Appendix 3, the estimated cost of supplying Gracetown from Margaret River is $1 080 000.

In addition to this direct initial cost, utilisation of the Margaret River water supply headworks would bring forward the requirement for upgrading the supply to Margaret River. Augmentation of Margaret River water supply estimated to cost $700 000, would be required to be undertaken in 1990/91 in lieu of 1995/96. In present worth terms, this is equivalent to an additional present day cost of $165 000. The total comparative cost of this proposal to supply Gracetown is $1 245 000.

4.7 Ellen Brook

Ellen Brook is located some 5 kilometres south of Gracetown. In its lower reaches the brook is perennial. Utilisation of this source would be essentially by a run of the river development in which the demand is supplied from stream flow. A small pipehead dam would be required to facilitate the operation and control of the transfer pumps.

A summary of stream flow observations for Ellen Brook is shown in Appendix 2. Summer flow in the brook is maintained by discharge from the springs on locations 673 and 202. Examination of the minimum summer flows appears to indicate that there has been a diminution in the flow in recent years. There has not been any change in the groundwater flow regime at the springs; this apparent reduction in minimum flows observed is due to the more frequent observations and to the below average rainfall in recent years, as shown in the following table.

Year	Data	Minimum Summer Flow (cubic metres per day)	Preceeding Year Rainfall at Margaret River (Average 1168 mm)
1978/79	9/1/79	1 040	1 126
1979/80	-	No observations	1 004
1980/81	16/3/81	950	1 100
1981/82	18/1/82	950	992
1982/83	3/2/83	690	915
1983/84	8/2/84	520	1 002
1984/85	13/2/85	430	960
1985/86	28/1/86	460	870

It is concluded that there is adequate flow in Ellen Brook to supply to the existing development at Gracetown. In the longer term as the water demand at Gracetown increases there will be some short fall in stream flow following dry years, if periods of minimum stream flow coincide with periods of peak water demands. Depletion of water storage in the pipehead dam, and the conjunctive use of Bore 1/74 will then be used to secure the supply during these periods.

Investigations for utilising Ellen Brook as a source for Gracetown water supply have considered two methods of development. The original conceptual design assumed that water would be pumped from the existing masonry pipehead dam located about 60 metres upstream of the Ellensbrook Homestead. Alternatively, a new pipehead dam could be constructed some 250 metres downstream of the Homestead.

As set out in Appendix 4, the cost of a scheme pumping from the existing pipehead dam is estimated to be $720 000. This estimate assumes that only a limited amount of underground power main is provided in the Homestead area. If all power main construction within the National Park (i.e. from the north west corner of location 673 to the pipehead dam) is underground, the cost of the scheme would increase to $780 000.

Alternatively, if a new pipehead dam is constructed downstream of the Homestead, the cost of the scheme is estimated to be $800 000 as detailed in Appendix 5. This estimate assumes that there are no environmentally sensitive areas requiring underground power main construction. If all power main construction within the National Park is underground, the cost of the scheme would increase to $870 000.

5. EVALUATION OF ALTERNATIVE PROPOSALS

5.1 General

Using Cowaramup Brook, groundwater, or the Ellen Brook Springs as sources for Gracetown water supply are not feasible because of water quality, adequacy of supply or environmental factors. These options are not considered any further.

5.2 Wilyabrup Brook

The Wilyabrup Brook scheme would involve construction of a dam of 60 000 m^3 storage on Wilyabrup Brook. If a suitable site is not available on Wilyabrup Brook an excavated offstream storage would be required to maintain supply to Gracetown during summer when streamflow ceases. In addition to a diversion structure and pumping station on Wilyabrup Brook, some 14 to 16 kilometres (depending on the location of the diversion structure) of buried pipeline would be required. This pipeline would follow Caves Road and the bitumised access road into Gracetown.

No field investigation of this proposal has been carried out. The scheme could have some impact on the environment downstream of the diversion structure and on the catchment area, where some controls on rural land use may be necessary. No attempt has been made to identify the environmental impacts of this proposal because of the relatively high cost of the scheme.

5.3 Excavated Dam and Bitumen Catchment

This proposal would require the construction of an 80 000 m^3 excavated dam and about 12 hectares of bitumen paved catchment area. No prospective site has been identified but it is anticipated that this scheme would involve the complete clearing of some 15 hectares of natural vegetation. In addition, the development of a gravel borrow area would be required if in situ soils on the catchment area are not suitable as a base course for bitumen paving. No attempt has been made to undertake a detailed evaluation of the environmental impacts of this proposal because of the relatively high cost of the scheme.

5.4 Margaret River

To supply Gracetown from the Margaret River water supply headworks would require the construction of a new pumping station adjacent to the existing dam at Margaret River and about 16 kilometres of pipeline. The pipeline would generally follow Carter and Caves Roads and existing tracks from Caves Road to the proposed service tank site at Gracetown. About one kilometre of pipeline would traverse State Forest along Carter Road, and one kilometre would be through National Park. Construction of the pipeline would result in only minor disruption of the environment. There are no restrictions on access in this portion of State Forest.

Implementation of this proposal would advance the need to augment the Margaret River water supply. Based on a 3% per annum growth in the number of services at Margaret River, this augmentation is estimated to be required in 1990/91 rather than in 1995/96, if Gracetown is supplied from Margaret River.

Construction of a new dam on the Margaret River is the most probable method of augmenting Margaret River water supply. Raising of the existing dam is unlikely to be feasible because of the nature of the existing structure (a simple buttressed wall), doubtful foundations (particularly on the north abutment) and the fact that it has already been raised (by about 0.4 metres) since its original construction. Detailed investigation would be required to identify a site for a new dam. If it was constructed immediately downstream of the existing dam, it is anticipated that the top water level of the existing storage reservoir would be raised by 1.5 to 2.0 metres. Identification of environmental impacts would be required to proceed in conjunction with engineering investigations for the dam. If there are any significant environmental constraints, the cost of augmenting Margaret River water supply could be significantly higher than the present estimate of $700 000.

No unacceptable environmental impacts have been identified in respect of the pipeline, pumping station and service tank to supply Gracetown under this proposal. The pipeline would be buried (except for the Margaret River crossing) and would follow existing roads and tracks. The pumping station would be located at the existing dam at Margaret River and the service tank would not be visible from Gracetown.

5.5 Ellen Brook

The Ellen Brook scheme involves development of a source within the Leeuwin-Naturaliste National Park either by utilising the existing pipehead dam on Ellen Brook or by constructing a new pipehead dam downstream of Ellensbrook Homestead. In addition to renovation of the existing dam (or construction of a new dam), a pumping station (and associated power main extension) and some 3 kilometres of the supply main to Gracetown will be constructed within the National Park. The balance of the supply main and the service tank will be constructed on vacant crown land within Gracetown townsite.

With careful attention to detail and restoration work, either of the Ellen Brook proposals can be constructed with minimum impact on the environment.

Environmental Consultants, Dames and Moore were commissioned to make a biotic survey of the area of the proposed works, to describe the likely impacts of the works on sensitive elements of the environment, and to define and report on management action required to mitigate any impacts. The Consultants' report "Biotic Survey of Ellen Brook", is appended to this Report.

The following paragraphs discuss the impact on the environment of various aspects of the project, and proposals to minimise these impacts.

5.5.1 Access Road

The Ellensbrook Homestead area is accessible only by four wheel drive vehicles at present. In conjunction with the restoration of the Homestead, the National Trust in collaboration with CALM proposes to upgrade this access track and establish a visitors parking area within walking distance, but out of sight of the homestead. This upgrading of the access track will proceed in conjunction with the implementation of this proposal.

At the existing pipehead dam, vehicular access for construction and maintenance purposes would be developed by an access track upstream of the dam. This track would be angled to join the Old Ellen Brook Road about 100 metres upstream of the dam as shown on Figure 4. This method of access to the dam pumping station is proposed to minimise the visual intrusion of the scheme on the general Homestead area.

Construction of a new pipehead dam downstream of the Homestead will require upgrading of a section of an old track which is presently under rehabilitation by the Department of Conservation and National Management (CALM) as shown on Figure 3. Use of this upgraded track will be restricted to authorised personnel; its development will not cause any further degradation of the beachfront dune system. This track will not intrude on the general Homestead area.

The suggested location of the visitors car park is shown on Figure 3. Vehicular access beyond the car park will be restricted. For normal operation and inspection purposes Water Authority officers will proceed on foot from the car park. Vehicular access will only be necessary when maintenance work is being carried out or when some heavy equipment is required at the dam.

The pipeline route to Gracetown follows existing tracks which were developed as firebreaks. Some upgrading of the track will be undertaken and the alignment will be rationalised where the existing track meanders unnecessarily. Utilisation of this track by the general public will be prevented by the provision of locked boom gates and rock boulder barriers north of the proposed permanent access track from Caves Road. The general location of these gates is shown on Figure 2. The precise location of the gates will be determined in consultation with officers of the Department of Conservation and Land Management. (CALM)

To minimise the risk of weed or dieback invasion into the Park, the access roads will be constructed, where necessary, using limestone and/or gravel imported from a site, or sites, approved by officers of CALM. To minimise erosion, precautions will be taken to divert runoff from the access track into the surrounding bush at regular intervals.

As noted in para 5.5.9, an improved access road to the Homestead is proposed by the National Trust, irrespective of any decision to proceed with the construction of the Gracetown Water Supply based on Ellen Brook.

5.5.2 Pipeline

The 150 mm asbestos cement pipeline from Ellen Brook to Gracetown will be laid below ground with a minimum cover of 450 mm. This type of pipe is laid with a sand bedding. Trench excavation material will be suitable for pipe bedding over most of the pipe route. A sand borrow area will be developed to provide bedding material where sand is not available in situ. Possible borrow areas have not yet been determined, but a suitable site should be readily available outside the National Park.

Sub-surface soil investigations have not yet been carried out along the proposed pipe alignment. Some rock (limestone) excavation is expected to be required. This will be accomplished using an excavator equipped with a hydraulic rock breaker if the use of explosives is not acceptable to CALM because of the existence of caves in the area.

As stated in Section 5.5.1, the pipeline will be laid adjacent to the existing track between Ellen Brook and Gracetown. The existing track will be widened to accommodate the track and pipeline alignment. Some rationalisation of the route will be effected where the existing track meanders unnecessarily.

After regrowth occurs over the pipe trench there will be no visual impact from the pipeline. Strong regrowth of the native vegetation can be readily achieved as evidenced by the recovery of the areas cleared for drilling exploratory bores in 1974, 1977 and 1978.

Pipeline marker posts will be installed at regular intervals on the pipeline alignment.

5.5.3 Power Main

Development of Ellen Brook at either the existing pipehead dam or by a new dam downstream of the Homestead will require the construction of a power main from Caves Road to the dam. As shown on Figure 1, the main will traverse private property (locations 1199, 886 and 673) and then follow the proposed access road to the Ellensbrook Homestead.

The power main extension to the new dam will be an above ground line. Alternatively, the power main extension to the existing pipehead dam would be above ground except for the final 200 metres which traverses an environmentally sensitive area. The poles will be 10 metres high at 80 to 100 metre spacing, and the standard SEC clearing profile of 20 metres width will apply. However, this is not a rigid requirement, and the cleared width can be reduced where the natural vegetation is lower. Also some larger trees may be left if they are not a threat to the line.

Location 1199 is mainly cleared farmland and the power main will be aligned to avoid a small cluster of trees. In location 886 and 673, the main will be constructed in an existing firebreak. Apart from scrub regrowth, about three trees in locations 886 and 673 will need to be cleared. About three trees in the National Park abutting location 673 will also need to be cleared in this section of the line.

Within the National Park beyond the north west corner of location 673, the line will be adjacent to the access road to the Homestead. The vegetation over this section of the route is almost entirely peppermint trees of about 5 metres. Due to the lower vegetation, clearing requirements can be relaxed. Including the access road, the total cleared width over this section of the route will approximate 15 metres.

As shown on Figure 3, some 200 metres of the power main would be constructed below ground over the final section of the route to the existing pipehead dam. The power main to the alternative dam site downstream of the Homestead will be above ground.

All above ground power main construction will be carried out by the SEC, but the SEC grid will be considered to terminate in the north west corner of location 673. The below ground main to the existing dam would be constructed by the Water Authority.

The visual impact of the power main extension will be kept to a minimum by construction in already cleared land, and along the alignment of the permanent access road to the Homestead. Below ground construction in the vicinity of the Homestead and the existing pipehead dam would prevent any visual intrusion on the historical significance of this area.

5.5.4 Pipehead Dam

The proposal to use the existing masonry pipehead dam on Ellen Brook would necessitate desilting of the storage basin of the dam. About 400 cubic metres of material would be excavated from the storage basin and subject to approval by CALM would be disposed of downstream of the dam where it will eventually be washed into the ocean. Failing this approval, the excavated material would be transported out of the National Park for disposal on land.

To ensure the structural stability of the existing dam, buttresses would be provided on the downstream face. These buttresses would be of masonry construction or cladding to harmonise with the appearance of the existing structure.

During summer when periods of minimum stream flow and peak demand coincide, there would be a visible reduction of stream flow past the homestead downstream of the dam. The visual impact of this reduction in flow would be minimised by using Bore 1/74 to augment the supply during periods of peak demand. It is expected that the reduction in flow would only be perceptible for three or four weeks during summer and would not be as severe following years of good rainfall.

Utilisation of the existing pipehead dam would actually have a positive impact on the scenic value of the dam, which is presently overgrown and silted up. Cleaning up the reservoir basin would greatly improve its appearance and restore it to its original condition. The reservoir of the existing dam would not be fenced, but signs advising its use as a public water supply source would be erected at appropriate sites.

The alternative proposal of constructing a new small pipehead dam downstream of the Ellensbrook Homestead will avoid any reduction in stream flow past the Homestead. The new dam will be a concrete structure with a top water level about 2 metres above invert level, creating a storage reservoir extending about 100 metres upstream. The reservoir basin (approximately 0.2 hectares) will be cleared of all vegetation.

For the new dam proposal, water quality considerations will require that general public access to the watercourse between the Homestead and the dam be prohibited. In addition, the caretaker's residence, visitors car park and public toilet facilities will have to be located some 300 metres north of the Ellensbrook Homestead as shown on Figure 3. A properly designed septic tank and effluent disposal system will be required to protect the water quality at the downstream damsite.

5.5.5 Pumping Station

The transfer pumps at Ellen Brook, at either the existing pipehead dam or at a new dam downstream of the Homestead will be installed below ground in a concrete well liner on the north bank of the reservoir. The visual impact of the station will be a prime consideration in its design. The area will be landscaped as much as possible to harmonise the station with its surroundings. The pumps and motor will be installed below ground. Careful selection of the equipment will ensure that noise is not a problem.

5.5.6 Service Tank

A 1000 cubic metre service tank will be constructed on vacant Crown land immediately east of the town. The tank will be located in a depression on the side of the hill and will not be visible from the residential area of the town or the approach road to the town. Top water level of the tank will be approximately R.L. 100m A.H.D. This will inhibit any further development of the townsite on higher ground than that already developed.

5.5.7 Impact on Freshwater Snail

A species of rare freshwater snail, Austroassiminea letha has been found adjacent to Ellen Brook. Apart from Ellen Brook, the only known living populations are located at Turner Brook near Deepdene Cliffs and at Cosy Corner. Extensive searches in the Deepdene Cliffs and Cosy Corner areas have failed to locate additional populations. At Ellen Brook, living populations are reported to have been found in algae growing on the side of the head race to the old water wheel, and at Meekadaribee Cave some 500 metres upstream of the homestead. Dead snails have been found at the downstream toe of the masonry pipehead dam and in the seepage area about 30 metres east of the Homestead.

The most important factor of the snails habitat is the availability of water. During winter, the snails disperse into seepage areas along the north bank of Ellen Brook, but when the seepage areas dry out, they are concentrated closer to Ellen Brook. During summer the major part of the snail populations are believed to be in fissures in the rocks, where either a minor flow of water or very high humidity would prevail even in mid-summer.

Some concern has been expressed about the impact on the snails of developing the existing pipehead dam as a source for Gracetown water supply. This concern relates to the effect of the reduction of stream flow on the snail population downstream of the dam and to the impact of the construction activity on the habitat of the snails.

In respect of water availability, the snail population downstream of the dam would be subjected to a slight reduction in stream flow during summer. This reduction in stream flow would be minimised by the use of Bore 1/74 and would be perceptible for only a short period. Initial peak demands can be supplied entirely from Bore 1/74, so that the opportunity exists to monitor the impact of reduced downstream flow on the snail population as water demands at Gracetown become established. Any such monitoring could be inconclusive because the snails are so small and difficult to find, and are relatively mobile. Pumping from the existing pipehead dam would not affect the snail's habitat in the hillside seepage areas downstream of the dam.

Construction activities in the area of the existing pipehead dam would have some impact on the snail's habitat but with careful planning and execution of the work it would be possible to restrict such impacts to an acceptable level. Development of vehicular access upstream of the dam as described in Section 5.5.1 would avoid traffic in the fissured rock area adjacent to and downstream of the dam. The refuge offered to the snails by these fissures would not be affected. The hillside seepage area about 30 metres east of the Homestead (downstream of the dam) would not be affected by construction activities, but a significant seepage area about 50 metres upstream of the dam would be affected by construction of the access track upstream of the dam. To minimise disturbance of the snail population in this area, this work would be undertaken before the onset of summer while the snails are still dispersed under moist conditions. Preservation of the seepage area as a habitat for the snails would be taken into account in the design of culverts under the proposed access track.

Although utilisation of the existing pipehead dam would have an impact on the snails, the impact is considered to be within acceptable limits. There would be no impact on snails upstream of the project area. Because of the snail's mobility, any areas affected by construction activity could be expected to be repopulated when construction is completed.

No snails have been found downstream of the Homestead. The alternative development of a new pipehead dam will not have any impact on the snail population.

5.5.8 Impact on Aboriginal Sites

The waterfall and cave known as Meekadaribee is understood to be an Aboriginal site with some mythological significance. As this site is located some 400 metres upstream of the existing pipehead dam, it would not be affected by the proposal.

As shown on Figures 2 and 3, there are two Aboriginal sites adjacent to the proposed pipeline from Ellen Brook to Gracetown. The site nearest the Ellensbrook Homestead is registered as Site S0242 and is considered to be of greater significance. The less important site north of Ellen Brook is registered as Site S2249 has not been thoroughly investigated. Both these sites are sand blow-outs where Aboriginal artifacts which were originally distributed throughout several metres of the soil profile are now concentrated at the surface. The sites are of archeological interest and have no religious significance. The sites do not have clearly identifiable boundaries. Advice from the Registrar of Aboriginal Sites is that the sites extend to cover any Aboriginal artifacts in the immediate vicinity of the sand blow-outs.

Development of the existing pipehead dam as a source for Gracetown water supply would require construction of the pipeline to Gracetown alongside Site S0242 for some 200 metres and in close proximity of Site S2249. One hole has been dug adjacent to Site S0242 as shown on Figure 3. An Aboriginal artifact was found in this hole at a depth of about 300 mm. It is anticipated that further artifacts would be uncovered by the excavation of the pipeline and power main trench along this section of the route. This construction work would not have any adverse impact on the sites. The entire trench excavation adjacent to the sites would be in sand and all excavated material will be used to backfill the trench. Implementation of the scheme will enable knowledge of the sites to be increased. The trench excavation will be inspected by an archaeologist before the pipeline is laid, and any significant artifacts salvaged. This inspection will be arranged in consultation with the Registrar of Aboriginal Sites.

Construction of a pipehead dam downstream of the Homestead will reduce the length of pipeline to be constructed adjacent to the known Aboriginal sites. As shown on Figure 3, some 30 metres of pipeline will be laid alongside Site S0242. It is possible that trench excavation adjacent to the old track now under rehabilitation will show that Site S0242 actually extends further west than presently thought. Nevertheless, like the proposal to use the existing pipehead dam, the pipeline from a new dam will have no adverse impact on Aboriginal sites.

5.5.9 Impact on Historical Values

The Ellensbrook Homestead marks the first European settlement in the Leeuwin-Naturaliste area. The National Trust is about to commence restoration of the Homestead and is also considering reconstruction of some associated structures. When restoration is completed, a caretakers house will be built near, but out of sight of the Homestead. Public access to the Homestead will be by foot from a visitors car park to be constructed near the caretakers house.

Development of supply from the existing pipehead dam will affect historical values in the Homestead area, but this impact is considered to be quite small. There will be an impact on historical values resulting from the provision of vehicular access to the pipehead dam and the pumping station. These works will be out of historical context with the original homestead. The visual intrusion of these works will be minimised by location of the vehicular access upstream of the dam and by installation of the pumps below ground. To avoid any visual impact, the power main extension will be constructed below ground near the dam and any renovation of the dam will harmonise with the existing structure.

