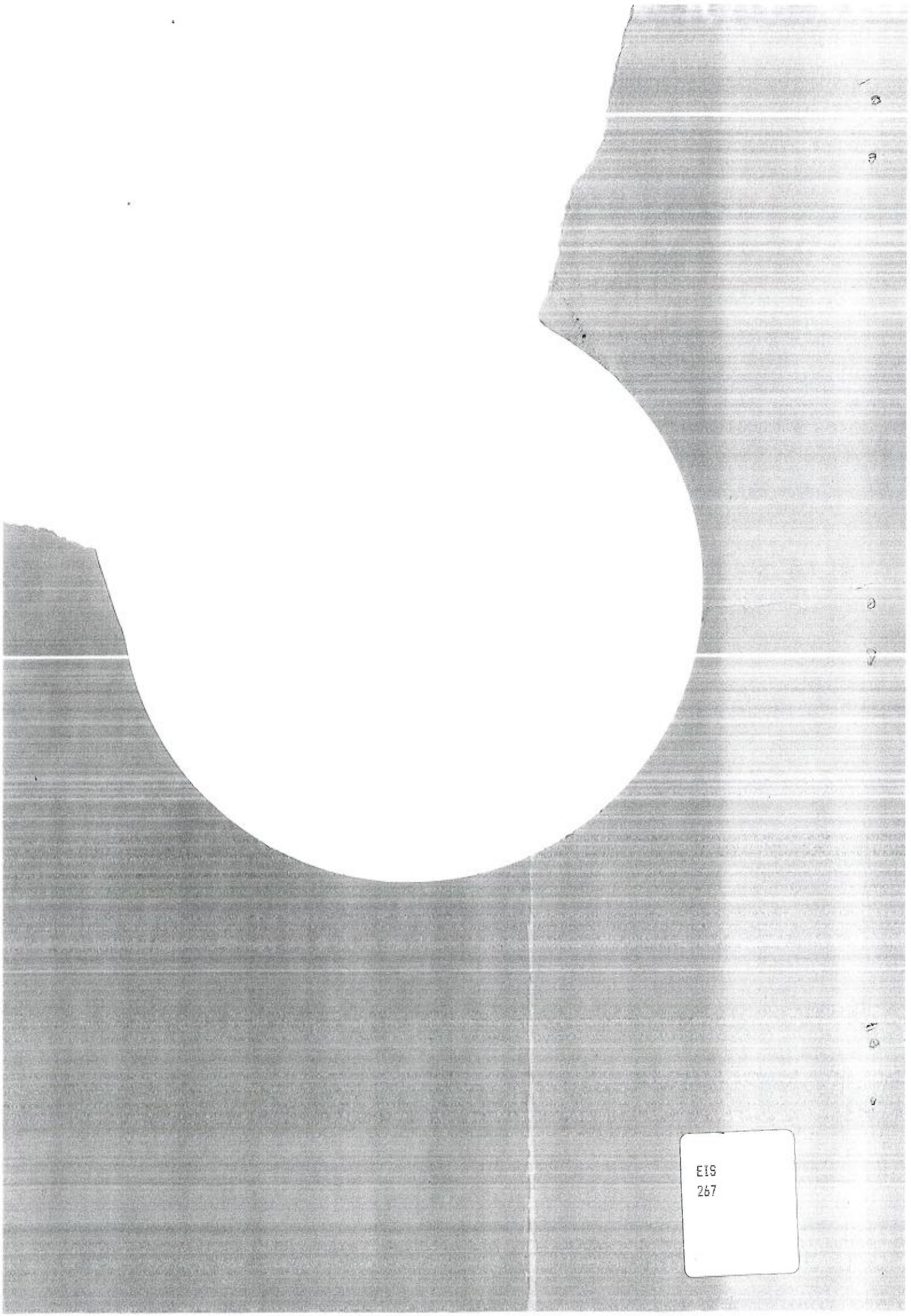
EIS 267

AA052603

Environmental impact statement -- proposed dredging of Wooli Wooli River for sand extraction : on behalf of Mr. R. Ronlund