Some further impact will arise when the scheme is operating and there is a perceptible reduction in stream flow downstream of the existing dam in both the stream bed and in the head race to the water wheel. This reduction in flow will be minimised by the use of Bore 1/74. The visual impact could be further reduced by the installation of a simple and inexpensive recirculation system in the water wheel head race. This system would not have to be installed at the inception of the scheme but could be delayed until made necessary by rising demand at Gracetown. The recirculation system would only be required to operate for the short period during summer when periods of peak demand and minimum stream flow coincide.

The alternative development of a pipehead dam downstream of the Homestead will not affect the historical values in the Homestead area.

5.5.10 Management and Rehabilitation

Responsibility for the management of the National Park lies with the Department of Conservation and Land Management. Installation and management of the reservoir, pumping station and pipeline route will be the responsibility of the Water Authority. The Water Authority recognises its particular responsibility for sound environmental management and undertakes to minimise impacts on the environment and to clean up and rehabilitate the site following construction. The Authority undertakes to seek and comply with the guidance of officers of CALM with respect to suitable practices for the installation and management of the project.

Specifically, the Water Authority undertakes to make and comply with the commitments related to protection, rehabilitation and maintenance of the environment, made in paragraph 3.4 - "Management and Rehabilitation" - of the Biotic Survey of Ellen Brook by Dames and Moore, which is appended to this Report (Appendix 7).

6. SELECTION AND DESCRIPTION OF PREFERRED PROPOSAL

6.1 Preferred Proposal

Ellen Brook is the resource preferred by the Water Authority as the source for a reticulated water supply at Gracetown. It is significantly cheaper to use Ellen Brook than other alternative sources. Although construction of a new dam is more expensive than utilisation of the existing pipehead dam, this proposal minimises any impact on the historical, aboriginal and aesthetic values of the area and eliminates any impact on the freshwater snail. Of the two options for developing Ellen Brook, the proposal to construct a new dam downstream of the Homestead is the option generally preferred by the various parties with an interest in the area. The proposal to construct a new dam downstream of the Homestead has therefore been selected as the Water Authority's preferred proposal.

6.2 Regional Development

Further growth in the Margaret River - Gracetown area does not affect the selection of Ellen Brook as the preferred source for Gracetown water supply. Provided the preferred scheme is able to supply the demand at Gracetown for at least five years, it is more economical to construct the preferred scheme and augment the supply from Margaret River when required, rather than to supply from Margaret River initially. The Shire of Augusta-Margaret River and the Department of Lands and Surveys have advised that on planning grounds, further development of Gracetown townsite should not be considered. Strong arguments would be required to justify any further development of the town; thus, the adequacy of the supply from Ellen Brook for a minimum period of five years is assured.

The Shire has advised that any future development in the area between Cowaramup and Gracetown would be for a special rural zoning. A reticulated water supply will not be required in this area.

Any future proposals for the provision of public water supplies to Prevelly Park and Wallcliff Wilderness Estate would not affect the choice of Ellen Brook to supply water to Gracetown. Local groundwater resources, if they exist, would be the cheapest source of supply for Prevelly Park and Wallcliff Wilderness Estate. Failing this, a piped supply from the existing headworks at Margaret River could be considered. Adoption of this latter proposal would not affect the cost of a piped supply from Margaret river to Gracetown, but there would be a minimal reduction in cost of upgrading the Margaret River headworks attributable to supplying Gracetown. If the Margaret

River headworks are used to supply Prevelly Park and Wallcliff Wilderness Estate, the headworks development cost associated with supply to Gracetown would reduce from $165 000 (see section 4.6) to about $150 000.

The size of Margaret River in relation to Gracetown precludes the growth in this town having any influence on the choice of a source for Gracetown water supply. That is the growth rate assumed for Margaret River (3% per annum adopted in section 4.6 and 5.4) has only a minimal effect on the overall cost of supplying Gracetown from the Margaret River water supply headworks. Comparative costs based on a 10% discount rate, are:

	Capital Cost $	Present Worth $
Ellen Brook		
Ellen Brook to Gracetown	800 000	800 000
Margaret River Headworks 1995/96	700 000	269 000
	1 500 000	1 069 000
Margaret River		
Margaret River to Gracetown	1 080 000	1 080 000
Margaret River Headworks 1990/91	700 000	434 000
	1 780 000	1 514 000

6.3 Description of Preferred Proposal

6.3.1 Sources of Supply

Ellen Brook will be developed as the principal source of supply for Gracetown by constructing a concrete pipehead dam on Ellen Brook about 250 metres downstream of the Homestead. The height of the dam wall will be about 2 metres above the invert of the Brook. The reservoir created by the dam will extend 100 metres upstream. A floating offtake will be installed in the reservoir to provide water to the pump well.

In addition to the depletion of storage in the reservoir, Bore 1/74 will be equipped to maintain supply when demands exceed stream flow. The bore will be equipped to deliver up to 400 cubic metres per day; its operation will be limited to supplying peak demand during summer.

6.3.2 Pumping Station

Two (one duty, one standby) 30 kilowatt electrically driven pumps will be installed below ground in a 2 metre diameter concrete well liner located on the north bank of the reservoir. A chlorinator, comprising a 550 mm x 900 mm x 1 760 mm aluminium cubicle (to house a chlorine cylinder) on a concrete foundation will be installed adjacent to the pump well and will operate in conjunction with the pumps.

Vehicular access to the dam and pumping station for construction and maintenance purposes will be by means of an access track generally following the old track under rehabilitation by CALM as shown on Figure 3.

6.3.3 Pipeline

The pipeline from Ellen Brook to the service tank site at Gracetown will be a below ground 150 mm nominal diameter asbestos cement pipeline. The pipeline will have a minimum cover of 450 mm. The route of the pipeline will follow existing tracks from Ellen Brook to Gracetown. Where required, a limestone and/or gravel surface will be provided to the existing track and some rationalisation of the route will be effected where the existing track meanders unnecessarily. The access corridor will be widened to about 5 metres to provide adequate space for construction work on the pipeline alignment adjacent to the track.

6.3.4 Service Tank

A 1000 cubic metre roofed reinforced concrete circular tank, having a height of 4.0 metres will be constructed on high ground immediately east of the existing development within Gracetown townsite.

6.3.5 Reticulation Mains

Reticulation mains within Gracetown townsite will be buried asbestos cement pipes of 58 to 200 millimetre nominal diameter.

6.3.6 Access Roads

The present access to the Ellensbrook Homestead area is along tracks which can only be traversed by four wheel drive vehicles. It will be upgraded in conjunction with proposals by the National Trust for improved access to the Homestead. The existing track south of Gracetown will be upgraded to provide access adjacent to the pipe route. Locked boom gates and rock boulder barriers will be provided to prevent public use of the track along the pipeline.

6.3.7 Power Supply

A three phase power main extension will be required from Caves Road to the pumping station as shown on Figures 1 and 3. The power main extension will be constructed above ground by the State Energy Commission.

6.3.8 General

With sound management, in close liaison with officers of CALM, the preferred proposal can be constructed and operated with minimal impact on the environment at Ellen Brook. The engineering elements of the project are relatively small. The pipehead dam (2m high) will occupy a small area (0.2 hectares), and the small (30 kilowatts) pumping station will be unobtrusive below ground. The small (150 mm diameter) pipeline will be buried. Access roads and power line to the Homestead area, will be constructed in conjunction with proposals by the National Trust and subject to approval by CALM.

APPENDIX 1

Gracetown Water Supply

Basis of Design Demands

Town	Average Day of Peak Week Consumption per Service (cubic metres)		
	1982/83	1983/84	1984/85
Augusta	2.21	1.91	2.01
Bremer Bay	2.35	1.74	1.75
Cervantes (1)	2.63	2.30	2.34
Cowaramup	2.34	3.13	3.29
Denmark	2.07	2.10	1.92
Dunsborough	2.70	3.01	2.57
Guilderton	2.30	2.11	2.25
Jurien (1)	3.23	3.00	2.59
Lancelin (1)	2.95	2.22	2.20
Ledge Point (1)	2.97	2.38	2.67
Margaret River	2.42	2.38	2.45
Quinns Rocks	2.59	2.30	2.76
Seabird (1)	2.24	2.44	2.65
Walpole	2.32	2.11	1.73

Notes (1) Crayfishing industry in the towns of Cervantes, Jurien, Lancelin, Ledge Point and Seabird causes slightly higher consumptions than otherwise.

APPENDIX 2

Ellen Brook

Summary of Flow Observations (in cubic metres per day)

Date	Station 610 1017 (Spring on Loc 673)	Station 610 1018 (Pipehead dam at Ellen Brook Homestead)	Station 610 1019 (Spring in National Park - formerly Loc 202)
1/12/74	860	NR	1 470
19/12/74	780	NR	1 470
5/2/75	1 040	NR	950
25/3/75	1 210	NR	390
18/4/75	1 120	NR	400
4/6/75	1 170	NR	970
15/11/78	260	3 370	690
12/12/78	260	1 900	690
9/1/79	260	1 040	690
21/2/79	260	1 640	520
19/3/79	260	1 120	600
1/5/79	260	1 640	600
7/8/80	850	138 000	860
13/11/80	430	4 060	520
10/2/81	350	1 210	600
16/3/81	350	950	600
13/4/81	350	1 640	600
11/5/81	350	1 210	600
4/8/81	350	2 760	690
15/9/81	350	20 000	950
23/11/81	350	3 280	520
18/1/82	260	950	600
23/3/82	170	1 040	430
29/5/82	260	1 640	600
18/8/82	350	14 500	600
13/10/82	260	9 160	780
9/12/82	170	1 300	780
31/12/82	90	1 040	170
3/2/83	170	690	430
28/2/83	90	1 300	350
7/4/83	170	860	520
26/5/83	170	950	350
22/6/83	170	15 200	350
19/7/83	NR	23 600	NR
14/9/83	NR	43 200	NR
22/12/83	NR	780	NR
29/12/83	170	950	350
4/1/84	170	1 810	350
10/1/84	260	780	430
18/1/84	280	570	690
26/1/84	260	1 050	290
1/2/84	220	670	600
8/2/84	130	520	350
13/2/84	120	670	580

22/2/84	120	600	400
27/2/84	160	670	400
7/3/84	150	560	410
14/3/84	130	650	430
21/3/84	160	800	460
27/3/84	160	660	410
5/4/84	170	690	420
13/4/84	170	750	410
26/4/84	150	790	370
23/10/84	260	3 970	520
20/11/84	260	NR	520
28/12/84	260	1 380	520
10/1/85	260	690	350
14/1/85	170	730	430
21/1/85	170	780	350
30/1/85	170	520	NR
7/2/85	170	520	520
13/2/85	90	430	430
20/2/85	130	520	NR
6/3/85	170	520	430
19/3/85	170	600	430
27/3/85	170	520	430
1/5/85	170	600	430
15/5/85	170	520	340
23/10/85	170	4 920	430
10/12/85	140	740	400
31/12/85	140	500	390
8/1/86	140	480	390
28/1/86	110	460	360
5/2/86	110	470	370
12/2/86	110	470	390

Notes 1. Flow rates in cubic metres per day
2. NR indicates no record i.e.estimate of flow not made

APPENDIX 3

Gracetown Water Supply

Cost of Supply from Margaret River

Access roads	10 000
Upgrade SEC power supply to Margaret River Dam	20 000
Upgrade existing pumping station at Margaret River Dam	60 000
Transfer pumping station	60 000
Supply main: 16 km 150 AC	440 000
Road, river and creek crossings	50 000
1 000 m^3 R.C.C. service tank	100 000
Reticulation mains	135 000
	875 000
+ 10% contingencies	85 000
	960 000
Overhead charges	120 000
	$1 080 000

APPENDIX 4

Gracetown Water Supply

Cost of Supply from Ellen Brook

(Pumping from existing masonry pipehead dam)

	$
Access road	20 000
Power main:	
Overhead line	32 000
Underground line in Homestead area	10 000
Rehabilitate existing dam	40 000
Transfer pumping station	80 000
Supply main: 6.3 km 150 A.C.	170 000
1 000 m^3 R.C.C. service tank	100 000
Reticulation mains	120 000
Equip Bore 1/74	10 000
	582 000
+10% contingencies	58 000
	640 000
Overhead charges	80 000
	$720 000

Note

Cost estimates include allowance for restoration after construction.

APPENDIX 5

Gracetown Water Supply

Cost of Supply from Ellen Brook

(Pumping from new pipehead dam downstream of homestead)

Access road	25 000
Power main:	
Overhead line	35 000
Pipehead dam	100 000
Transfer pumping station	80 000
Supply main 6.4 km 150 A.C.	175 000
1000 m^3 R.C.C. service tank	100 000
Reticulation mains	120 000
Equip Bore 1/74	10 000
	645 000
+ 10% contingencies	65 000
	710 000
Overhead charges	90 000
	$800 000

Note

Cost estimates include allowance for restoration after construction.

APPENDIX 6

SUBMISSIONS BY INTERESTED PARTIES

ENVIRONMENTAL PROTECTION AUTHORITY
BP HOUSE,
1 MOUNT STREET, PERTH, WESTERN AUSTRALIA 6000
Telephone 322 2477

UNDER SECRETARY FOR WORKS

Attention: Mr Combs

Your Ref. PWWS 1068/71
Our Ref. 209/83

GRACETOWN WATER SUPPLY

The proposal to develop a reticulated water supply for Gracetown, utilizing an existing water storage on Ellen Brook, has been referred to the EPA for consideration, under Section 56 of the Environmental Protection Act.

It would appear that there are several aspects of the proposal which may be cause for concern on environmental grounds. Accordingly, the Authority requests that the Public Works Department prepare a Notice of Intent, investigating the proposed scheme and possible alternatives in greater detail and suggesting means of avoiding or reducing the likely environmental impacts.

Officers of the Department of Conservation and Environment are available to discuss this issue with you. May I suggest you make contact with either Mr G Whisson or Mr N Orr to arrange a meeting.

A R MAIN
CHAIRMAN

23 February 1984

A 16104
A Parker
420 2943

The Chairman
Environmental Protection Authority
BP House
1 Mount Street
PERTH W AUST 6000

GRACETOWN WATER SUPPLY

In response to your request of February 23, 1985, and following discussions with officers of the Department of Conservation and Environment, a Notice of Intent has been prepared in respect of the proposed Gracetown Water Supply. Seven copies of the Notice are submitted herewith for your consideration.

Notes describing the proposal to pump water from Ellen Brook to Gracetown were distributed to all known interested parties in January 1984. Nine written responses were received which commented on various aspects of the environmental considerations involved. In the preparation of the Notice of Intent, careful consideration has been given to the written responses. and to the extensive on-site discussions which have since been held with many of the responding parties.

DIRECTOR OF WATER RESOURCES

August 23, 1985 BC

Enc.

ENVIRONMENTAL PROTECTION AUTHORITY
BP HOUSE,
1 MOUNT STREET, PERTH, WESTERN AUSTRALIA 6000
Telephone 322 2477

DIRECTOR OF WATER RESOURCES
WATER AUTHORITY OF WESTERN AUSTRALIA

Your Ref. A16104
Our Ref. 204/83

GRACETOWN WATER SUPPLY NOTICE OF INTENT

Thank you for your letter of 23 August 1985 enclosing a Notice of Intent on the above project.

As you may be aware, there are a number of regional planning initiatives being carried out in the Leeuwin-Naturaliste Block, and the EPA has recently written to LRPC to encourage the provision of a broad strategy plan. The purpose of the plan is to provide a context against which various development proposals can be assessed, taking account of land capability and other considerations.

At its meeting held on 12 September 1985 the Authority determined that the most appropriate approach on the Gracetown Water Supply proposal would be to defer an assessment of the proposal, until the regional planning has been progressed to a sufficiently advanced stage, to set the context in which to carry out the assessment.

If this decision will cause undue hardship, then please do not hesitate to communicate with me.

B A CARBON
CHAIRMAN
26 September 1985

WATER AUTHORITY of Western Australia

629 NEWCASTLE STREET
LEEDERVILLE W.A.
Postal Address P.O. Box 100 Leederville
Western Australia 6007
Telephone (09) 420 2420 Telex: AA 95140

Your Ref 204/83
Our Ref A16104
Enquiries B Combs
Tele Direct 420 2942

The Chairman
Environmental Protection Authority
BP House
1 Mount Street
PERTH WA 6000

GRACETOWN WATER SUPPLY - ENVIRONMENTAL ASSESSMENT

The provision of a reticulated water supply at Gracetown has been under investigation for many years. During this time, the number of permanent residents in the town has steadily increased and the town now has a high priority for this service.

Following strong representations by Gracetown residents and the Shire of Augusta-Margaret River, provision has been made in the Water Authority's 1985/86 Capital Works Programme to commence construction of the scheme, subject to obtaining the necessary environmental clearances. Deferral of the environmental assessment of the water supply proposal as suggested in your letter of September 26, 1985 would delay the provision of a reticulated water supply by at least one year.

The use of Ellen Brook as a source for Gracetown water supply is not considered to have any regional impact. Substantial development, over a very short period of time would be required before a regional water supply scheme (probably based on supply from the Margaret River) could be justified. Enquiries with the Town Planning Department and the Shire of Augusta-Margaret River have confirmed that such development is unlikely to occur in the immediate future. Using discounted cash flow analysis, it can be shown that it is economical to develop Ellen Brook initially and to augment the supply from Margaret River when required, provided that Ellen Brook (and Bore 1/74) will suffice for a minimum period of 5 years. The most likely scenario of some steady development at Gracetown suggests that the Ellen Brook source will suffice for at least 10 years.

In view of the established need for a reticulated water supply at Gracetown and the fact that supply from Ellen Brook can be justified as the first stage of a larger scheme if significant further development does finally eventuate, it is requested that the Environmental Protection Authority proceed with assessment of the proposal. Following discussions in your office on October 28, 1985 the alternative options for using Ellen Brook have been reviewed. Acknowledging the public opposition to the use of the existing masonary pipehead dam the lower site has been adopted as the source of supply for Gracetown.

Attached is a copy of the amended Notice of Intent and I would be pleased if you will advise whether the document will be suitable as a Public Environmental Report or the changes necessary to meet your Authority's requirements.

DIRECTOR, WATER RESOURCES

November 21, 1985 KT

1302R

ENVIRONMENTAL PROTECTION AUTHORITY
BP HOUSE,
1 MOUNT STREET, PERTH, WESTERN AUSTRALIA 6000
Telephone 322 2477

DIRECTOR
WATER RESOURCES
WATER AUTHORITY OF WA

Your Ref. A16104
Our Ref. 204/83

Attention : Mr B Coombs

GRACETOWN WATER SUPPLY - ENVIRONMENTAL ASSESSMENT

Thank you for your correspondence of November 21, enclosing copies of a revised Notice of Intent for the above project.

The Authority notes your concerns regarding delays to the project which would result from its deferal until regional planning initiatives had progressed to an advanced stage. It has accordingly determined that an environmental assessment of the proposal should proceed. You should note however, that this does not constitute approval for the project to proceed.

Provision of a water supply for Gracetown via the preferred option would result in development within a National Park, and has the potential to affect the historic precinct associated with the Ellensbrook Homestead and registered Aboriginal archaeological sites. As such, an opportunity for the public to comment on the proposal during the assessment process is desirable. The Authority believes that a Public Environmental Report (PER) would facilitate the appropriate level of assessment for this project.

The NoI presented to the Authority with your correspondence referred to above would be suitable for release as a PER, provided additional information is provided in relation to the following:

. The anticipated future rate of development in Gracetown, Margaret River, Prevelly Park Wallcliff Wilderness Estate and the area between Cowaramup and Gracetown, and the effect this will have on demand for reticulated water supplies;

. The biotic environment, expecially the flora, that would be affected by the development. This is particularly significant given that the area involved is part of a National Park;

.../2

- The reasons for the progressively declining minimum summer flows recorded in Ellen Brook over the last few years, (is this correlated with a period of dry years, or is some other factor, possibly a change in the catchment or in the aquifer feeding the springs involved);

- The estimated quantities of water that could be drawn from the aquifer within the Gracetown townsite to supplement supplies from Ellen Brook, and any restrictions on landuse in the aquifer catchment that may be required to protect this resource; and

- The comparative costs of the preferred option versus upgrading the Margaret River Storage, taking into account the implications of anticipated development in the region on demand for reticulated water, and the possible need to suppliment supplies from Ellen Brook with water from Margaret River in approximately 10 years time.

A brief description of the approval process should also be included in the background section of the PER.

Please liaise with Mr Whisson of the Department of Conservation and Environment should you have any queries in relation to the above and to co-ordinate release of the PER for public comment.

Yours sincerely

B A CARBON
CHAIRMAN

5 December 1985

Department of
CONSERVATION & LAND MANAGEMENT

Your Ref: PWWS 1068/71
Our Ref: NP 50/1 E JS:AMB

Managing Director
WESTERN AUSTRALIA WATER AUTHORITY

GRACETOWN WATER SUPPLY - ELLEN BROOK

I am aware that a Public Environmental Review is being prepared for the proposal to draw water from Ellen Brook for the Gracetown Water Supply and that notes were forwarded to the former National Parks Authority as part of a draft proposal.

Since that time the Department for Conservation and Land Management has been created as has a National Parks and Nature Conservation Authority. The responsibility for managing National Parks now comes under this Department which is advised by that Authority.

Subsequent to my appointment and following a visit to the Leeuwin Naturaliste National Park the proposals for drawing water from Ellen Brook were brought to my attention. There are a number of issues relating to the proposals that are of interest to me. In particular I am concerned that the option of drawing water further downstream rather than from the small masonry dam near the homestead may not be given adequate consideration.

I would therefore appreciate an opportunity for discussion of the draft of the Public Environmental Review.

CHRIS HAYNES
DIRECTOR OF NATIONAL PARKS

27 August, 1985

STATE OPERATIONS HEADQUARTERS 50 HAYMAN ROAD COMO, WESTERN AUSTRALIA
P.O. BOX 104 COMO 6152 PH: (09) 3676333

HEAD OFFICE HACKETT DRIVE CRAWLEY PH: (09) 386 8811
All correspondence to be addressed to Executive Director State Operations Headquarters.

DEPARTMENT OF LANDS AND SURVEYS
Cathedral Avenue,
Perth,
Western Australia 6000

Your Ref. PWWS 1068/71
Our Ref. 535/984 TT:BD
Telephone Enquiries 323 1277

UNDER SECRETARY FOR WORKS

GRACETOWN WATER SUPPLY

I refer to your memo of January 16, 1984 in which you enclosed the draft proposal for the provision of a reticulated water supply proposed for Gracetown.

It is acknowledged that it is important to provide 166 dwellings at Gracetown with a reticulated water supply and that limited funds will be available for the project.

However it is noted that the proposed pipeline route will traverse a distance of about 5 kilometres from the pipe-head dam, parallel to, and about one kilometre from the coast through Class "A" Reserve 22673 (Leeuwin - Naturaliste National Park) and vacant Crown land (Gracetown Townsite), to the service tank.

Being mindful of the area's status, this Department would like to be assured that there are no other suitable alternative routes that could be considered and for a more comprehensive environmental impact statement to be undertaken, than which has been provided.

B. L. O'Halloran
UNDER SECRETARY FOR LANDS

March 29, 1984

Shire of Augusta-Margaret River

COUNCIL OFFICE: TOWN VIEW TERRACE, MARGARET RIVER. 6285.

PLEASE ADDRESS ALL COMMUNICATIONS TO:— SHIRE CLERK,
P.O. BOX 61,
MARGARET RIVER, W.A. 6285

OUR REF.: TRG/ES/10083 KSP:BMT°
YOUR REF.:
INQUIRIES: Shire Clerk

TELEPHONES: 57 2244, 57 2092

The Under Secretary for Works,
Public Works Department,
Dumas House,
2 Havelock Street,
WEST PERTH 6005

Dear Sir, GRACETOWN WATER SUPPLY

In reply to your letter dated 16th January, 1984, of above reference, I wish to advise that Council, following consultation with the Gracetown Progress Association, wishes to support the draft proposal for the provision of a reticulated water supply at Gracetown, based on supply from the existing pipehead dam on Ellen Brook.

Council expresses its appreciation for the opportunity to comment on this proposal and trusts that funds will be available for the water supply as soon as possible.

Yours faithfully,

K.S. Preston
SHIRE CLERK

February 14, 1984

THE NATIONAL TRUST OF AUSTRALIA (W.A.)

Telephone:321 6088

The Old Perth Boys' School
139 St. George's Terrace
PERTH, W.A. 6000

Your Ref. PWWS 1068/71
Our Ref. MAF:mfn:10F

18 January, 1984

Under Secretary for Works
Public Works Department
Dumas House
2 Havelock Street
WEST PERTH 6005

Dear Sir,

RE: GRACETOWN WATER SUPPLY
PROPOSAL FOR SUPPLY FROM ELLEN BROOK 159

In reply to your letter of 4 January, 1984 and as discussed by phone with your Mr Bill Combs, the Trust has concern for the following issues:-

1. The visual environmental situation around and adjoining the Homestead and the valley of Ellen Brook is our prime concern. Consequently we would consider underground power and a carefully located entry road to the dam essential.

2. Your para. 4.4 Pipehead Dam

   Concern is raised about the term "normal operations" - line 8 of above paragraph. A dry stream downstream from the dam could be disastrous for the caring for, and presentation of the Homestead in the proposed recreated garden setting.

   Details of the dam and buttress construction cannot be commented upon until more details are available.

3. Your para. 4.5 Pumping Station

   The visual aspects of the pumps and motors and the chlorinator cannot be commented upon until their size and location can be shown on a detailed plan and indicated by pegs on site.

   It is believed that if the other environmental issues can be resolved, that a meeting on site with the Trust representatives included with National Parks Authority and others may help to resolve some of the detailed matters.

.../2

4. Your para. 4.9 Additional Environmental Aspects

The Trust would accept the advice of the Museum in relation to the rare snail, Austroassiminea letha and the assessment and care required in relation to the waterfall and cave known as Meekadaribee.

To enable the Trust to prepare an adequate response, we ask that you provide a detailed up to date topographic plan of the area which delineates clearly the relationship of the waterfall, cave, stream, dam, homestead and surrounding area, as well as the contours. This will be essential to select road entry and other data for the management plan.

Yours faithfully,

M A. Feilman.

RECEIVED
PUBLIC WORKS DEPT.
19 JAN 1984
RECORDS

MARGARET A. FEILMAN
CHAIRMAN OF COUNCIL

c.c. Mr C. Sanders
National Parks Authority

20 JAN 1984
BRANCH

W.R.
19.1.84.

Hold pending response from the organisations who did not send the summary of proposals.

23/1/84

2 35

THE NATIONAL TRUST OF AUSTRALIA (W.A.)

Telephone: 321 6088

The Old Perth Boys' School
139 St. George's Terrace
PERTH, W.A. 6000

CEW:jeg:1OF

24 May, 1985

Public Works Department
2 Havelock Street
WEST PERTH WA 6005

Attention : Mr Bill Coombs (Your Ref. EW:WS 1068/71)

Dear Mr Coombs

RE ELLENSBROOK - GRACETOWN WATER SUPPLY

Thank you for the opportunity of discussing proposals with you on site yesterday.

We will arrange for Mr S Chape of the Department of Conservation & Environment to discuss with you the overall Land Management Plan for the area.

As we are sure you will appreciate it, from discussions on site, there are very good reasons why we would prefer to see the dam located to the west of the Homestead. However, we will be making further enquiries and will write to you again once the National Trust Council has formalised a policy in respect of the matter.

Yours faithfully

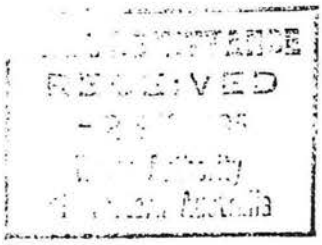
for R H CLEMENT
CHIEF EXECUTIVE OFFICER

THE NATIONAL TRUST OF AUSTRALIA (W.A.)

Telephone: 321 6088

The Old Perth Boys' School
139 St. George's Terrace
PERTH, W.A. 6000

CEW:jeg:10F



30 August, 1985

Water Authority of WA
629 Newcastle Street
LEEDERVILLE WA 6007

Dear Sir

RE ELLENSBROOK - WATER SUPPLY TO GRACETOWN

In a letter dated 4 January, 1984 the Public Works Department enclosed a report setting out a preferred option for the removal of water from the Ellen Brook, immediately above the homestead, to be piped to Gracetown.

At the time, the National Trust, the National Parks Authority (as it then was) and the Museum opposed the proposal for a variety of reasons. This letter is to set out the National Trust's position for your urgent consideration in view of recent press statements which suggest that planning for the supply is being brought forward for early consideration.

We would mention that a meeting was held with an officer of the P.W.D., on site, some two months ago in which the Trust's current position and a discussion of the various alternatives was carried out in some detail. However, to ensure that the matter is properly considered we would make the following comments:-

1. We understand that it is proposed that the existing dam, immediately above the house is to be deepened and scoured out - with any remedial works necessary being carried out to the masonry. Further, that a pump station including two submersible pumps, together with a chlorinator will be constructed on the north side of the dam. These will be located in concrete pipes and would have access from a newly constructed road. The road would be of sufficient width as to allow the turn around of large supply and equipment trucks.

2. We understand that power supplies will be from an overhead source.

3. Most importantly it is noted that water from Ellen Brook will be drawn out to suit the requirements of Gracetown. That is to say, at periods of highest draw off in the summer months will of necessity require the heaviest draw from the brook at a time when it is running at its lowest. Accordingly, one can anticipate that for a large part of the summer the brook will be virtually dry.

Trust's position

The Trust opposes the current proposal for the following reasons:-

1. It is currently receiving substantial State and Commonwealth funds for the restoration of the house for which we will demonstrate the existance and mode of living in an early homestead and its relationship to the immediate environment. Clearly, the axiom of this relationship is the running of the brook itself and its use by the early settlers in farming and dairying operations. Any proposal which would change this relationship is therefore contrary to all of the restoration principles which we are now implementing.

2. Further, the effect of allowing the brook to dry out will cause a significant drying out of the immediately adjoining areas on which the house itself stands. Therefore, one can anticipate that there will be serious structural implications for the fragile buildings by this change of events.

3. The location of the proposed plant and equipment - and the service road have serious implications in that they change the visual environment of the house and the brook and produce an obtrusive effect.

4. The National Trust, together with the Department of Conservation and Land Management is currently producing a management plan for the house and its environs to ensure that when the restoration work is completed visitors to the house will not be able to see car parks, amenity blocks and warden's houses from the existing homestead - and thus they will be able to enjoy the restored house in its appropriate environment. Clearly, the proposed works for the water supply will cause an adverse effect on the whole of this strategy.

Cost of Restoration

The National Trust itself is expending sums of in excess of $100,000 in the restoration of the house and the provision of an associated warden's accommodation. In addition, the Department of Conservation and Land Management will be spending substantial sums to provide a properly managed access to the property and its immediate area.

Alternative Proposals

In these circumstances, we recommend that the proposed draw off for the water supply be located downstream of the house at a place which was identified during our recent discussions with an officer of the PWD. It is approximately 80 meters upstream from the ocean and at this point it would cause substantially less environmental impact than the proposal currently being considered.

The effect of this alternative site would be to overcome all of the objections which have been raised by both the National Trust and other interested parties.

We understand that there will be an additional cost of perhaps $100,000, which includes the costs of the road and power supply which will be of considerable benefit for future management of the beach areas. In these circumstances we are sure that you will recognise the need for a re-assessment of the scheme in the light of our comments. Clearly, an arrangement which can be agreed between all parties at this stage will pre-empt the possibility of long term and unnecessary conflict. Whilst the National Trust would prefer that no water is taken from the brook, we recognise the needs of Gracetown and therefore the current alternative proposal is endorsed as a preferred option.

We would welcome the opportunity of meeting senior officers of the Department at any time to resolve this issue, and look forward to your early advices.

Yours faithfully

R H CLEMENT
CHIEF EXECUTIVE OFFICER

Date

Our reference

Your reference

Western Australian museum

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Maritime Museum
Cliff Street Fremantle
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February 10, 1984

The Under Secretary for Works,
Public Works Department,
Dumas House,
2 Havelock Street,
West Perth, 6005
W.A.

Dear Sir,

Gracetown Water Supply

Thank you for your letter of January 16 addressed to the Trustees, and for the enclosed draft proposal for the provision of a reticulated water supply to Gracetown.

It is considered by my staff that extremely important environmental, archaeological, historical and aesthetic considerations are involved in this proposal, which are only touched on in your draft proposal.

I understand that the Acting Registrar of the Aboriginal Sites Department has replied to you in a letter dated February 4 (Ref. 258/77) pointing out that there are a number of registered sites in the vicinity and that a survey would be required to ascertain the effects of the water supply proposal.

It has been brought to my notice that Federal funding under the Wage Pause Employment Scheme has been sought on behalf of the Country Water Supply for construction of a pumping station and associated works on Ellen Brook. It is also my advice that funding under the Scheme would be conditional upon favourable outcome of a comprehensive environmental impact assessment by the Department of Conservation and Environment. Your confirmation of this would be appreciated.

Yours faithfully,

P.F. BERRY,
Acting Director.

To Mr J. Stone, with the authors' compliments.

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Austroassiminea letha, gen. nov., sp. nov., a rare and endangered prosobranch snail from south-western Australia (Mollusca: Prosobranchia: Assimineidae)

by Alan Solem[1], Elizabeth-Louise Girardi[1], Shirley Slack-Smith[2] and George W. Kendrick[2]

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Manuscript received 21 July 1981: accepted 17 November 1981.

Abstract

A few isolated freshwater seepage areas between Turner Brook north of Augusta and Ellen Brook north of Margaret River in the south-west corner of Western Australia support populations of *Austroassiminea letha*, which is described as a new genus and species of the prosobranch family Assimineidae. Anatomical structures differentiate it from previously described assimineids and suggest strongly that it is a phylogenetic relict. Pleistocene fossils are known from several places on the coast, as far east as Point d'Entrecasteaux. Each of the three known living populations is small and in danger of destruction from agricultural or other human activity. Efforts are needed to preserve this important relict component of the Western Australian fauna.

Introduction

Subfossil specimens of a small "terrestrial" prosobranch were taken first at Cosy Corner by Barry R. Wilson in 1963. Subsequent collections by Anne Paterson (Brearley) from Turner Brook in 1971 and by Shirley Slack-Smith from Ellen Brook in 1975 have been supplemented by further collections in 1980 by Shirley Slack-Smith, George W. Kendrick and Mike Ellis. Materials adequate for description and tentative classification are now available.

Assimineids are common in South-east Asia and Indonesia through New Guinea and onto the Pacific Islands, but this is the first anatomically studied species for the family in Australia. A salt-marsh species from Tasmania and New South Wales, "*Assiminea*" *tasmanica* Tenison Woods, 1876, is placed correctly in the family Assimineidae; generic assignment must wait publication on its anatomy by Dr W. F. Ponder. The features of the new taxon, *Austroassiminea letha*, combine characteristics of the two generally recognized subfamilies of the Assimineidae, and no closely related extralimital genera could be identified. There is a long history of exotic organisms having been introduced to Australia. Therefore, considerable efforts were made to compare this species with extralimital taxa. The occurrence of *Austroassiminea letha* in presumed Pleistocene fossil soils from the south-western coast of Western Australia (Fig. 13) is additional strong evidence for it being an endemic faunal element.

The present study is a cooperative effort with different primary responsibilities: Alan Solem provided the systematic descriptions, comparisons, SEM analyses and photographs, and did much of the dissection work and supervision of the illustrations; Elizabeth-Louise Girardi worked extensively with illustrator Elizabeth Liebman and Alan Solem on the anatomical structures and interpretations; Shirley Slack-Smith is primarily responsible for the data on ecological occurrence and field collections; and George W. Kendrick did much of the fossil collecting and provided data on the geology and interpretation of the deposits.

All specimens used in this study are presently [illegible]ns of the Western Australian Museum (WAM) and the Field Museum of Natural History (FMNH).

Ecological occurrence

All collections of active individuals have been in actual seepage films or splash zones by small freshwater streams near the coast. Fissured rocks or talus through which the water can trickle are present. Aestivating and recently dead individuals have been taken on logs, leaves and rocks immediately adjacent to such areas. These findings probably represent wide-foraging individuals stranded by increasing dryness. The main reservoir of the populations would be inside the boulder fissures or talus, where either a minor flow of water or very high humidity would prevail even in mid-summer drought. The source of this water is runoff and percolation from areas lying further up the drainage basin of each stream. In all cases the water drains from areas of limestone and, in some, directly from the contact zone between the limestone and the underlying granitic rock. The Turner Brook site involves present or proposed agricultural areas that are subject to chemical spraying and/or fertilizer applications. The effects of such chemicals on amphibious snails are not known. They are highly unlikely to be beneficial, and probably are quite harmful. The limited extent and thus small size of this population does not provide a margin for experimentation as to such effects. The immediate steps necessary to minimize the possibility of extinction occurring would be to ban chemical applications on the few hectares immediately involved in seepage drainage through the known live snail area.

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Although the snails are clearly associated with freshwater seepage areas, the lack of any gill remnant, and the fact that they will at least temporarily seal to a log, leaf or rock, indicates that they are marginally terrestrial. All known live occurrences of *Austroassiminea letha* are well above tidal or ocean spray influence. These snails are best considered to be amphibious in the same sense as the North American *Pomatiopsis* (see Dundee 1957). The limited and spotty distribution of *Austroassiminea letha* is typical of such taxa, and also reflects the limited number of suitable habitat sites in south-western Western Australia.

Systematic review

The most recent reviews of the Assimineidae (Thiele 1927, 1929) provide a framework for generic reference. Abbott (1958) produced an excellent review of the Philippine members of the genus *Assiminea*, which gives entry to the widely scattered literature on this group. Known habitats range from mudflats through amphibious situations to dry upland forest areas. Habitat occurrence does not correlate with the admittedly form genera currently used. The most obvious anatomical features differentiating assimineids from members of the hydrobioid groups are their pectinate marginal tooth, relatively simple lateral teeth and general lack of basal denticles on the rachidian tooth of the radula. Unfortunately, few assimineids have been dissected in detail, so that only limited anatomical comparisons can be made with other genera.

Family Assimineidae

Genus *Austroassiminea* gen. nov.

Diagnosis: The simple snout without an accessory cape, absence of accessory basal plates for the lateral teeth, lack of basal denticles on the rachidian radular tooth, pectinate single marginal tooth, paucispiral operculum without posterior protrusions, retention of long tentacles, huge penis with bifurcate tip and internal vas deferens but no lateral protrusions, and simple female system combine aspects of the family-level units Assimineinae (= Syncerinae) and Omphalotropidinae as delineated by Abbott (1949, p. 262) and Tutuilanidae of Hubendick (1952). Most genera traditionally referred to these complexes are known from shell and operculum only. Radular cusps, shape of the verge, and external features of the head region have been recorded for a few taxa, but details of the internal anatomy equivalent to those presented here are not recorded in the literature. The form genera *Assiminea* Fleming 1828, *Paludinella* Pfeiffer 1841 and *Omphalotropis* Pfeiffer 1851, with which *Austroassiminea letha* might be associated, differ in most of the above characters (see Abbott 1949, 1958).

Description: Foot not divided, a prominent lateral groove extending from mantle cavity to head. Tentacles long, with raised eyespots lateral to base. Snout of moderate length, no cape or shield present, terminating in two lips reaching slightly beyond mouth, which is a vertical slit. Operculum paucispiral, corneous, nucleus acentric, no trace of calcareous deposits. Radula taenioglossate. Rachidian tooth without basal denticles; normally 7 denticles on upper edge, central largest. Laterals multicuspid; inner with greater variation in denticle size, weak protrusions on inner side of base which is shovel-shaped. No accessory basal plates. Outer lateral with flatter, tapering base, sharply recurved denticles. Marginal tooth fan-shaped, pectinate, with minute recurved denticles. Male with enormous verge having a bifurcated tip and internal vas deferens. An unusual release valve from the vas deferens enters the hindgut. Suprapallial structures of male system relatively simple. Female with small spermatheca, seminal receptacle a kinked area in upper oviduct; pallial oviduct large, U-shaped, with vaginal orifice near anus.

Type species: Austroassiminea letha n. sp.

Remarks: Intertidal, supratidal, freshwater and terrestrial species of similar conchological mien from most continents have been referred to the Assimineidae and to the form genera *Assiminea* Fleming 1828, and *Paludinella* Pfeiffer 1841. Recorded data on these species consist mostly of shell and opercular features that are notoriously subject to convergent simplicity. Occasional outlines of radular denticles and the upper parts of the basal plates, or of the extended head and foot, plus an outline of the cephalic verge complete most available data. Abbott (1958) monographed the Philippine Islands *Assiminea*, greatly extending our knowledge of structure, although he was (p. 224) "...unable to satisfactorily work out the female genital system." In an earlier paper, Abbott (1949) described several new assimineids from the Mariana Islands and provided expanded definitions of the subfamilies Assimineinae (under the name Syncerinae) and Omphalotropidinae, even hinting that they might be separate families. Turner and Clench (1972) recorded some data on *Omphalotropis nebulosa* Pease 1872 and *Pseudocyclotus levis* (Pfeiffer 1855) from the Solomon Islands.