B. W. McCLOSKEY
CONSULTANT TOWN PLANNER & SURVEYOR
GRAFTON



ENVIRONMENTAL IMPACT STATEMENT

PROPOSED DREDGING OF WOOLI WOOLI RIVER

FOR SAND EXTRACTION

ON BEHALF OF MR. R. RONLUND

B. W. McCLOSKEY
CONSULTANT TOWN PLANNER &
REGISTERED SURVEYOR
11 DUKE STREET, GRAFTON, 2460
TELEPHONE (066) 42 4790

JULY, 1985
83001/10/1

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1. INTRODUCTION

1.1 Wooli is located on the north coast of N.S.W. approximately 36 km south east of Grafton. At Wooli, the Wooli Wooli River (known also as the Little River) enters the South Pacific Ocean after commencing on the eastern side of the Coastal Range (east of Halfway Creek).
Wooli is a fishing and tourist village and the river is used extensively for swimming, fishing, boating, oyster farming etc.

1.2 The applicant, Mr. R. Ronlund, proposes to extract sand from the bed of the Wooli Wooli River in the Shire of Ulmarra. The bed of the Wooli Wooli River is not zoned in the deemed Local Environmental Plan for the Shire of Ulmarra, consequently the Lands Office is the determining authority for the sand extraction. The determination is an activity under Part V of the Environmental Planning and Assessment Act 1979 and its Regulations and as such the Crown Lands Office is required to take into consideration all the environmental factors associated with the activity. The filling of land or the stockpiling of sand requires consent under the deemed Local Environmental Plan and is therefore a separate issue - the consent authority in this instance is the Ulmarra Shire Council.

1.3 Initially the applicant proposed to extract 130,000 - 135,000m^3 of sand over a 10-15 year period. However the proposal now is to extract 27,000m^3 of sand over a 3 year period, and where it was initially intended to supply sand for Wooli on a long term basis the intention is now not to sell any sand.