The level of recorded knowledge for extralimital taxa is thus meagre, which makes meaningful comparisons difficult. Since *Austroassiminea* agrees with the Assimineinae in snout and operculum, but with the Omphalotropidinae in length of eye stalk and pectinate marginal tooth on the radula, doubt is cast on the reality of current suprageneric categories in the Assimineidae. We choose to ignore the subfamily and tribal names of Thiele (1927, 1929), since they appear to be artificial pigeonholes based on inadequate evidence, and classify *Austroassiminea* only to family level. It is quite possible that monographic revisions will split the family or attach sections to other family units. Consideration of such changes is well beyond the scope of this study.

Data on the anatomy of some Pacific island taxa are given by Abbott (1949, 1958). Quick surveys of Melanesian and Polynesian assimineids in the alcohol collections at Field Museum of Natural History showed a pattern of these species having both a proboscid cape and a deep posterior slit on the foot, characters that Abbott (1949, 262) used as subfamily features for the Omphalotropidinae. Both of these features are absent from *Austroassiminea letha* (see Fig. 12). While some of the Pacific island taxa have similar-appearing shells, the above differences in external anatomy alone are sufficient to exclude congeneric classification of *Austroassiminea* with any of the genera based on Pacific island taxa that Abbott (1949) included in the Omphalotropidinae (*Omphalotropis* Pfeiffer 1841, *Paludinella* Pfeiffer 1841, *Electrina* Gray 1850, *Quadrasiella*

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Moellendorff 1894, *Garrettia* Paetel 1873, *Allepithema* Tomlin 1931, *Thaanumella* Clench 1946, or *Wrayanna* Clench 1948). The pectinate marginal teeth of the radula in *Austroassiminea* are a major difference from the situation in *Assiminea* Fleming 1828, *Acmella* Blandford 1869, *Turbacmella* Thiele 1927, and *Conacmella* Thiele 1927, taxa that although lacking the proboscid cape and posterior foot slit, have much shorter eye-stalks and non-pectinate marginal teeth on the radula.

It is quite possible that these characters considered by Abbott (1949, 1958) as indicative of suprageneric categories will be shown to be less important when the family is revised, but such a revision cannot be undertaken at this time.

The combination of features listed for *Austroassiminea* in the diagnosis is very different from the combinations recorded for any of the above genera. This, combined with the extreme geographic isolation of *Austroassiminea* from potential relatives (see diagnosis of the species for comparisons), makes description of a new genus necessary.

The name *Austroassiminea* refers to both its geographic position and taxonomic relationship to the assimineid complex.

Austroassiminea letha sp. nov.

(Figs. 1-12)

Type locality: Cosy Corner, Hamelin Bay, near Augusta, Western Australia, ca. 34° 15′ 05″ S, 115° 01′ E, under tussocks of grass on granite cliffs near coast wet by seepage from limestone-granitic rock contact above.

Holotype: WAM 71.80, adult shell, probably a female. Collected by Anne Paterson (Brearley), 8 July 1971.

Paratopotypes: WAM 778.66, WAM 472.80, WAM 477.80, WAM 478.80, WAM 479.80, WAM 699.80, FMNH 200985, FMNH 200986.

Paratypes: Deepdene Cliffs, near Augusta, from seepage area, moss and *Agonis* leaf litter, foot of cliffs, ca. 34° 15′ 09″ S. 115° 03′ E, WAM 476.80, FMNH 200987; Deepdene Cave area near Lakes Rat Hole, Cave 3, 0-0.1 m, WAM 1175.69, subfossil; Turner Brook near Deepdene Cliffs, ca. 34° 15′ 09″ S, 115° 03′ E, WAM 475.70, WAM 694.80, FMNH 200989; entrance to Meekadorabbie Cave, Ellen Brook, 33° 54′ 36″ S, 114° 59′ 40″ E, Leeuwin-Naturaliste National Park, WAM 693.80, WAM 695.80, WAM 696.80; upstream from Ellensbrook homestead, under logs, 2-3 m above water level, WAM 700.80, WAM 701.80; below dam on Ellen Brook, WAM 697.80, WAM 698.80, FMNH 200988; Ellen Brook, ca. 33° 54′ 10″ S, 114° 59′ 30″ E, WAM 473.80; Sta. WA.284, banks of Ellen Brook, east of homestead, FMNH 200598. Fossil at: on the coast west of Strongs Cave, south end of North Point, 34° 09′ 41″ S, 115° 01′ 23″ E, WAM 68.385, WAM 81.19, FMNH 198759; Donnelly River mouth, ca. 0.5 m (0.8 km) south-east of the river mouth, ca. 34° 29′ 24″ S, 115° 40′ 38″ E, WAM 70.2691, WAM 70.2692; ca. 0.5 m (0.8 km) north of Windy Harbour townsite, quarry on south side of track to Salmon Beach, 34° 49′ 14″ S, 116° 00′ 52″ E, WAM 70.895, WAM 70.897, WAM 70.898.

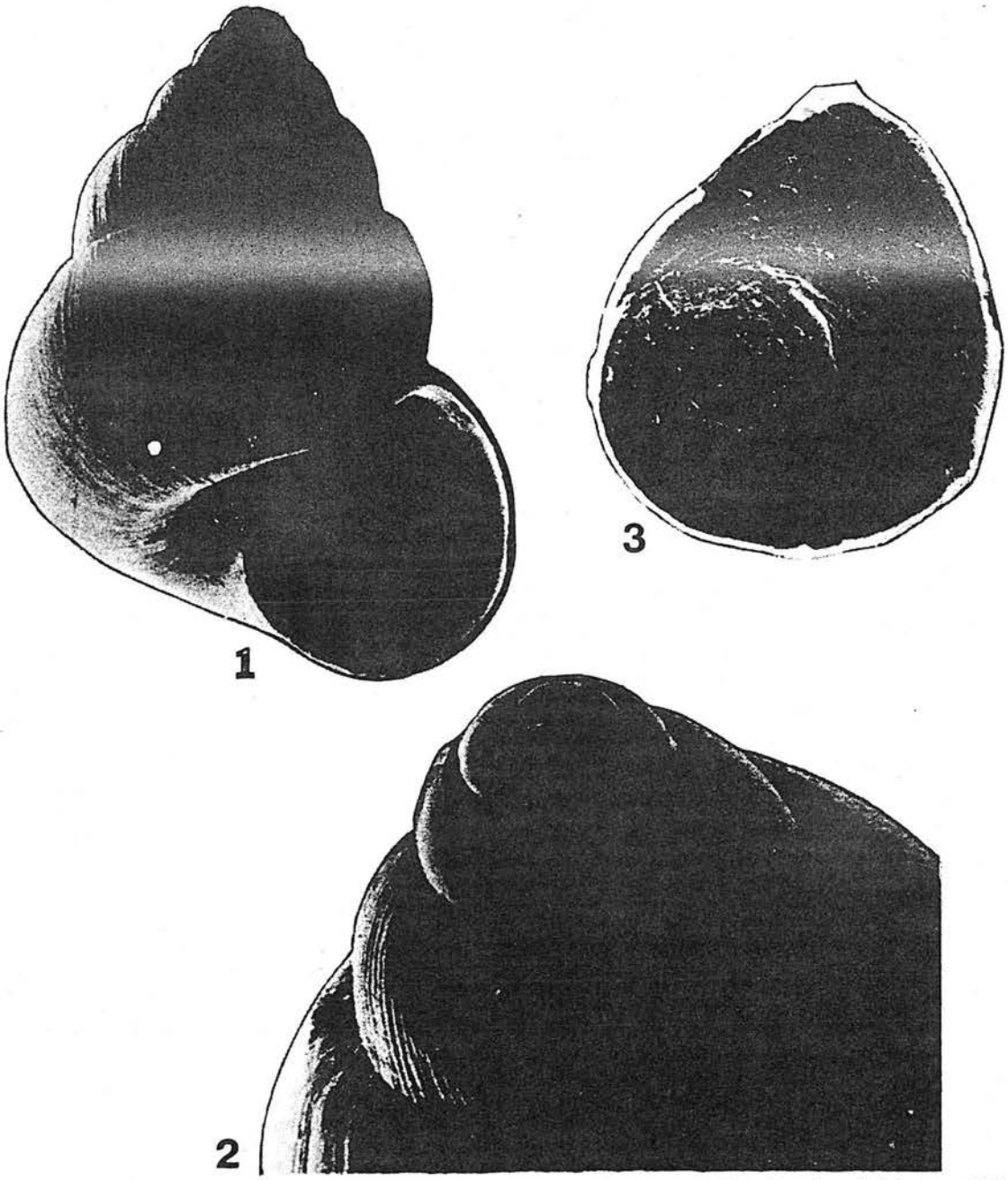
Diagnosis: The combination of smooth apex, moderate radial ribbing on the upper spire, frequent presence of peripheral spiral cords and weak spiral cords on the shell base, relatively open umbilicus of the shell; paucispiral corneous operculum without posterior projections; absence of basal denticles on the central tooth of the radula, comblike marginal tooth with clear slits; extremely large bifurcated penis without lateral protrusions, small spermatheca, and long tentacles effectively differentiate *Austroassiminea letha* from geographically nearby taxa. *Hydrococcus graniformis* Thiele (1928, p. 374-5, 380, pl. 8, figs 10, a), described from the Swan River, Western Australia, has a multispiral operculum with central nucleus and posterior projection; a hydrobiid, rather than an assimineid radula; and a globose, rather than elongated, shell. *"Assiminea" tasmanica* Tenison Woods 1876, reported from Tasmania north to Queensland (Hedley 1906, p. 527-8, Figs 27-30; Iredale and McMichael 1962, p. 43), and also southwestern Australia (*teste* Ponder), has a generally banded shell without radial ribs, a nearly closed umbilicus, more acentric paucispiral operculum with posterior projection, and quite different lateral teeth on the radula. The New Zealand species, *"Assiminea" vulgaris* (Webster 1905) and *Suterilla neozelanica* (Murdoch 1899), as summarized by Powell (1933), obviously differ in radula, nearly closed umbilicus, lack of shell sculpture and in basic habitat. Both are marine or strand line in association.

The long tentacles, lack of any lateral protrusions on the male verge, absence of basal denticles on the radular central tooth, open umbilicus, radial ribbing on the spire and freshwater habitat, effectively eliminate the possibility that *Austroassiminea letha* might be based upon introduced examples of the British *Assiminea grayana* Fleming 1828.

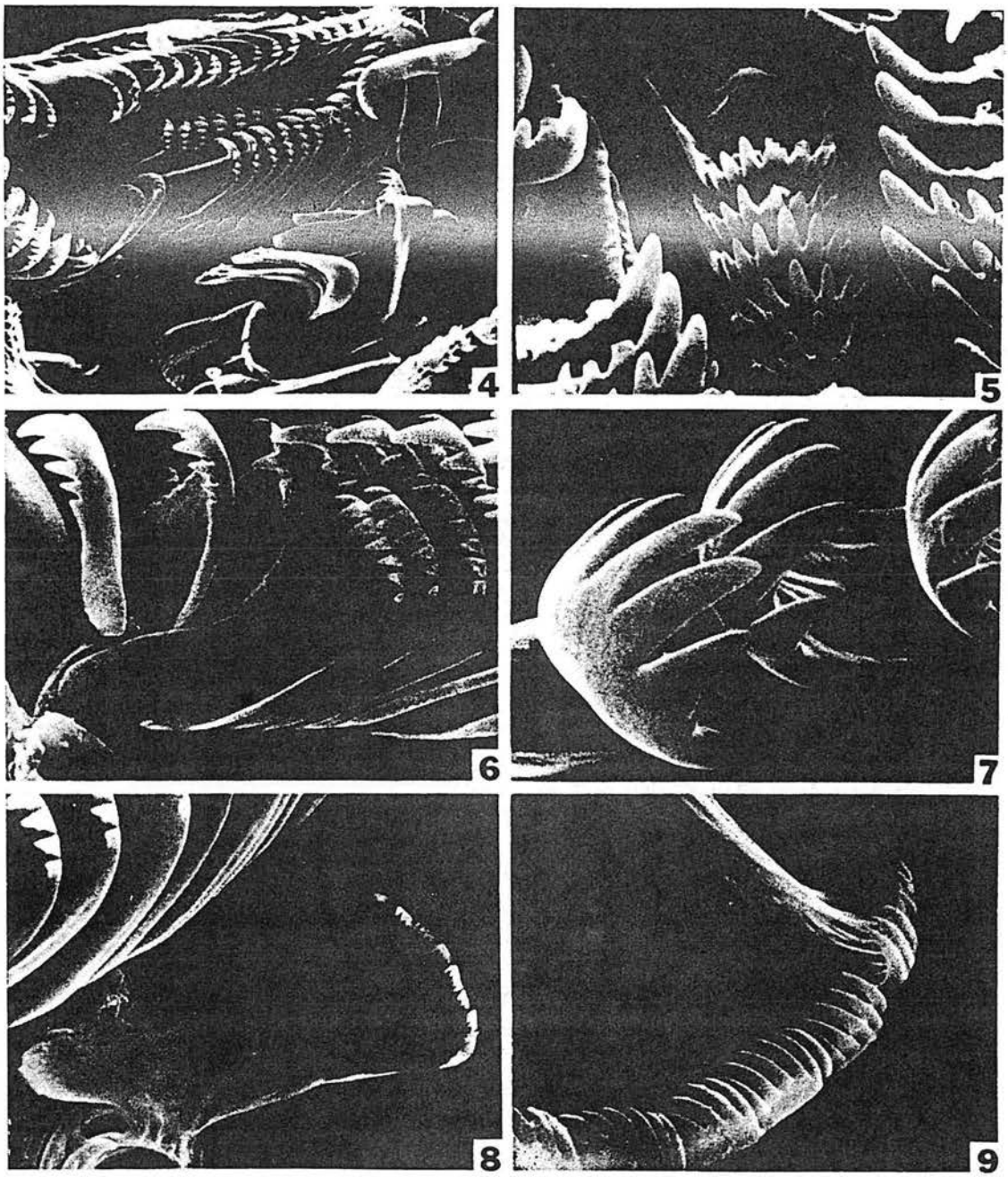
Description: Shell variable in shape, from squat ovate-conic to elongate-conic, spire angle generally uniform, H/D ratio 1.23-1.55 (mean 1.38). Males often smaller and squatter than females. Shell height 3.45-5.39 mm (mean 4.50 mm), diameter 2.60-3.78 mm (mean 3.26 mm). Apex (Fig. 2) smooth, upper spire with fine radial ribs that become irregular to absent on lower spire and body whorl (Fig. 1). Whorls 4 7/8– to 6 1/8– (mean 5 1/2–). Sutures well impressed, whorls evenly rounded, a weak (Fig. 1) to prominent spiral keel visible on periphery of penultimate and body whorls, sometimes weak spiral cords on shell base. Umbilicus narrowly open, without carina or keel. Lip of adults expanded, noticeably thickened on columellar and parietal walls (Fig. 1). Based on 227 adult specimens.

Operculum (Fig. 3) corneous, paucispiral, nucleus slightly acentric, without calcareous granules or posterior projections. Head of animal (Fig. 12) without unusual features. Eyespots (EY) lateral to base of tentacles (TE). Snout (SN) relatively short, ending in two expanded superior lobes (L) that extend in front of mouth (M). Edge of snout marked by a groove (BG) from mantle cavity. Foot (F) undivided, truncated in front, tapering posteriorly. Operculum (OP) mounted on a raised flap.

Radula taenioglossate, 7 teeth per row. Rachidian tooth Figs 4, 5) normally with 7 cusps, median cusp slightly enlarged, sides of tooth with weak bumps, but no developed denticles. Centre base of rachidian



Figures 1-3.—*Austroassiminea letha* sp. nov. 1—side view of Holotype WAM 71.80, x20.9. 2—spire of holotype, x54.3. 3—operculum of paratype, WAM 472.80, x42.2.



Figures 4-9.—*Austroassiminea letha* sp. nov. Radula of paratype WAM 472.80. 4—partially fragmented radula, x400. 5—central teeth, x1,335. 6—lateral teeth, x1,110. 7—side view of outer laterals, x4,000. 8—single marginal tooth, x1,270. 9—edge of comb marginal, x3,960.

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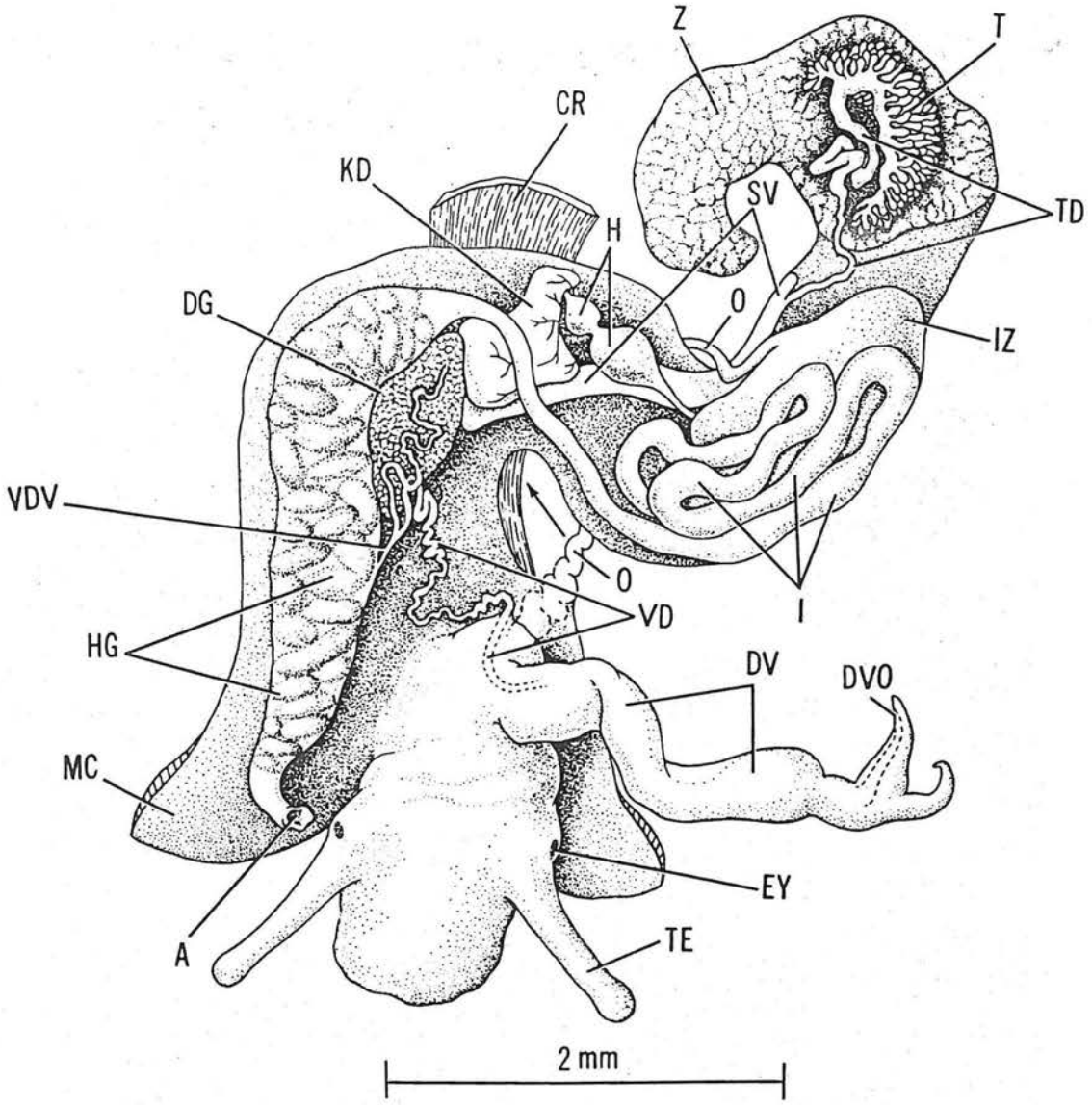

Figure 10.—*Austroassiminea letha* sp. nov. Paratype WAM 472.80. Gross anatomy of male. Arrow indicates apex of mantle cavity. Drawing by Elizabeth Liebman. See Table 1 for explanation of labels.

slightly protruded, but without denticles. Inner laterals (Figs 4-6) with concave, shovel-shaped base; inner side of tooth with a row of low protrusions (Fig. 5, left), denticles asymmetrical with largest 2nd from inner side, gradually reduced in prominence outward, normally totalling six. Outer laterals (Figs 6-7) with base less concave, clearly tapered; sides of tooth without bumps or accessory denticles; upper margin sharply recurved (Fig. 7) and bearing normally seven denticles that are less differentiated in size than those of the inner laterals. No accessory basal plates on either lateral tooth. Marginal (Figs 8-9) broad, relatively flat, base tapering as in outer lateral; edge split 7-8 times and thus pectinate, each pectination edge with sharply recurved, minute denticles, 4-7 in number.