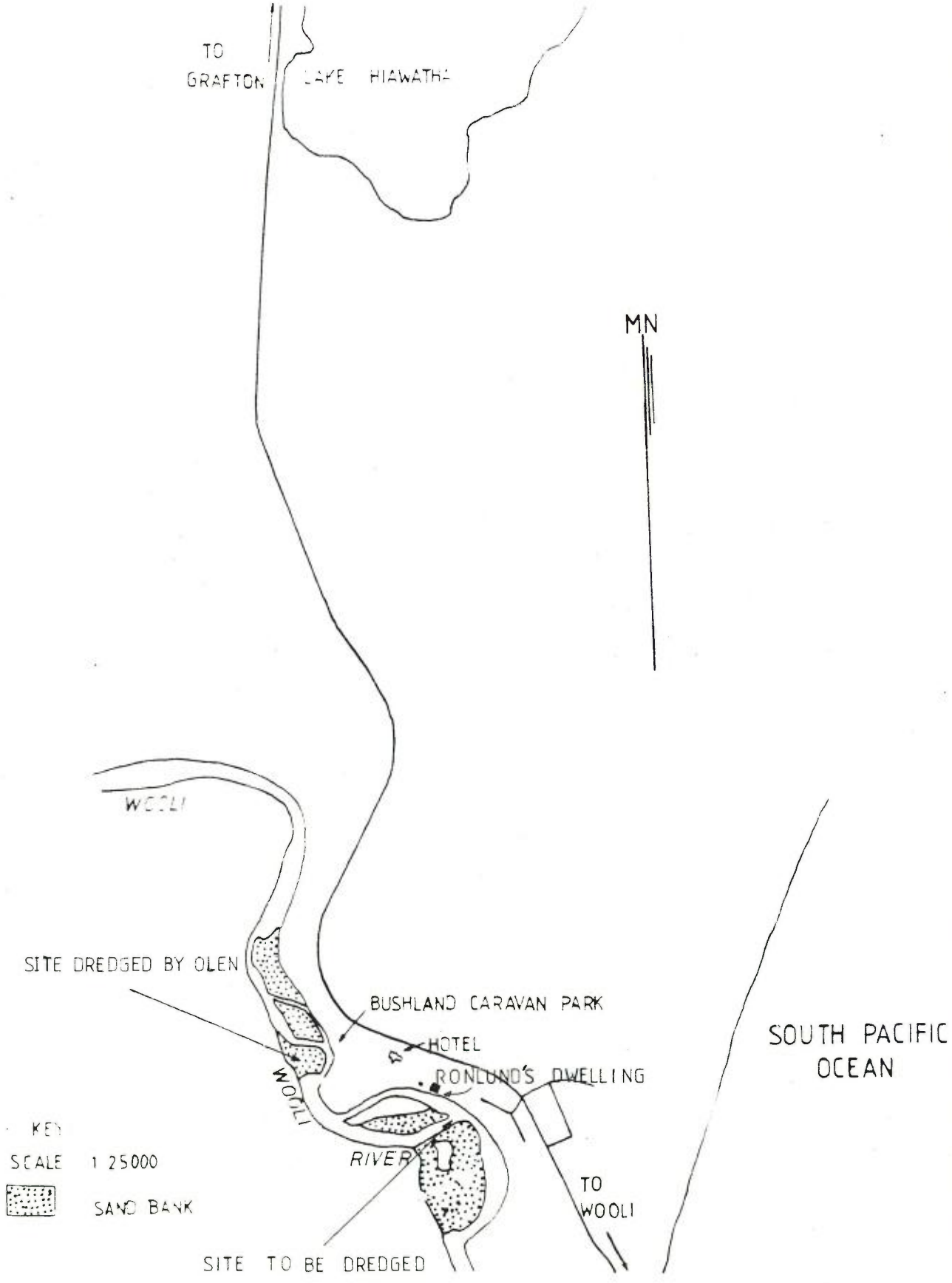
1.4 The proposed E.I.S was referred to the Director of the Department of Environment & Planning on 7th November 1983 - refer to correspondence enclosed.

1.5 A report by A.A. Racek Dr. rer. nat., Senior Lecturer in Biology (Hydrobiology) University of Sydney (retired), named "A Critical Assessment of Ecological and Hydrobiological Factors of Concern" was prepared as scientific background for this Environmental Impact

Statement and is attached to and forms part of this Statement.

1. 6 Initially the proposed extraction amounted to 130,000m^3 of sand, this would have allowed for the long term supply of sand for the Wooli area. The Lands Office has indicated that it would prefer to see a short term proposal and consequently the applicant now proposed to obtain enough sand to land fill his own property only - an amount less than 30,000m^3.