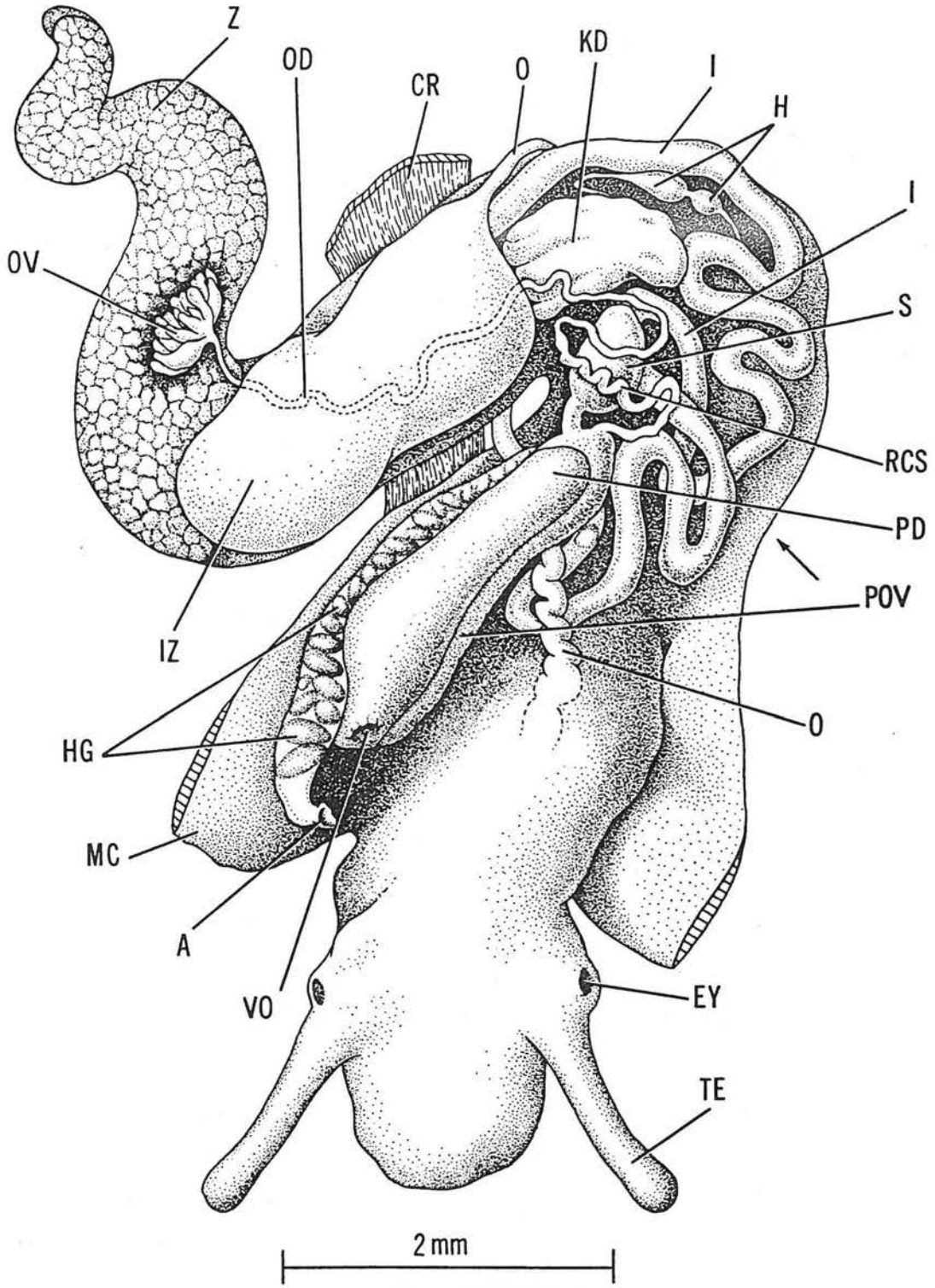

Figure 11.—*Austroassiminea letha* sp. nov. Paratype WAM 472.80. Gross anatomy of female. Arrow indicates apex of mantle cavity. Drawing by Elizabeth Liebman. See Table 1 for explanation of labels.

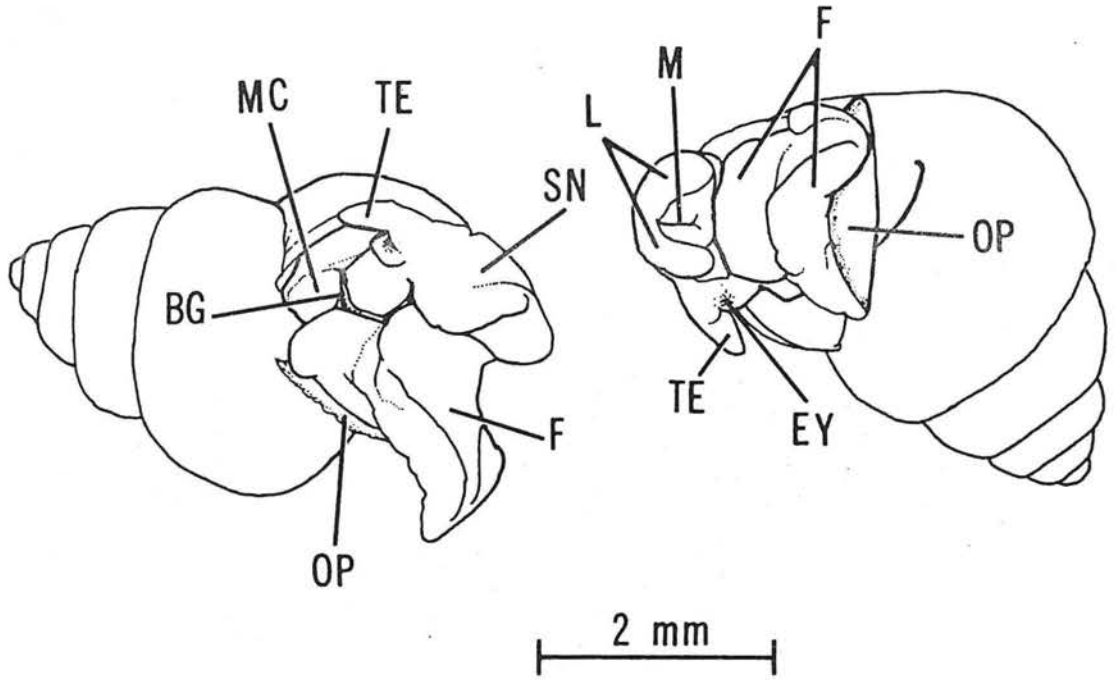

Figure 12.—*Austroassiminea letha* sp. nov. Paratype WAM 694.80. Head and foot of preserved animal. Drawing by Linnea Lahlum. See Table 1 for explanation of labels.

Table 1

Explanation of anatomical labels

A	anus	OD	oviduct
BG	back groove	OP	operculum
CR	columellar retractor muscle	OV	ovary
DG	prostate gland	PD	dorsal lobe of oviduct
DV	verge	POV	ventral lobe of oviduct
DVO	external pore of verge	RCS	seminal receptacle
EY	eye spot	S	spermatheca
F	foot	SN	snout
H	heart	SV	seminal vesicle
HG	hindgut	T	testis
I	intestine	TD	testis duct
IZ	stomach	TE	tentacle
KD	kidney	VD	vas deferens
L	snout lobes	VDV	escape valve of vas deferens
M	mouth	VO	vaginal orifice
MC	mantle collar	Z	digestive gland
O	oesophagus		

Oesophagus (O) entering stomach medially in male (Fig. 10), anteriorly in female (Fig. 11). Looping of intestine (I) also differing, aligned with stomach (IZ) in male (Fig. 10), linearly anterior to enlarged stomach in female (Fig. 11). Hindgut (HG) normally filled with faecal pellets, opening near anterior margin of mantle collar (MC) through a raised anal pore (A) (Figs 10, 11). Digestive gland (Z) distinctly larger in female (Fig. 11) than male (Fig. 10). Details of heart (H) and kidney (KD) not worked out.

Nervous system not studied because of limited material.

Male genitalia (Fig. 10) simple. Testis (T) with branched tubules along an apically running collecting duct, buried in base of digestive gland. Testis duct (TD) kinked apically, wider at first, narrowing after leaving digestive gland, entering seminal vesicle (SV) subapically. Seminal vesicle (SV) a narrow strip of tissue attached loosely to body wall, running just below kidney to enter prostate (DG), which is a mass of acinar tissue lying at apex of pallial cavity next to hindgut (HG). Collecting tubule of prostate zig-zags anteriorly, emerging as vas deferens (VD) at anterior margin of prostate. Branching of vas deferens occurs almost immediately. A slender "escape valve" (VDV) continues anteriorly to enter hindgut and the posteriorly directed main branch of the tube leads to the verge (DV) after complex coiling. Verge massive, located on back of neck, tip bifurcated with opening of vas deferens (DVO) through larger arm of bifurcation. Shaft of verge without bumps or other structures, exact internal passage of vas deferens through verge not determined.

Female genitalia (Fig. 11) simple. Ovary (OV) a single clump of large acini near base of digestive gland (Z). Oviduct relatively narrow and uncoiled down to level of seminal receptacle (RCS), which appears as an area of tight kinking in the oviducal tube. After one major curve, this enters apically into the pallial oviduct (PVO). Latter U-shaped, with a dorsal (PD) and ventral (POV) lobe. Vaginal orifice (VO) slightly posterior to anus (A). Spermatheca small, globose, on short duct.

The holotype, probably an adult female, is 5.00 mm in height, 3.59 mm in diameter, H/D ratio 1.39, with 5 1/2 whorls. Although collected alive, it had dried out subsequently.

Remarks: The name *letha* comes from the Greek *lethos*, referring to forgetting or escaping notice, an appropriate name for this rare and well-hidden species.

The dissected material from Cosy Corner (WAM 472.80) provided the impression that male shells were smaller and slightly squatter than females. This could not be documented by measurements as parts of the shells had been chipped away prior to study by Solem and thus could not be measured. The other live-collected and well-preserved set from Turner Brook (WAM 694.80) had most specimens retracted sufficiently that they could not be sexed without damaging or destroying the shell. Dried out materials from Cosy Corner and Deepdene could not be sexed. Thus, comparative measurements (Table 2) are based on lumped samples. Data is recorded only as mean and range for each area. The actual sex ratios and size differences are unknown.

Adult specimens were defined as those with both thickening of the basal lip and a beginning of irregular, gerontic growth visible behind the palatal lip. This gerontic growth may continue for more than an eighth of a whorl and in the very old and large specimens from Cosy Corner, the inside of the aperture has a substantial callus built up on all walls. All measurements were made with an ocular micrometer at x16, height and diameter accurate to within 2%, and whorls to within 1/8th accuracy. Differences among the samples are summarized in Table 2.

Specimens from Turner Brook below Deepdene Cliffs (WAM 694.80), collected 3 July 1980, are smallest in size and slightly lower in whorl count. They show the shortest area of gerontic growth and may well represent younger examples, rather than indicating a smaller "adult" size for that population. Specimens collected live, but aestivating, and freshly dead in September, October and November from Deepdene Cliffs (WAM 476.80), Ellen Brook (WAM 697.80, WAM 698.80), and Meekadorabbie Cave, Ellen Brook (WAM 696.80) are distinctly larger in size and with noticeably greater thickening to the shell lip. The differences among these populations are not significant. The Cosy Corner samples, nearly all collected dead and many in bleached condition, are large (Table 2) and many show much greater thickening of the shell lip and noticeably longer gerontic growth. We cannot say if this population actually is larger, or if biased samples of mainly gerontic individuals have been taken.

Living specimens of *Austroassiminea letha* are known from three localities just north of Augusta. They are Turner Brook near Deepdene Cliffs, Cosy Corner, and Ellen Brook just north of the Margaret River. At Turner Brook they have been found in seepage areas at the base of limestone cliffs, or in litter near the creek banks in an area located only a few hundred metres from the creek mouth. Near the base of Deepdene Cliffs they were on rocks splashed by a miniature waterfall and on the ground above, a seepage area draining from the high limestone on the southern side of Turner Brook. At Cosy Corner they have been taken in grass tussocks on granite cliffs wet by seepage from the limestone-granitic rock contact above and located less than 200 metres from the beach. Dead shells are common in what we presume to be Holocene deposits, but live material has been found in an area of only a few square metres. **At Ellen Brook**, live material was taken in algae growing **on the sides of concrete and wooden troughs carrying flowing water from Ellen Brook to the Ellensbrook homestead.** The snails were in algal growth above the water line in the troughs. This site was several hundred metres from the stream mouth and significantly more elevated than the small sandy delta of Ellen Brook. Additional field work along Ellen Brook in September and October 1980 found specimens alive or freshly dead adjacent to the dam at Ellensbrook homestead and on moss and algal covered limestone forming the sides of the waterfall at the entrance to Meekadorabbie Cave and the banks of the brook above it. Specimens on soil, leaves and twigs were aestivating or recently dead. All of these localities, although near the ocean, are well above storm water marks and are not subject to sea water inundation.

Table 2

Size and shape variation in *Austroassiminea letha*

Locality	No. of adults measured	Mean (and range)			
		Shell Height (mm)	Shell Diameter (mm)	H/D ratio	Whorls
Turner Brook, below Deepdene Cliffs	20	3·94 (3·48–4·67)	2·91 (2·60–3·39)	1·35 (1·23–1·47)	5½– (4¾–5½+)
Deepdene Cliffs	25	4·39 (4·01–5·33)	3·20 (2·96–3·68)	1·39 (1·31–1·55)	5¾– (5–5¾)
Cosy Corner	120	4·76 (4·08–5·39)	3·42 (2·99–3·78)	1·39 (1·29–1·49)	5¾– (5¼–6¼–)
Ellen Brook	31	4·24 (3·45–5·16)	3·12 (2·70–3·52)	1·36 (1·27–1·47)	5¾– (5+–5¾)
Meekadorabbie Cave, Ellen Brook	31	4·14 (3·49–4·97)	3·08 (2·63–3·62)	1·34 (1·23–1·48)	5¾– (5–5¾)

Several visits to the Deepdene and Cosy Corner sites since 1963 demonstrate that the populations persist within very small areas. Extensive searches in similar-appearing habitats along the Deepdene Cliffs and near Cosy Corner have failed to reveal additional populations. At both Cosy Corner and Deepdene, ground areas remain moist even during the middle of summer, and live snails have the option of retreating into deeply fissured rocks back to the retracted water trickle that eventually forms the basal ground soak. All localities would be subject to heavy morning dews, another dependable source of water in this area of coast. Living specimens have been taken only at times when flowing water was in the seepage zones, but this may only be indicative of an extended foraging zone bringing them out into areas accessible to prying fingers of scientists. While water associated, they are in damp terrestrial habitats that are close to the water margin.

Because of the very limited populations observed, collections have been restricted mainly to samples of dead shells. Some early collections were dried and the anatomical data recorded here are based upon material from Cosy Corner (WAM 472.80) collected 22 June 1980 specifically for this review.

Fossil records

Evidence that *A. letha* is an endemic relict comes from three fossil occurrences on the lower southwest coast of Western Australia. On the southern side of North Point (34° 09′ 41″ S, 115° 01′ 23″ E), a 25 m sea cliff of Tamala Limestone (Playford *et al.* 1976) rises on a basement of Precambrian gneiss. It shows a sequence of four prominent, brown fossil soils, separated by units of paler aeolian calcarenite. A thin gneiss-calcrete conglomerate underlies the lowest fossil soil and is itself underlain at about HWM by a poorly exposed, marine shelly limestone; the limestone-gneiss contact is partly obscured by an apron of fallen boulders.

The lowest fossil soil, up to 2.3 m thick, lies in the splash zone and is being eroded vigorously. It is a brown, friable clayey to silty calcarenite, without obvious bedding structure and with thin bands of calcareous cementation; rhizoconcretions occur near the top and in the lower part occur pebbles and cobbles of near-black calcrete. This fossil soil contains a sparse land snail assemblage of four species—*Austroassiminea letha, Bothriembryon* sp. and a species each of the Charopidae and Punctidae. Of the first mentioned, 15 specimens (WAM 68.385, WAM 81.19, FMNH 198759) have been collected, of which the largest has a height of 4.84 mm. This species has been found only in the lowest fossil soil and mainly within 0.6 m of its base. Numerous shells of other land snails, notably *Bothriembryon* sp., occur in the overlying fossil soils.

The section at North Point, including the basal marine unit, resembles others from the Cape Leeuwin-Cape Naturaliste coast described by Fairbridge and Teichert (1953) and Fairbridge (1953). The marine units were noted by Lowry (1967) and assigned a late Pleistocene age. All snails from the North Point fossil soils represent living species, which is consistent with a relatively "late" Pleistocene age. The presence of *Austroassiminea letha* only in the lowest fossil soil indicates that the species last inhabited the site during the accumulation of that unit. By analogy with modern occurrences of the present species, it seems likely that the site incorporated a freshwater discharge at the gneiss-limestone contact, which became buried beneath mobile aeolian sands early in the regression following the "Last Interglacial" of the Late Pleistocene. Other land snails were able to maintain populations on the sandy terrains that resulted from this episode of dune building, but not *Austroassiminea letha*, which became extinct locally. With the return of sea level to its modern position about 6000 years ago (Mörner 1976), wave erosion established the fresh cliff section visible today.

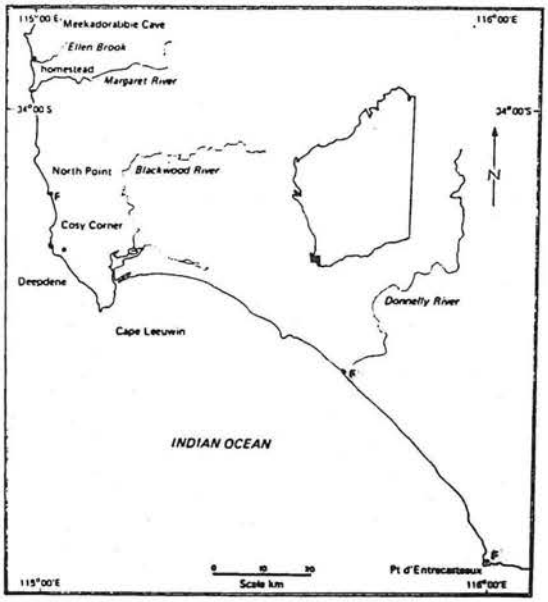

Figure 13.—Part of southwestern Australia with localities of *Austroassiminea letha* sp. nov. shown by •. F denotes fossil locality.

A calcareous, sandy fossil soil, reported to lie at about 2.5 m above sea level is exposed within a coastal cliff of aeolian calcarenite behind a sandy beach about 0.8 km SE from the mouth of the Donnelly River (34° 29′ 24″ S, 115° 40′ 38″ E). Five shells of *Austroassiminea letha* (WAM 70.2691, 70.2692) were collected from this deposit, the height of the largest being 5.07 mm. Other land snails present included species of *Succinea, Bothriembryon*, Charopidae and Punctidae. All of these species appear to be extant and a Late Pleistocene age is probable. We have not examined this isolated locality and are unable to comment on the presence or otherwise of any freshwater discharge, past or present, at the site.

The elevated limestone headland of Pt d'Entrecasteaux (35° 50′ 32″ S, 115° 59′ 40″ E) features several exposures of lithified fossil soils with land snail shells (Kendrick 1978). The assemblage includes species of Charopidae and Punctidae, two extinct species of *Bothriembryon* and *Austroassiminea letha* (WAM 70.895, 70.897, 70.898), height of the largest 4.47 mm. These fossil soils are

probably of Pleistocene age and their snail assemblage suggested to Kendrick (1978) "a humid, well-vegetated, probably forested environment . . ., in contrast to the exposed coastal heath that presently characterizes the area". The deposits lie about 100 m above sea level and overlie a substantial thickness of porous, sandy limestone. They are dispersed over several square kilometres of open terrain, with no evidence of concentrated freshwater discharge or seepage, such as those associated with modern populations of *A. letha*. This association of *Austroassiminea letha* with forest litter snails is puzzling. We are not agreed as to whether *A. letha* was either dispersed more or less generally on the leaf litter of a forest floor, under conditions of higher and more sustained levels of humidity than now prevail in the area (Kendrick), or washed in from nearby localities featuring its current habitat (Solem). Of the three fossil localities reported here, only Pt d'Entrecasteaux contains extinct species and we conclude from this that it is the oldest geologically. A more precise dating of this deposit within the Pleistocene is not possible at present. We suggest that the Pt d'Entrecasteaux records of *A. letha* antedate, wholly or in part, the events which led to the severe fragmentation of the species' modern range.

Conclusions

The recent and fossil distribution data indicate that *Austroassiminea letha* had a more extensive range in the geologically recent past. **Three of the six known occurrences are fossil only and indicate a high rate of local extinction by natural processes. It is now relatively abundant at each of three localities in areas of only a few square metres. Human activities could easily extinguish each extant colony. We thus consider it to be both a rare and endangered species.**

The absence of any other amphibious or terrestrial assimineid from Australia is remarkable in view of the wide distribution that terrestrial members of the family have from South-east Asia into Polynesia. We can offer no reasons for the lack of representation in northern and eastern areas of the continent. The presence of a species in the south-western tip of Australia suggests that it is a Gondwanic relict. The fact that the anatomical features of this species combine aspects of both recognized subfamilies of the Assimineidae, may have major phylogenetic implications. If the characters used by Abbott (1949) to delineate subfamily units are significant, the combination in *Austroassiminea letha* of features from both subfamilies may indicate that it is close to the ancestral condition, a phylogenetic relict as well as geographic. It is also possible that the selection of subfamilial characters is in error, but until modern revisions of the Indonesian to Polynesian taxa are available, this question cannot be settled.

Regardless of its exact phylogenetic position, *Austroassiminea letha* represents a significant addition to the fauna of Western Australia, and is a species reduced to remnant populations that can be wiped out by man unless they are afforded protection from environmental pollution and habitat destruction.

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A 13104

Western Australian museum

Francis Street Perth
Western Australia 6000
Telephone (09) 328 4411

Date: 27 June 1985

Your Ref:

Our Ref: 258/77

Metropolitan Water Authority
629 Newcastle Street
LEEDERVILLE WA 6007

Att: Mr A. Parker

PROPOSED ELLEN BROOK - GRACETOWN PIPELINE

I understand from Mr Dortch, Curator of Archaeology, Western Australian Museum, that your Authority plans to construct a water pipeline from Ellen Brook homestead to Gracetown.

According to Mr Dortch's report the pipeline, as currently proposed, is likely to disturb two Aboriginal sites known to date and may affect others which may exist in the area.

We recommend that the relocation of the pump unit, dam and the first 100 metres of the pipeline from Ellen Brook be considered by your Authority to prevent the disturbance of site S0242. The section of the route which has not been investigated by Mr Dortch should be examined and if any sites are found, the route should be modified if possible.

If the relocation is likely to be difficult we would be most happy to discuss the matter with you to reach a mutually satisfactory solution.

Thank you for your co-operation.

Vera Novak

V. NOVAK
Assistant to Registrar
Department of Aboriginal Sites

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Museum
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258/77

REPORT

TO : Registrar of Aboriginal Sites

FROM : Curator of Archaeology

RE : A PROPOSED PWD WATER PIPELINE AFFECTING SITE S0242 AND POSSIBLY OTHER SITES

For some time the PWD has been planning to construct a water pipeline from Ellen Brook homestead to Gracetown, at Cowaramup Bay (see sketch). Various interest groups and informed individuals believe that the proposed pipeline and attendant facilities would adversely affect or even destroy several features of aesthetic, cultural or environmental significance. This report briefly notes how the proposed pipeline affects site S0242(the Ellen Brook dune site: Bindon and Dortch 1982), and possibly other Aboriginal sites along its route.

The surveyed route of the pipeline extends northward from the existing small dam on Ellen Brook, some 60 m east of the homestead. The first 100 m of the route crosses the Western part of site S0242. After that the pipeline route turns east along the larger track giving access to Caves Road, and then runs cross country to Gracetown, some 4 km to the north. Note that the pipeline will be buried some 30-40 cm below the surface, and that an improved access road will run alongside it.

On 11 June I went to Ellen Brook and there met two PWD engineers and Shirley Slack-Smith, who is concerned about the effect which an improved, larger dam and pump unit would have on a population of rare snails living along this part of the stream. The engineers (Bill Coombes and Alan Parker) and I examined the route along the western part of site S0242. Here we dug a small hole and discovered a fossiliferous chert flake in situ in apparently undisturbed soil at a depth of some 30 cm. We then discussed re-routing the pipeline sufficiently to the west as to avoid the site altogether. I told them also that the entire 4½ km pipeline route would have to be checked by an archaeologist, and then spot checked during the trenching operation.

Bill Coombes informed me of another Aboriginal site in a 1-2 Ha. deflated area 500 m NNE of S0242, and some 100 m west of the pipeline route. Later that day we examined this site and found it to be very similar to S0242, with fossiliferous chert artifacts and other archaeological material lying as a lag on the deflation surface. This site is not as rich in artifacts as S0242, and has been tampered with by persons unknown, judging by the presence of at least one heap of a dozen artifacts recently stacked together (and including two chert pieces chipped along their edges, revealing the unpatinated stone within). Because of the probability of previous unauthorised

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artifact removal and re-scattering, I decided to collect a dozen archaeologically important chert specimens from this site, including a half-dozen specimens in the one or two "modern" heaps of artifacts. Note that all or most of the artifact scatter has been redeposited by deflation, and that the present configuration of the artifact scatter can have little or no cultural significance. The same is probably true of the artifact scatter at S0242, but not for Quininup Brook, site 4 which has been exposed but not significantly redeposited by deflation (cf. Ferguson 1981).

One of the people in our party discovered a tektite at this site, the first known from south western Australia. This specimen is already under study by Dr B. Mason a visiting tektite expert recently retired from the Smithsonian Institution in Washington, D.C. Dr Mason and I will visit this and other sites in the area within a few days. At that time I would hope to collect charcoal in situ at this site for radiocarbon dating. Any tektites discovered would be collected, since it is not known whether they were brought to the sites by prehistoric people, or were part of a more widespread tektite fall than previously known. During this planned visit I should have a chance to make a better general assessment of this site.

In Perth Shirley Slack-Smith informed me that she and the two engineers examined an alternative position on Ellen Brook for a new dam and pump unit. This second position is some 100 m downstream from the homestead. Placing these facilities there and the consequent re-positioning of the first 100-200 m of the pipeline would greatly lessen the developmental impact on the features of cultural or environmental importance referred to earlier, including S0242.

My recommendations are as follows:

(1) The alternate position for the pump unit and dam and westward shifting of the first 100 or more m of the pipeline is much preferable to the proposed route in that it would minimise risk to S0242.

(2) The 4 km of pipeline route between the main east-west access road and Gracetown should be checked by an archaeologist prior to pipeline construction. However, it seems unlikely that any major sites would be uncovered during pipeline construction. This is because of the shallowness of the pipeline trench. Also I walked the first 1500 m of the proposed route and saw no artifacts exposed in the existing track.

(3) That special attention be paid to the pipeline route where it passes near known sites (i.e. S0242 and the newly discovered dune site).

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(4) That once the pipeline route was cleared by the ACMC, that it be spot checked during the trenching operation. If the southernmost 100 m of the present route were retained, then a series of test pits would have to be dug along the western edge of S0242 prior to the trenching operation. Depending upon what was discovered in the pits a relatively large salvage operation may be required.

(5) That no sand be removed from S0242 or other sites for construction purposes.

C. DORTCH
19 June 1985

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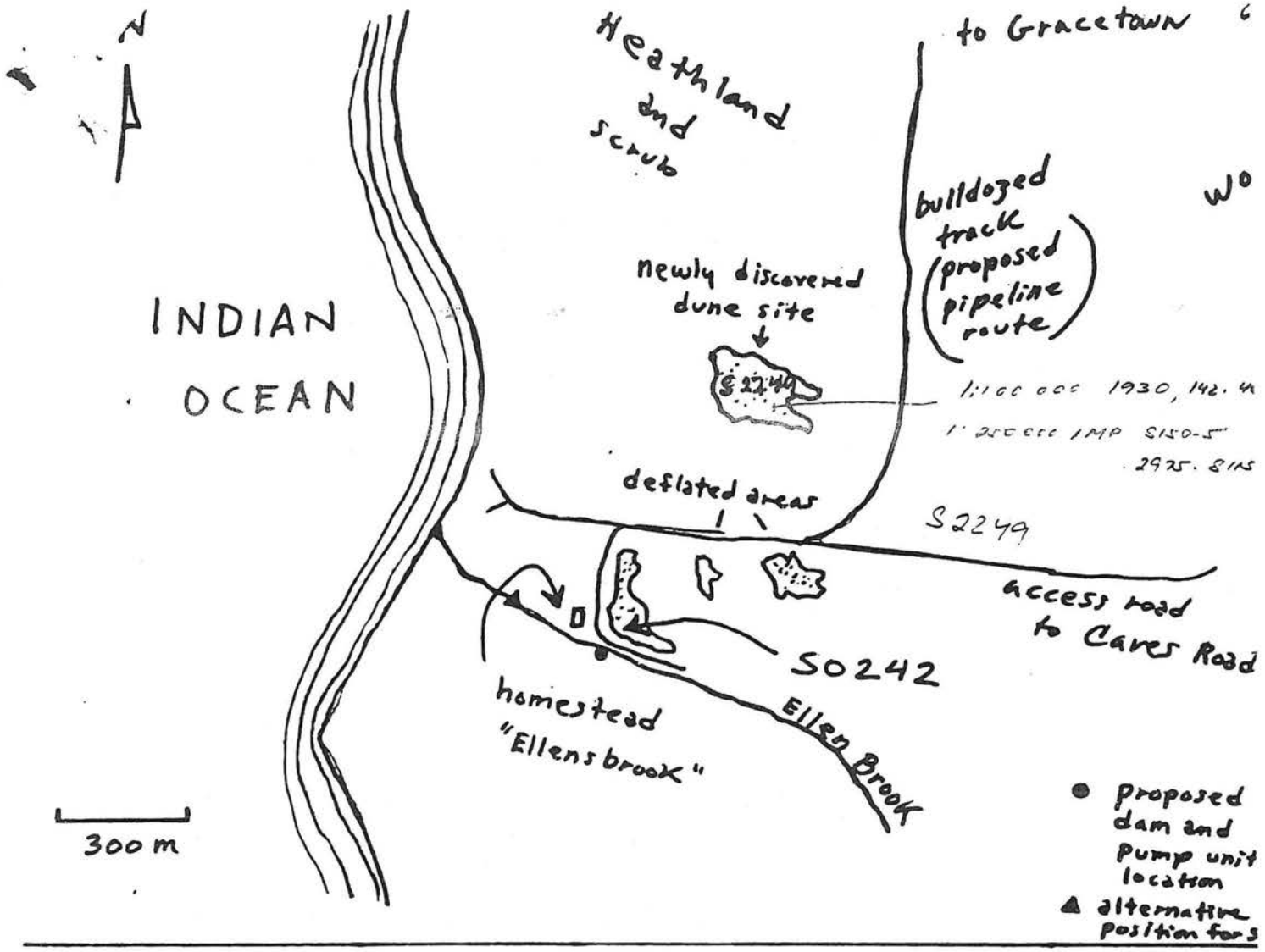
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to Gracetown
bulldozed track (proposed pipeline route)
newly discovered dune site
INDIAN OCEAN
deflated areas
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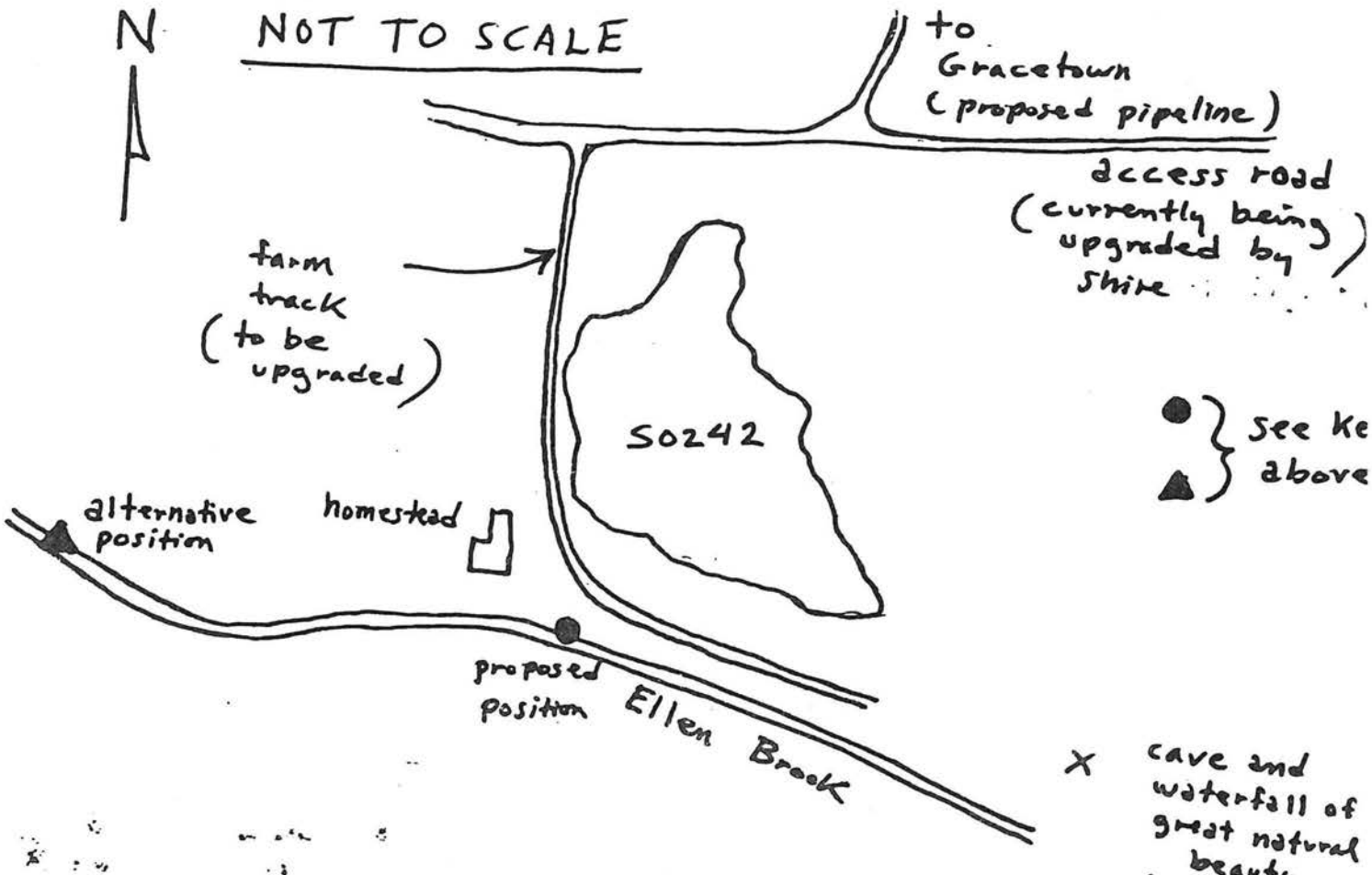
access road to Caves Road
S0242
homestead "Ellens brook"
Ellen Brook
300 m
proposed dam and pump unit location
alternative position for s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Ellen Brook
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above
cave and waterfall of great natural beauty (and very like

Date 3 February 1984

Our reference 258/77

Your reference PWWS 1068/71

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Under Secretary for Works
Public Works Department
2 Havelock Street
WEST PERTH 6005

Dear Sir

GRACETOWN WATER SUPPLY 73

I refer to your letter of 16 January.
Examination of the Site Register indicates that there are a number of sites in the general area of the proposed water supply.
However, the area has not been systematically examined and it is possible that other sites may exist there. We suggest that a survey be arranged to ensure that sites are not disturbed by the proposed development.
We would be happy to provide you with a list of consultants able to undertake this work.

Yours faithfully

V. Novak

V. NOVAK
Acting Registrar
Department of Aboriginal Sites

Your ref: PWWS 1068/71

Mr. K. T. Cadee
Under Secretary for Works
Attention Mr. Coombs
Dumas House
2 Havelock Street,
WEST PERTH. W.A. 6005.

6th February, 1984.

Dear Mr. Cadee,

Thank you for the information regarding the Gracetown Water Supply, despatched on January 16 1984. The "Friends of Ellensbrook" held a meeting on February 3 to discuss the information which you so kindly provided. We have set out the comments of the meeting as follows:-

3.3 Ellen Brook Springs

The meeting applauded the P.W.D. decision not to use the spring on location 202 for aesthetic and environmental reasons.

3.4 Ellen Brook Pipehead Dam

Paragraph one, with reference to the population estimate for Gracetown, the meeting expressed some concern at the implications of population growth for Gracetown with regard to the draw on the proposed water supply from Ellen Brook, i.e. will demand exceed supply?

Paragraph two. The Friends support the acquisition of a below ground power main within the National Park, not only for aesthetic reasons but also because this would reduce the risk of bushfire.

4.2 Access Road (Caves Road to Homestead)

We support the proposed route.

4.3 Power

We support the National Park's Authority view that underground power mains would be preferable. As indicated (see attached) in our letter to the Minister for Water Resources, of 15 December 1983, the Friends would appreciate provision of 240 volt power to the homestead of Ellensbrook, in order to make maintenance and security better for the volunteer parties. Internal wiring of the homestead could be carried out by qualified electricians associated with the Friends of Ellensbrook. We will approach the National Trust and the National Parks Authority for their views on this suggestion.

4.4 Pipehead Dam

The Friends support the proposal and appreciate the blending of masonry with the existing dam.

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4.5 Pumping Station

In order to reduce noise from the pumps it is suggested that these be sited behind a rise in the ground, if possible. The Friends would appreciate an estimate of the pump and chlorination plant dimensions in order to pass comment on their potential environmental impact. We note the P.W.D's concern (4.7) for the appearance of equipment of this kind.

4.9.1 Additional Environmental Aspects

We appreciate the concern shown for aquatic species. Will the downstream flow be maintained? We feel that it is important that downstream flow be permitted throughout the year, not only for ecological reasons, but because the very name "Ellensbrook" should always be associated with a stream running past the house.

We propose to send a copy of this letter to the National Parks Authority and the National Trust for their information. We also attach a copy of a letter to the Minister for Water Resources dated 15 December 1983, together with his reply, which indicates, where possible, support for our recommendations. You will note from this letter (paragraph six) that we have also suggested that fresh water be provided to the house. The present internal piping is unsatisfactory, due to calcification. We would appreciate your comments on this suggestion.

Thank you for the explicit information provided and the opportunity to discuss the draft proposal. We appreciate the concern you have shown for the public interest and hope that we will be able to co-operate as effectively as possible.

Yours sincerely,

Elaine Davison
Bill Bunbury
on behalf of the Friends of Ellensbrook.

Elaine Davison

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APPENDIX 7

BIOTIC SURVEY OF ELLEN BROOK

BIOTIC SURVEY
OF ELLEN BROOK

Prepared for

Water Authority of Western Australia

Dames & Moore

Dames & Moore Job No. 08076-042-71

February 1986

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APPENDIX

1.0 INTRODUCTION

This biotic survey has been undertaken as part of the Public Environmental Report (PER) for the proposed pipehead dam at Ellen Brook, five kilometres south of Gracetown. The survey covers the proposed damsite, the reservoir and the transmission and pipeline corridors.

The PER has been prepared at the request of the Environmental Protection Authority (EPA) as part of the environmental impact assessment procedure. The PER is intended to fill the recognised need for a document which permits public participation in project assessment where, in the opinion of the EPA, detailed assessment in the form of an Environmental Review and Management Programme (ERMP) is not warranted.

Four areas of environmental concern in relation to the pipehead dam project were listed in the Notice of Intent (NOI) for the project and four other environmental concerns have been raised subsequently. These eight concerns are:

- the impact on a species of rare freshwater snail that occurs along Ellen Brook,
- the impact on Aboriginal sites in the vicinity of Ellen Brook and along the proposed pipeline route to Gracetown,
- the impact on historical values and the general intrusion into the secluded Ellen Brook area,
- the impact of construction within the Leeuwin-Naturaliste National Park,
- the impact on habitats of Bristlebirds, either Western Bristlebird or Western Rufous Bristlebird,
- the impact on populations of Red-eared Firetails and Red-winged Fairy-wrens,
- the impact on sensitive flora (i.e. plant species that are rare, geographicaly restricted or poorly collected) and
- the impact on types of vegetation poorly represented in Leewin-Naturaliste National Park or other conservation reserves.