LOCALITY MAP



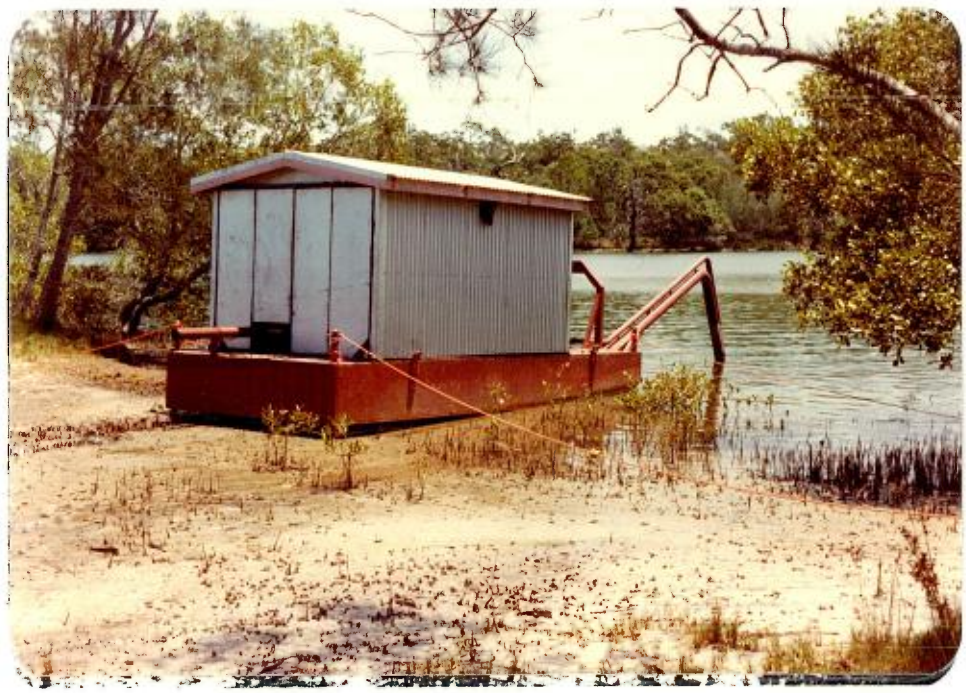
2. FULL DESCRIPTION OF THE PROPOSED ACTIVITY

2. 1 The applicant Mr. R. Ronlund proposes to dredge part of the bed of the Wooli Wooli River for the purposes of filling his land being Lot 2 D.P. 568117 Wooli Road Wooli.

2. 2 The quantity of sand will be approximately 27,000m^3 over a three year period.

2. 3 The subject site of the proposed dredging is situated at that part of the Wooli Wooli River opposite the applicant's dwelling and downstream approximately 310 metres. The area of the river to be dredged will be 2.27 hectares approximately.

2. 4 The sand will be collected by a suction dredge which has a 150 m.m. suction pipe entry and then which pumps the sand through a 100 m.m. pipe to the point of deposit. The 6/4 Warman Slurry Pump will be operated by a 130 horsepower 6 cylinder Perkins diesel engine. The motor activates the pump which creates a suction and draws in the water and sand at a rate of approximately 2700 litres per minute. The suction end of the equipment is movable and any disturbed matter on the bed of the river is automatically suctioned into the pump and deposited on the fill site. The amount of sand deposited will vary according to the ratio of sand/water in the pumping system however advice from the manufacturers indicates that approximately 25 to 30 percent of the volume will be sand - this will yield approximately 30-45 cubic metres per hour. The sand as it is deposited from the discharge pipe is left on the ground whilst the water runs off the filled area. The dredge will move around the lease area as the sand is extracted to the required depth. Experience of dredging at Olen's property (just upstream of this site) has shown that there is a minimum of noise. The pipelines are laid in a manner so that once they leave the dredge they are sunk to the bottom of the river and then run up the river bank onto the property. The dredge and pipe line are required to be marked



THE DREDGE THAT IS TO BE USED FOR THE EXTRACTION OF SAND BY MR. RONLUND - CURRENTLY MOORED AT MR. OLEN'S SITE UPSTREAM IN THE WOOLI WOOLI RIVER.

in accordance with the requirements of the Maritime Services Board - refer to correspondence enclosed.

2. 5 A levee will be constructed around the fill area to trap any silt. Experience at Olen's property has shown that there is very little silt which is produced from the land fill operation and in that land fill operation it was found that a levee bank was sufficient and it was not necessary to install silt detention dams.

2. 6 It will be normally necessary for two people to work the proposed operations, particularly in relation to the moving of the discharge pipes from one point to another. Sand will have to be levelled out on the site. This will involve additional labour however this work is expected to be carried out under contract.