The January 1986 biotic survey was undertaken to:

- survey and report on types and condition of vegetation which will be affected by the dam, pipeline and powerline, with particular reference to sensitivity and representation elsewhere in the Park,

- o prepare a brief resume of the biotic environment in general of the above area, with particular reference to sensitive flora and fauna, especially the Western Bristlebird (Dasyornis brachypterus longirostris) and the Western Rufous Bristlebird (Dasyornis broadbenti litoralis),
- o describe the likely impacts of the developments on sensitive elements of the biotic environment and
- o define and report on management actions required to mitigate any impacts.

2.0 METHODS

The survey comprised four overlapping and integrated phases, which concentrated on species that are rare, geographically restricted, poorly known, vulnerable, endangered or otherwise considered to be sensitive. The phases were:

- o collection and review of relevant published and unpublished articles, reports, 1:15,000 scale aerial photographs and vegetation maps (including the 1:50,000 compilation sheets for Smith's 1:250,000 scale vegetation map - Smith 1973),
- o interviews with experts, both professionals and amateurs, on sensitive species sightings, habits, habitats and distributions,
- o search through collections of the Western Australian Herbarium for identities, geographical ranges, abundances, flowering times and habitats of sensitive plant species and
- o field work aimed at determining identity, location, condition, sensitivity and, so far as possible representation elsewhere in the national park of vegetation and sensitive species likely to be affected by the proposed project.

3.0 RESULTS AND DISCUSSION

3.1 TYPES AND CONDITION OF VEGETATION IN PROJECT AREA

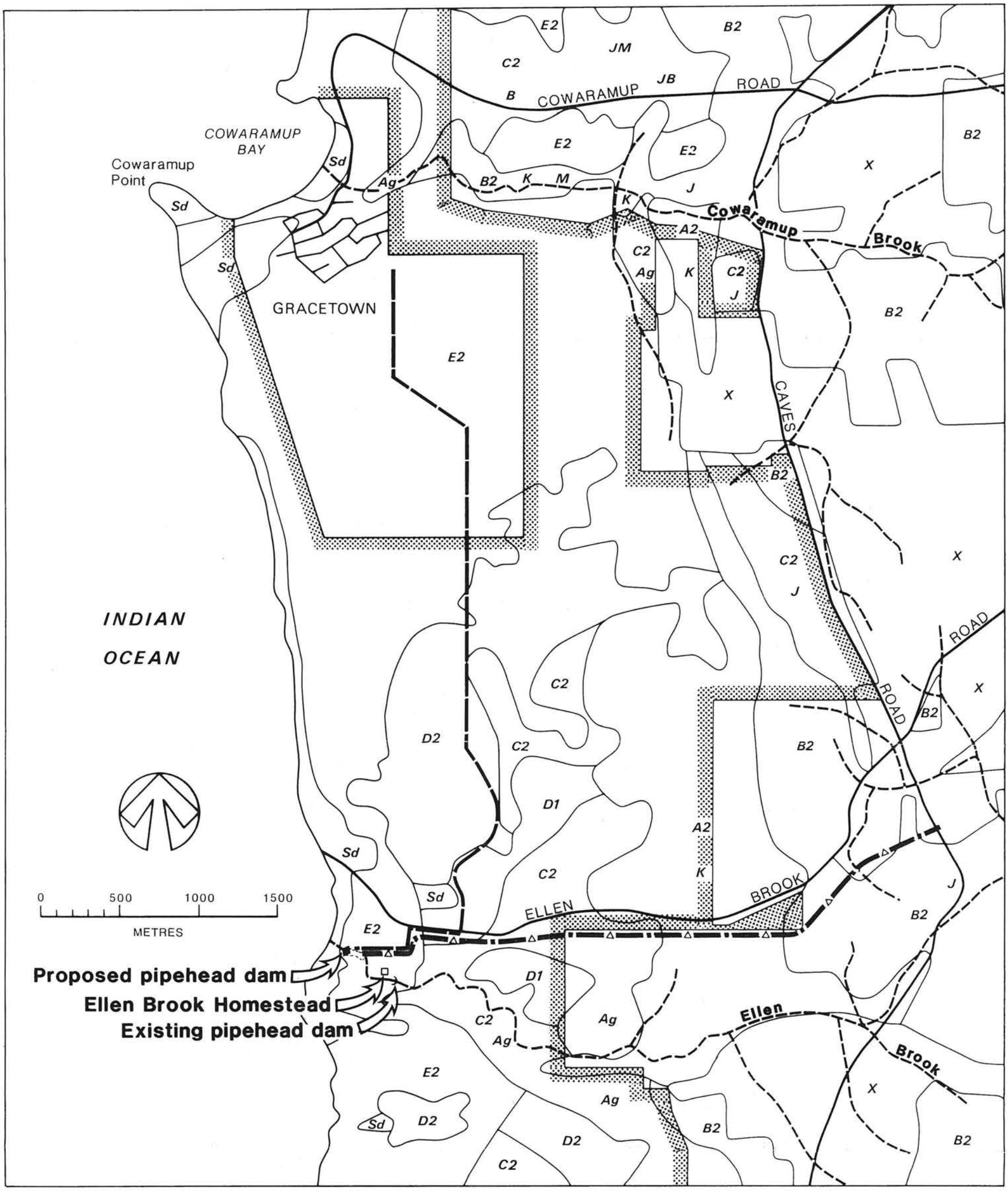
The 1:50,000 scale compilation sheet drawn by Smith shows seven types of vegetation that occur in the project area and which would be affected by the project. Figure 1, based on Smith's map, shows the vegetation of the project area. Table 1 lists these seven types of vegetation along with the project items (dam and reservoir, power main extenstion, pipeline) that would affect them, the estimated adequacy of their representation elsewhere in the National Park north of Prevelly, representative plate numbers and the dominant or characteristic species of each type.

The sensitivity to disturbance and adequacy of reservation of each type of vegetation varies with the particular features of each stand: its habitat, its age since last being burnt, its density and height, its species composition and its general condition. In general, the low open forests, scrubs and heaths in the southern end of the project area have not been burnt for at least ten years and are in good condition. Exceptions to this generalisation include tracks, firebreaks, gravel pits, blowouts and areas near the homestead that have been cleared and grazed. Some of the tracks are being rehabilitated (Plate 2E), but others are being widened through use by Park visitors, with trackside shrubs and trees being broken off to provide traction for bogged vehicles (Plate 2C). Previously cleared areas near the homestead are regenerating in native vegetation or, more commonly, in tea-tree (Leptospermum laevigatum) thickets and swards of Juncus sp., sedges, Centella asiatica and weedy grasses.

The closed scrub and open heath along Ellen Brook below the homestead and in the valley north of the homestead, through which the track to the beach runs, are less well-represented elsewhere in the national park than Table 1 and F.G. Smith's maps indicate. The scale of the maps is too small to show the diversity in composition and structure associated with variations in soils, moisture and exposure. These stands, in particular, are mature mosaics of forms characterised by different species and, through absence of burning for a sufficiently long period, have developed structures that appear to make them optimally suitable habitats for Western Rufous Bristlebirds.

There are five principal types of scrub/heath vegetation in the lower Ellen Brook - beach track valley area. The lowest, most wide-spread type and the least likely to support Bristlebirds is the vegetation that clothes the stable dunes: shrub communities less than 2m tall of Olearia axillaris, Rhagodia ? preissii, Ammophila arenaria and, sometimes, Acacia littorea and Acacia cyclops (Plates 2E, 1F and background of 2F).

Taller, denser shrub communities in sheltered areas adjoining the Olearia - Rhagodia stands along the beach track are more likely to be Bristlebird habitat and are, in fact, the vegetation in which there were reported sightings of the bird in 1980. These communities are 2m to 5m tall and dense, but with open ground layers to 0.5m, and they are dominated by Melaleuca huegelii (Plate 2F) or Spyridium globulosum (Plate 2D), often with scattered peppermint. Associated species include Rhagodia ? preissii, Olearia axillaris, Sollya heterophylla, Lepidosperma gladiatum, Acacia cyclops, Boronia alata, Hibbertia cuneiformis, Hardenbergia comptoniana and Exocarpos sparteus. Marram grass appears to be invading some of the stands, although around Perth marram grass covered dunes tend to be invaded by native shrubs (Smith 1985).



VEGETATION OF ELLEN BROOK DAM PROJECT AREA

Figure 1
Dames & Moore

TABLE 1
VEGETATION OF THE ELLEN BROOK DAM PROJECT AREA
(after Smith, unpub.)

SYMBOL (Figure 1)	VEGETATION	DAMSITE/ RESERVOIR	POWERLINE ROUTE	PIPELINE ROUTE	PLATE NOS.	REPRESENTATION	SPECIES	COMMENTS
A2	High Open Forest	-	X	-	-	Poor	Karri	Small stand north of eastern end of poweline route, with understorey of bull banksia, bracken and other species.
Ag	Low Open Forest	X	X	X	1E;2B,C	Poor to moderate	Peppermint	Peppermint groves with sword sedges or grassy, often park-like understoreys; in sheltered areas on seaward side of ridge.
B2	Open Forest	-	X	-	-	Moderate to good	Jarrah, Marri	Powerline route crosses tall jarrah-forest with dense though partially burnt understorey west of Karri forest.
C2	Low Open Forest	-	X	X	-	Poor to moderate	Marri, Banksia	West of the jarrah-marri forest and also next to the peppermint grove shown in Plate 2B the routes cross low, moderately dense stands of spreading marri and banksia trees.
D1	Closed Scrub	X	X	X	2D,F	Poor to moderate	Melaleuca huegelii, Parrot bush, Spyridium globulosum, Peppermint	Stream banks and in valleys and other sheltered areas on lower parts of the terrain. Variable in height, composition and age. Often dominated by a single species.
D2	Open Scrub	-	X	-	2A	Good	Peppermint, Parrot bush Jacksonia horrida, Bullich, Yate, Jarrah, Marri, Blackboy, Melaleuca acerosa	Variable, open, 2 to 3 layered scrub, with scattered mallees (±), on the Leeuwin-Naturaliste ridge.
E2	Open Heath	X	-	-	1C,D,F	Moderate	Spyridium globulosum, grey Olearia axillaris, Leucopogon pariviflorus, Rhagodia ? preissii	Variable in height, density, age and composition. Groves of introduced tea tree (Leptospermum laevigatum) near homestead.

Also in Figure 1

Ag Peppermint
B Banksia
J Jarrah
K Karri
M Marri
Sd Sand dunes (barren)
X Cleared of native vegetation

The scrub bordering Ellen Brook in the damsite and reservoir site area is dominated principally by Spyridium globulosum or peppermint, often with Acacia cyclops and Acacia rostellifera. The two communities vary widely in structure and often grade into each other, into small patches of Oxylobium lanceolatum and Trymalium floribundum and into the swards of Lobelia alata, Juncus sp., Stenotaphrum secundatum, Pelargonium capitatum, Centella asiatica and other weedy aliens that have become established along the stream. There are a few patches, particularly near peg 'E', with a Spyridium globulosum overstorey over three metres tall and Lepidosperma gladiatum ground layer which might be suitable habitat for the Western Rufous Bristlebird, but no one can be sure because no one knows what range of vegetation is suitable habitat for the bird. The optimum habitat appears, however, to be a type of heath or scrub that has not been burnt for at least 8 to 10 years (Carter 1924; Smith 1977). Comparable scrub communities were not found along Turner Brook, which has conditions that are probably more similar to Ellen Brook's than anywhere else in the Leeuwin-Naturaliste strip. Turner Brook is privately owned and runs through Deepdene, between Cosy Corner and Augusta.

3.2 SENSITIVE SPECIES

Twenty species of plants considered, on the basis of surveys of herbarium collections and field work by Department of Conservation and Land Management staff (Rye and Hopper 1981; Rye 1982; Patrick and Hopper 1982), to be sensitive have been recorded from the broader area that includes Ellen Brook. The 20 species of sensitive plants are listed in Table 2, along with their families, number of collections in the Western Australian Herbarium and recorded habitats, flowering times and distributions. None of the species was recorded during the January survey, nor did the Western Australian Herbarium have any collections of sensitive plant species from the project area. It is possible, though not likely, that species of sensitive plants would be found in the project area at the times when they are in flower; flowering specimens of only one of the 20 species have been previously collected in a January.

Two species of very rare and geographically restricted fauna and two species of otherwise sensitive fauna have been recorded from the Ellen Brook project area. The two very rare and restricted species of fauna are a freshwater snail and a species of Bristlebird. The two species that are otherwise sensitive are the Red-eared Firetail and the Red-winged Fairy-wren. None of the four species were seen during the January survey.

TABLE 2
RARE, GEOGRAPHICALLY RESTRICTED AND POORLY COLLECTED SPECIES OF VASCULAR PLANTS THAT MIGHT OCCUR IN OR NEAR THE ELLEN BROOK REGION

SCIENTIFIC NAME	FAMILY	HABITAT	FLOWER[1]	DISTRIBUTION	NO.[2]
Acacia inops	MIMOS	Swampy	4-9, 8-9	Yallingup - Margaret River	7
A. mooreana	MIMOS	Swamps; jarrah-marri forest		Yallingup - Stewart Road	19
A. semitrullata	MIMOS	Swamps; jarrah-marri-banksia open forest	9-10	Yarloop - Karridale	22
Banksia meisneri var. ascendens	PROTE	Sandy (semi-) swamp	2,4,10	Busselton - Scott River	7
Caladenia excelsa	ORCHI	Jarrah-marri-banksia woodland	10	Mammoth cave, Yallingup	8
Eucalyptus calcicola	MYRTA	Stabilised dune western slopes	5-6	Hamelin Bay area	-
Grevillea brachystylis	PROTE	Jarrah-banksia-Xanthorrhoea woodland	6,8-9	Yoongarillup - Scott River	5[3]
Hodgsoniola junciformis	ANTHE	Sandy (semi-) swamp	10-11	Cape - Scott River	14
Hybanthus volubilis	VIOLA	Stream bank thickets	10-12	Margaret River	5
Isopogon sp.	PROTE	-	-	-	-
Jansonia formosa	PAPIL	Jarrah-marri forest; swampy riverbank	8,10-1	Margaret River - Walpole	15
Prasophyllum triangulare	ORCHI	Jarrah-marri-banksia low woodland	10-11	Margaret River - Albany	4
Pultenaea drummondii	PAPIL	Jarrah-marri forest	7,9-11	Ludlow - Augusta	17
P. pinifolia	PAPIL	Marri woodland, swampy	10-12	Busselton - Karridale	8
Restio amblycoleus	RESTI	Sandy (semi-) swamp	9-10	Ambergate - Scott River	7
R. ustulatus	RESTI	Open grass plain; sandy (semi-) swamp	9-5	Ambergate - Scott River	10
Samolus valerandi	PRIMU	Damp coastal sand	3,10-11	Margaret River - Augusta	3
Stylidium barleei	STYLI	Sandy jarrah forest	10	Busselton - Brockman Highway	3
Thomasia laxiflora	STERC	Jarrah forest	10-11	Cowaramup	2
Verticordia lehmannii	MYRTA	Swampy sedge and heath	12-5	Scott River Road - Quindalup	8

1. Numbers of the months (e.g. 12 = December) when flowering specimens were collected.
2. Number of collections in the Western Australian Herbarium.
3. Some specimens may be on loan and not in herbarium.

3.2.1 The Freshwater Snail Austroassiminea letha

The rare and endangered species of freshwater snail, Austroassiminea letha, was first collected at Ellen Brook by Slack-Smith in 1975 and subsequently in 1980 (Solem et al., 1981). The species is only known from three locations, each of only a few square metres in area, on the Leeuwin-Naturaliste coast in the far southwestern corner of Western Australia. The snail was found upstream of the proposed damsite, and although well searched for none have been recorded downstream of the homestead. This is probably due to a lack of suitable habitat. The snail's habitat is the wet/splash zone where water seeps along the contact between igneous rock and overlying strata. Feeding on organic detritus, the snails prefer soils rich in organic matter rather than the highly leached siliceous sands downstream (Slack-Smith, pers. comm). It is highly unlikely that the proposed pipehead dam will have any detrimental impact on the snail's abundance or survival.

3.2.2 Western Rufous Bristlebirds Dasyornis broadbenti litoralis

Ellen Brook is one of the few positively identified sites for the very rare Western Rufous Bristlebird (Dasyornis broadbenti litoralis). First discovered by Milligan in 1901 at Ellensbrook, the Western Rufous Bristlebird appears to have been confined to a narrow strip of coastal country between Cape Naturaliste and Cape Leeuwin. The most recent collection of a Western Rufous Bristlebird was in 1906, from Cape Naturaliste, but there are more recent reported sightings (and hearings), including ones in 1908 by C. Conigrave, in 1940 by G. Storr, in 1954 by K. Highman and in the late 1970's and early 1980's by J. Malone, E. West, N. Dunlop and others (Serventy and Whittell 1976; S. McNee, J. Talbot, G. Chapman, J. Malone, and E. West, pers. comms.).

The most recent reported sightings of Western Rufous Bristlebirds were in 1980 by J. Malone, who made two sightings at the edge of valley scrub along the track to the beach north of Ellen Brook homestead between 100m and 300m northwest of the pipeline-powerline route. One bird was seen at each of two visits in January 1980, and the bird and habitat were photographed during the first visit. Although the photographs were indistinct and out of focus, one was sufficiently clear to confirm that the bird was indeed a Bristlebird (G. Chapman, pers comm: Appendix). The likeliest species of Bristlebird is the Western Rufous, since the Western Bristlebird has not been recorded closer to the project area than 100km (Smith 1977).

The Western Rufous Bristlebird is a shy, elusive bird that dwells largely on the ground in tall, dense coastal scrub or heath that has not been burnt for many years. It prefers to run through the dense scrub rather than fly. It is difficult to see and, apparently, seldom calls, even during the breeding season. Its most common call is reported to be a single, short, high-pitched call sounding like a squeeky cartwheel, which is soon followed by a similar reply (Talbot pers. comm.).

3.2.3 Red-eared Firetails (Emblema oculata) and Red-winged Fairy-wrens (Malurus elegans)

Red-winged Fairy-wrens and Red-eared Firetails were once common in the Leeuwin-Naturaliste area and in dense scrub in swamps and along streams (Carter 1923; West pers. comm.; Talbot pers. comm.), but settlement, clearing and burning have severely reduced available habitats and, consequently, the abundance and range of the birds (Serventy and Whittell 1976). However, Red-eared Firetails have been found to be more abundant and widely distributed in the northern jarrah forest than previously thought (Nichols et al. 1982) and Firetail populations are increasing in Margaret River areas where appropriate habitat is encouraged to regenerate (West pers. comm.).

Both species are known to occur in the vegetation along Ellen Brook in the vicinity of the homestead (Talbot pers. comm.) and would probably be affected by clearing of the reservoir site.

3.3 POSSIBLE IMPACTS

The possible impacts of the project on sensitive elements of the biota can be considered in four sections:

- o construction of the dam,
- o clearing of the reservoir and impoundment,
- o construction of the pipeline and
- o construction of the powerline.

Although the project will undoubtedly have some impacts on the native biota, probably the only sensitive species of plants or animals that might be affected are the Western Rufous Bristlebird, the Red-eared Firetail and the Red-winged Fairy-wren. The most likely effect, if any, on these species would be through destruction of habitat and reduction of habitat availability.

3.3.1 Dam Construction

Approximately 0.25ha will require clearing to accommodate the dam, pump and construction work site. It is assumed that construction of the dam will involve the use of heavy equipment, the clearing of an area for a worksite and pumping station, the widening of the existing track in order to bring in the equipment and the clearing of an additional track to link the existing track and the damsite, presumably along the old track being rehabilitated by the Department of Conservation and Land Management. There should be no need to fell any trees, to disturb the trackside peppermint grove or to disturb any possible Bristlebird scrub habitat except, possibly, at the damsite itself, where there is Spyridium globulosum - peppermint scrub of a type described in Section 3.1.

3.3.2 Reservoir

The reservoir site is about 100m long by 20m wide; thus about 0.2ha would be cleared of vegetation. The vegetation to be cleared would probably include portions of the Spyridium, peppermint and Spyridium - Lepidosperma scrub described in Section 3.1 and discussed as possible Bristlebird habitat. The thicket vegetation in the reservoir site may also support Red-eared Firetails and Red-winged Fairy-wrens. Preparation of the reservoir would involve clearing more than 50% of this thicket. Additional portions of the scrub might be cleared if the reservoir is fenced to keep out swimming and other incompatible uses.

3.3.3 Pipeline Construction

Construction of the pipeline in an access corridor 5m wide by about 5km long should have minimal impact except where the access track is widened or where the pipeline deviates from existing tracks. About 2.5ha will be affected. Aside from the southern end of the pipeline route, discussed in Section 3.3.1, pipeline construction will not affect any poorly reserved vegetation except marri low open forest north of the peppermint grove. It will, however, be possible to avoid most of the woodland by locating the pipeline in the track or on the side of it opposite the woodland.