2. 7 There are registered oyster leases in the immediate vicinity, discussions have been held with the Fisheries Division of the Dept. of Agriculture and agreement has been reached on the location of the initial area to be dredged. The area now proposed to be dredged is much smaller than that originally proposed and is within the agreed area. See Sec. 5.8 Possibly one of the major factors in a dredging operation is the depth to which one intends to excavate. In this instance it is not intended to dredge below the deepest point of the channel. There will be a batter of 1:10 to the new invert of the channel which will be R.L. -2.0m Australian Height Datum.

2. 8 The hours of operation will be 7.00 a.m. to 7.00 p.m. Monday to Saturday. However this will vary to the rate of demand by the applicant for sand - sometimes the dredge may work for 5/6 consecutive days whilst on other occasions it may work only 2 days per week.

2. 9 It will be observed from the plan that it is not intended to dredge close to the main shoreline nor within 10 metres of any registered oyster lease. The maximum batter on the sides of the dredged area will be 1 in 10.

2.10 All sand will be deposited onto Mr. Ronlund's property where it will be used for land filling for a future residential subdivision. A development application has been lodged with the Ulmarra Shire Council to fill the site to R.L. 2.64m A.H.D. which is 100 m.m. below the existing lower floor level of Mr. Ronlund's dwelling. Levels taken from the March 1974 flood at the site show that floodwater reached R.L. 2.55m A.H.D. Council has issued development consent for the filling of the land subject to the conditions referred to in the attached consent.

2.11 There will be no alteration of property boundaries, mean high water, adjacent roads etc. There will be an alteration to the level of Mr. Ronlund's property to approximately R.L. 2.64m Australian Height Datum. This aspect is subject to a Development Application submitted to Ulmarra Shire Council and forms part of a flood plain management study being conducted by the Public Works Department (Coffs Harbour) and Council.

2.12 Prior to dredging taking place it is intended to

(i) Stockpile top soil to the final R.L. around existing trees to prevent the direct contact with the salt water.

(ii) Stockpile the balance of the grass and top soil so that it may be respread after the land has been filled.

(iii) A levee will be constructed around the area to be filled. The area within the levee will be used to hold the slurry and to enable any silt to settle. A pipe or series

of pipes just above the top of the fill will enable trapped water to be released back into the river. If any significant silt is encountered, detention dams will be constructed outside the levee to trap the silt.

(iv) A levee will be constructed either side of the watercourse so as the sand filling will not interfere with the natural flow of water. At a later date and in the subdivision stage the watercourse will probably be relocated and piped.

2.13 Noise

The dredge that will be used is that used by Mr. Olen in his sand extraction. The following is an extract from that E.I.S.

"Noise readings have been taken with the dredge operating at the edge of the Wooli Wooli River. The following readings were recorded with an eight knot breeze blowing from the South South West and from the dredge towards the observer.

Natural background level 58dB(A)

8m from the dredge	- motor operating but not under load	73dB(A)
8m from the dredge	- motor under load	79dB(A)
40m " " "	- " " "	68dB(A)
60m " " "	- " " "	62dB(A)
70m " " "	- " " "	60dB(A)

The above readings were taken with the enclosed side of the dredge in line with the sound level meter, An additional reading was taken 8m away from and in line with the dredge motor under load, this resulted in an increase of 2dB(A) to 81dB(A).

The following table which shows the permissable noise exposure levels adopted by the U.S. Department of Labour shows that the dredge will not have any effect on persons residing at the caravan park as they will be well inexcess of 150 metres from

the noise source.