The existing track which follows the top of the ridge to Gracetown meanders slightly, apparently to follow the contours and to avoid scattered trees and mallees of jarrah, marri, bullich and yate. Keeping the pipeline close enough to the existing track to use it for access would minimise disturbance to the open scrub and open heath vegetation on the ridge.

3.3.4 Powerline Construction

The clearing width in the powerline corridor will, according to the NOI, be approximately 15m. According to SECWA there will be a 20m easement, within which 6m will be cleared to allow vehicle access etc. An area of about 0.6ha within the Park will be cleared. Within the 20m width there will be selective pruning and lopping and possible removal of any large trees which might fall across or otherwise interfere with the powerline. To minimize fire risks, trees outside the 20m easement may also be pruned if they are likely to interfere with the powerline. Minor impacts may therefore, occur outside the 20m easement. There are, however, very few if any large trees in the section of the powerline that runs inside the current boundaries of the National Park. It avoids the Park's jarrah and karri forests by running through private property south of them.

3.4. MANAGEMENT AND REHABILITATION

Responsibility for the management of the National Park lies with the Department of Conservation and Land Management. Installation and management of the reservoir, pump station and pipeline route will be the responsibility of the Water Authority. The Water Authority recognises its particular responsibility for sound environmental management and undertakes to minimise impacts on the environment and to clean up and rehabilitate the site following construction. Consistent with sound environmental management and the efficient and reliable operation of the water supply, the Authority undertakes to seek and comply with the guidance of CALM with respect to suitable practices for the installation and management of the project.

Specifically, the Water Authority undertakes to make and comply with the following committments related to protection, rehabilitation and maintenance of the environment. Close liaison will be maintained with officers of CALM at all times.

3.4.1 Dam Construction

The area to be cleared will be kept to the minimum required for safe operations. Approximately 0.25ha will require clearing to accommodate the dam, pump and construction work site. Construction sand and crushed rock will be imported from outside the National Park. Clean, weed free sand will be used. Vegetation and topsoil from the worksite will be separately cleared and stockpiled.

The worksite will be rehabilitated by

- o removal of all waste material from the site including excess sand, rock or concrete,
- o reprofiling and grading,
- o return of topsoil and
- o respreading of cleared vegetation.

Experience with the regeneration of drill sites in the area suggests that effective re-establishment of vegetation will result from these practices.

3.4.2 Reservoir

Clearing within the reservoir area will be kept to the minimum requirement to accommodate top water level. Approximately 0.2ha will require clearing. All equipment will be washed down for dieback control prior to entry on-site. Machinery operations will be confined to the site and cleared material pushed to the inside of the cleared area. Any large timber will be removed from site. Shrub and understorey vegetation will be stockpiled for return to areas, such as the construction site, which require rehabilitation. Additional topsoil may be recovered from this area if required. The natural surface profile of the reservoir bed will be retained to avoid slumping or undercutting.

3.4.3 Pipeline Construction

Pipeline construction will involve the separate removal and windrowing of understorey vegetation and topsoil from approximately 2.5ha of land. The route will parallel existing tracks/firebreaks throughout and will avoid all trees. Rock removed during trenching will be returned to the surface to discourage access, or will be removed from site, as

directed by CALM. Where sand padding is necessary for the pipe, clean, weed free sand will be imported from outside the National Park. Following backfilling of the trench, any excess soil will be graded out or removed as required. Erosion of the trench or surface is not expected due to the porous nature of the soil and rock in the area. Windrowed topsoil and brush will be returned to the route and vegetation will be allowed to regenerate throughout. The existing tracks and firebreaks will be retained as access to the route.

3.4.4 Powerline Construction

The State Energy Commission of Western Australia (SECWA) will be responsible for the provision of power. The Commission has indicated that it recognises the environmental sensitivity of the proposed route. Therefore, it is proposed that officers from CALM inspect the route with SECWA. The route will cross private property for the most part and about one kilometre of the National Park. Clearing of about 0.6ha within the Park will be limited to a 6m wide access track. The removal of trees will be avoided wherever possible. Pruning will be restricted to those trees which could interfere with the line and create a fire hazard. Elsewhere, shrub and peppermint tree vegetation will be retained outside the access track. Standard timber poles 10m high will be used to limit visual intrusion of the powerline on the natural landscape. Any waste materials will be removed from the site following construction. The SECWA will regularly inspect and maintain the line to minimise the risk of electrical ignition of fires.

Key elements of sound environmental practice will be:

- minimal clearing,
- recognition of the need to prevent fires,
- disturbed sites which are not required in the long term will be revegetated with native vegetation,
- limitation of opportunities for weed and dieback invasion and
- general tidiness and cleanliness.

As well as the commitments detailed earlier, the Water Authority undertakes to ensure that its employees and contractors are aware of the points given above and will ensure that they do not light unauthorised fires, that they wash down all equipment before entry to site and that they will clean up any waste materials and litter.

4.0 ACKNOWLEDGEMENTS

The list of people who contributed time, information and suggestions during the preparation of this report include Jeremy Talbot, Graeme Chapman, Ernie West, Shappelle McNee, Paul Frewer, John Malone, Kathrine Highman, Graeme Smith, Stephen Hopper, Greg Keighery, Shirley Slack-Smith, John Lack, Paul Wilson and several staff members of the Water Authority of Western Australia.

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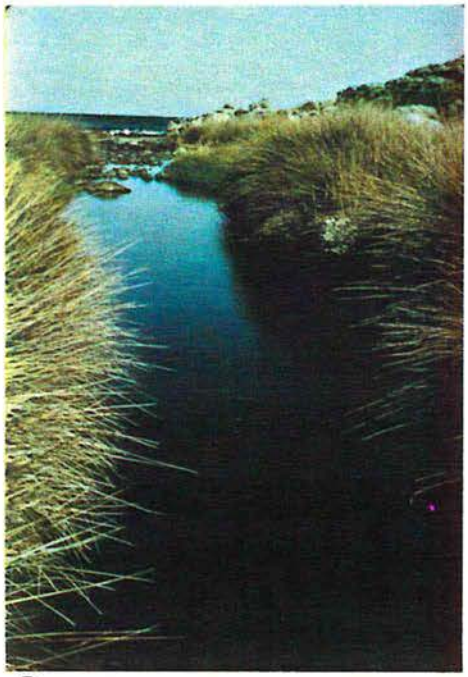
PLATES

A



B

C

D

E

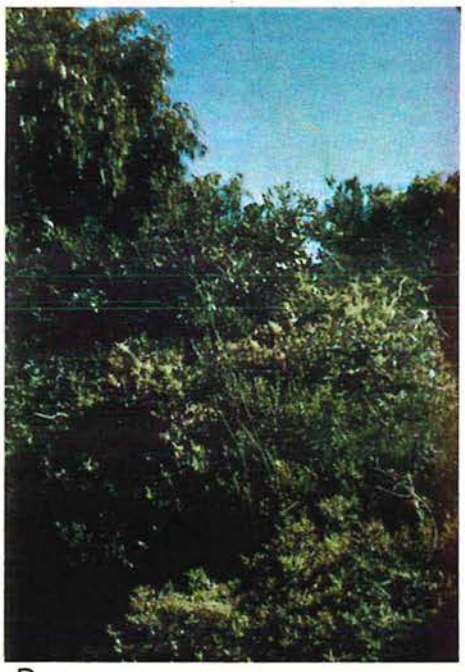
F

Plate 1
Dames & Moore

A

B

C



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E

F

Plate 2
Dames & Moore

APPENDIX

Transcription of Letter from Graeme Chapman to John Malone

P.O. Box 10,
Glen Forrest, 6071,

25 October, 1981

Dear John,

I was down at Two Peoples Bay reserve recently and managed to photograph a Western Bristlebird, my first real encounter with this species. Having spent some time taking pictures and also on looking at the slides (sample of reject enclosed) I am now quite convinced that the bird you photographed at Ellen Brook was a Bristlebird.

The birds Mike Bamford refers to at Fitzgerald River are Western Bristlebirds, not Rufous Bristlebirds and they were seen there a couple of yeas ago by Les Moon and Graeme Smith.

I'm sorry you haven't been able to visit your Bristlebird spot recently. I am now quite sure they are there and assume that they must do most of their calling earlier in the year, probably in July and August.

I can't see my way clear to visit Ellen Brook in the near future, much as I would like to. I do hope you will be able to get down there again and see the bird again; and also get the credit for re-discovering the species there after 40 + years.

Cheers

Graeme Chapman

Note: One of Graeme Chapman's photographs of the Western Bristlebird appears in an article by Malcom Taylor (1985).

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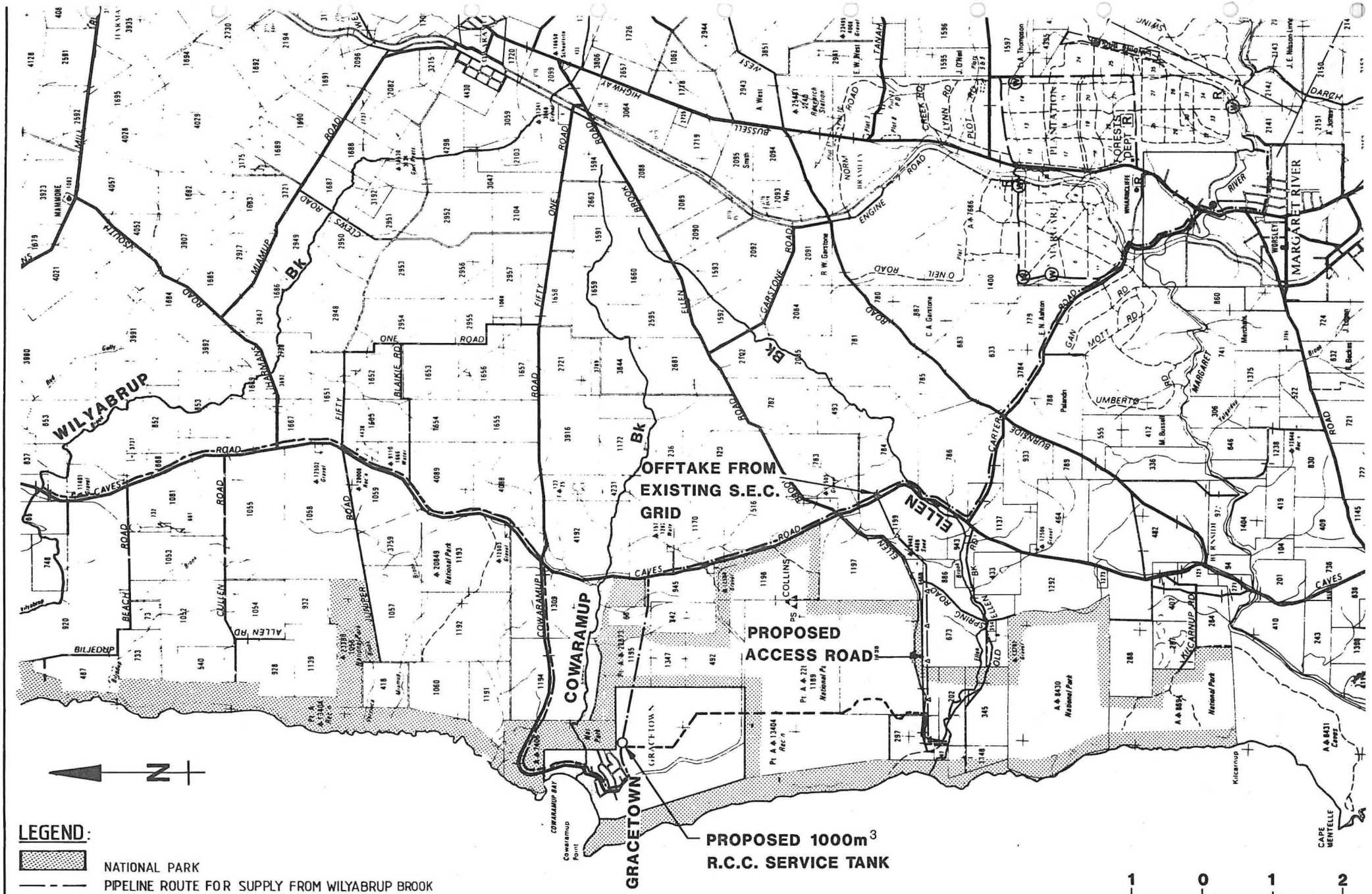
FIGURES



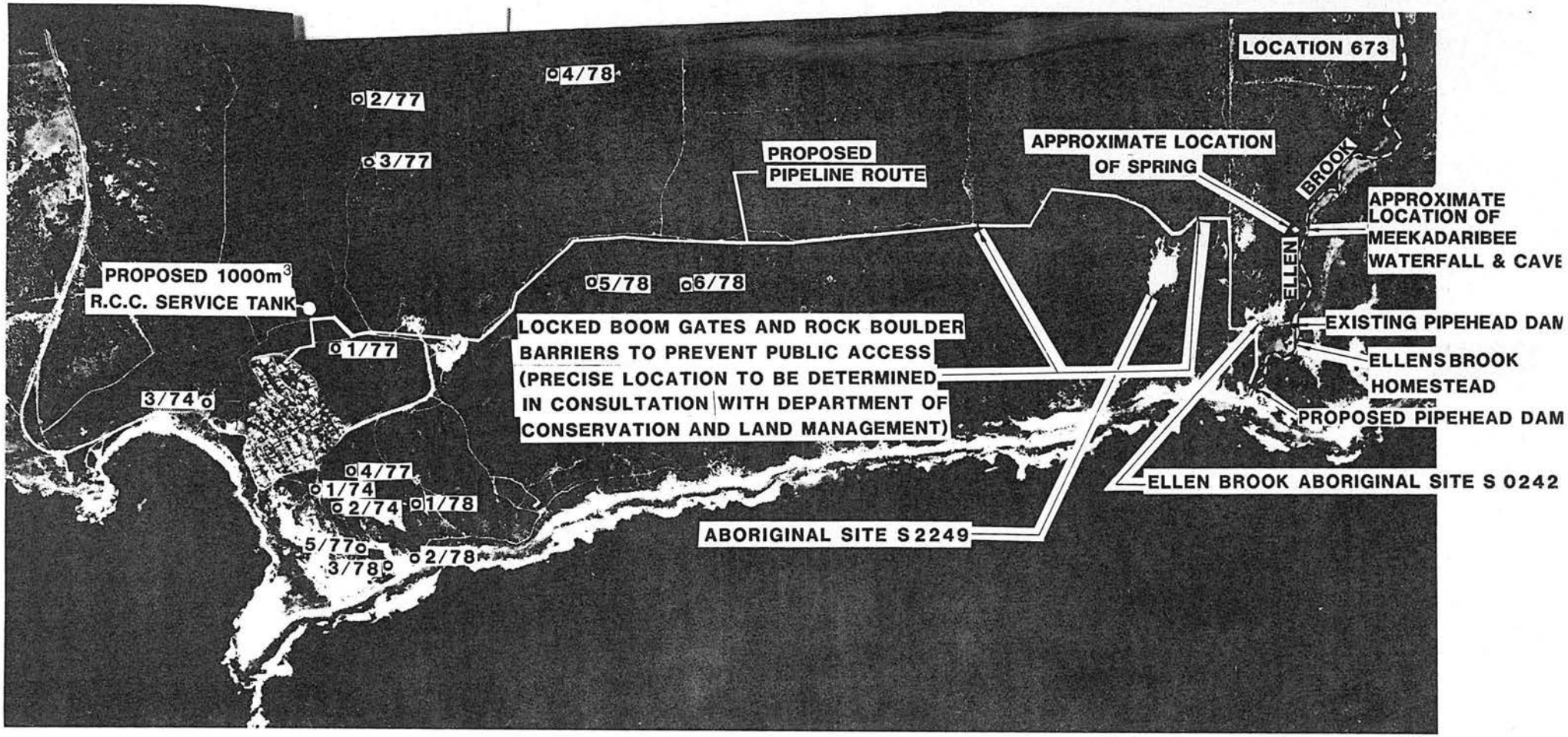
LEGEND:

- NATIONAL PARK
- PIPELINE ROUTE FOR SUPPLY FROM WILYABRUP BROOK
- PIPELINE ROUTE FOR SUPPLY FROM MARGARET RIVER
- PIPELINE ROUTE FOR SUPPLY FROM ELLEN BROOK
- PROPOSED POWER MAIN EXTENSION

GRACETOWN WATER SUPPLY
SUPPLY FROM ELLEN BROOK

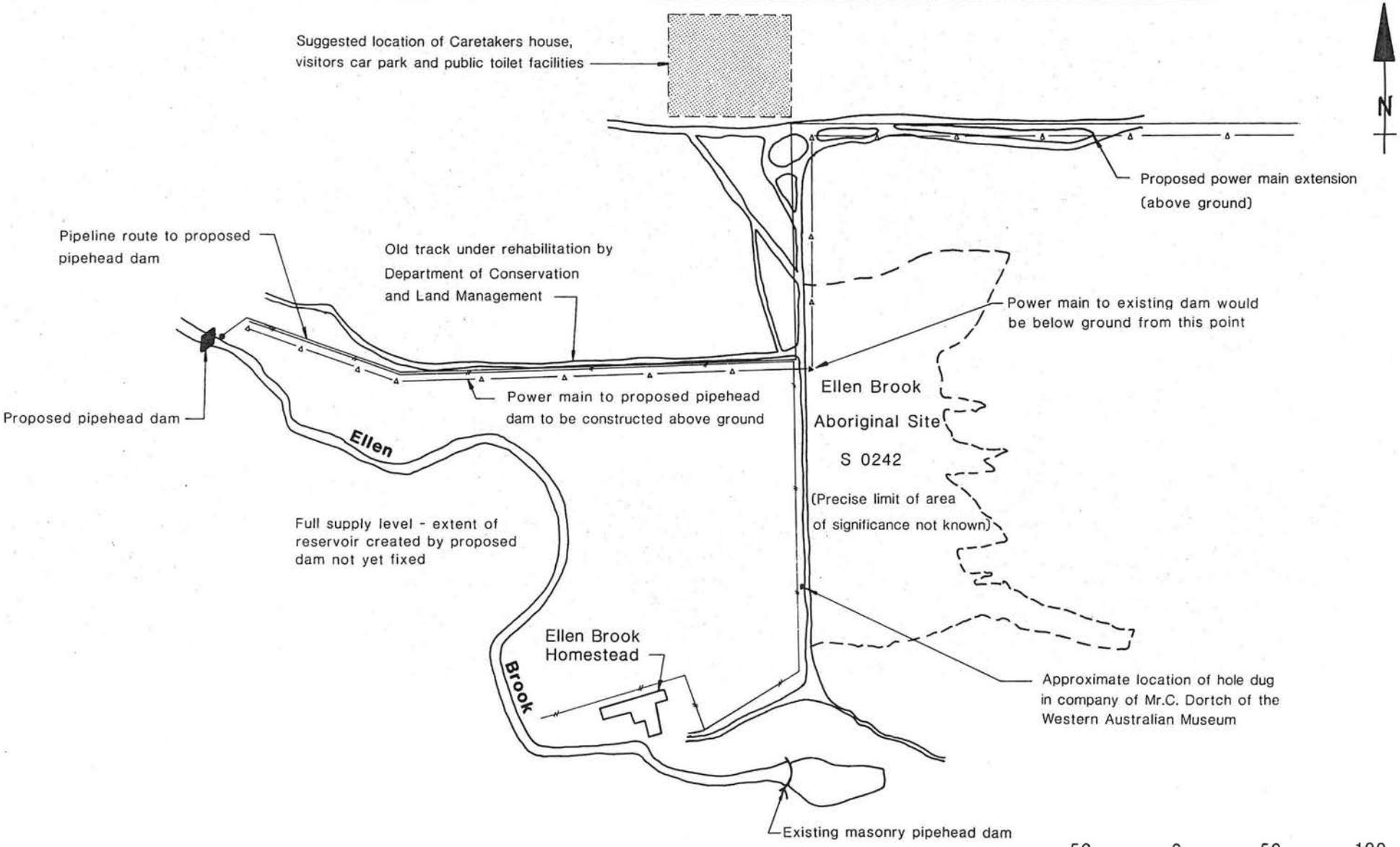
1 0 1 2
SCALE OF KILOMETRES
(1: 50000)

Figure 1



GRACETOWN WATER SUPPLY
SUPPLY FROM ELLEN BROOK

Figure 2



GRACETOWN WATER SUPPLY
SUPPLY FROM ELLEN BROOK

Figure 3