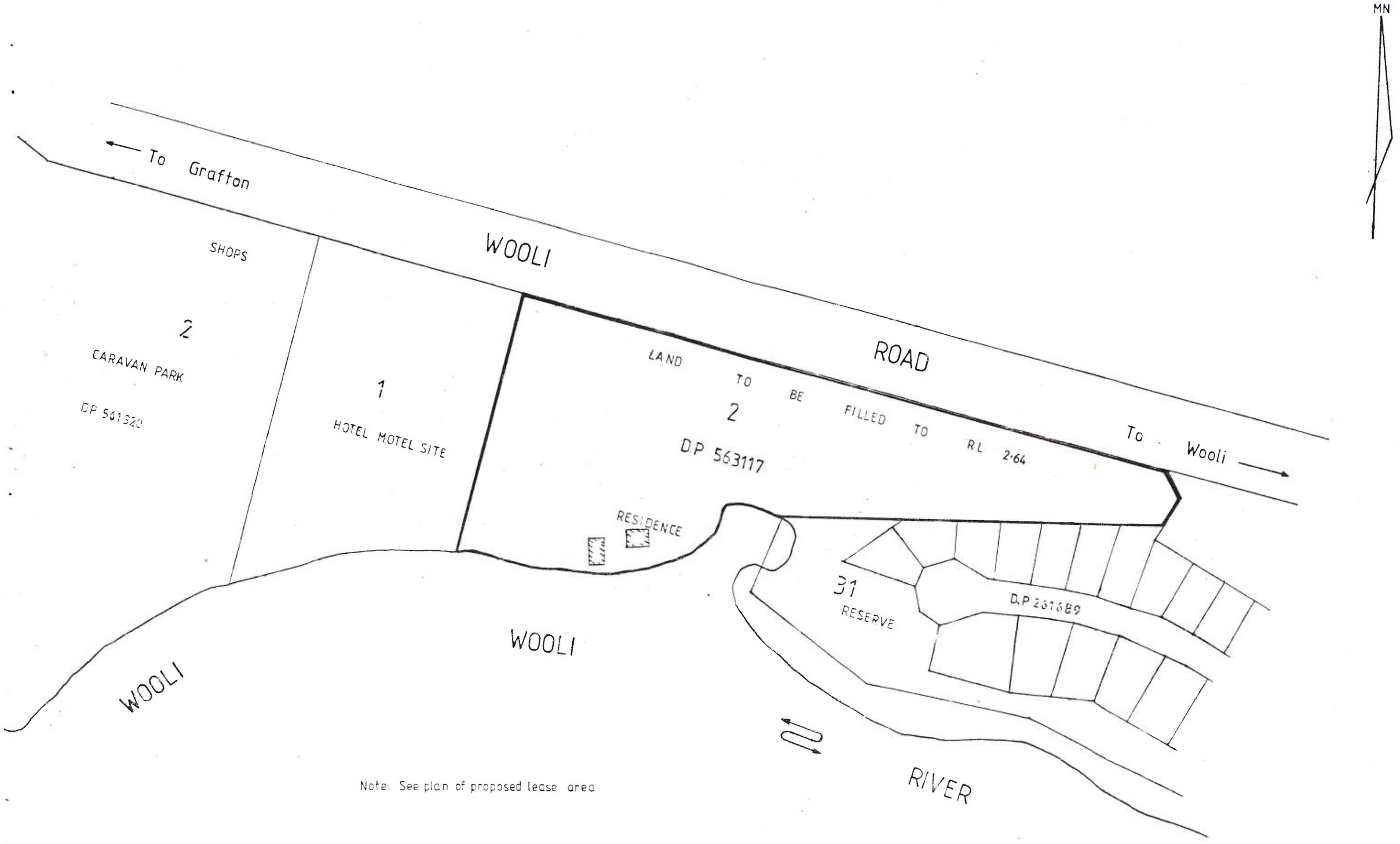
Duration per day (Hours)	Sound level dB(A) a Weighting Slow response
80	90
6	92
4	95
3	97
2	100
1-1.5	102
1	105
½	100
¼ or less	115

The Crown in its assessment of that E.I.S has stated:-

> "Noise readings of the dredging operations have been taken at the edge of the Wooli Wooli River. The readings were well below the accepted standards. Additional safeguards are not required. Some noise will emanate from the landfill operations and haulage of the material from the site. Both of these operations will be of a very limited nature and therefore will not have a significant impact."

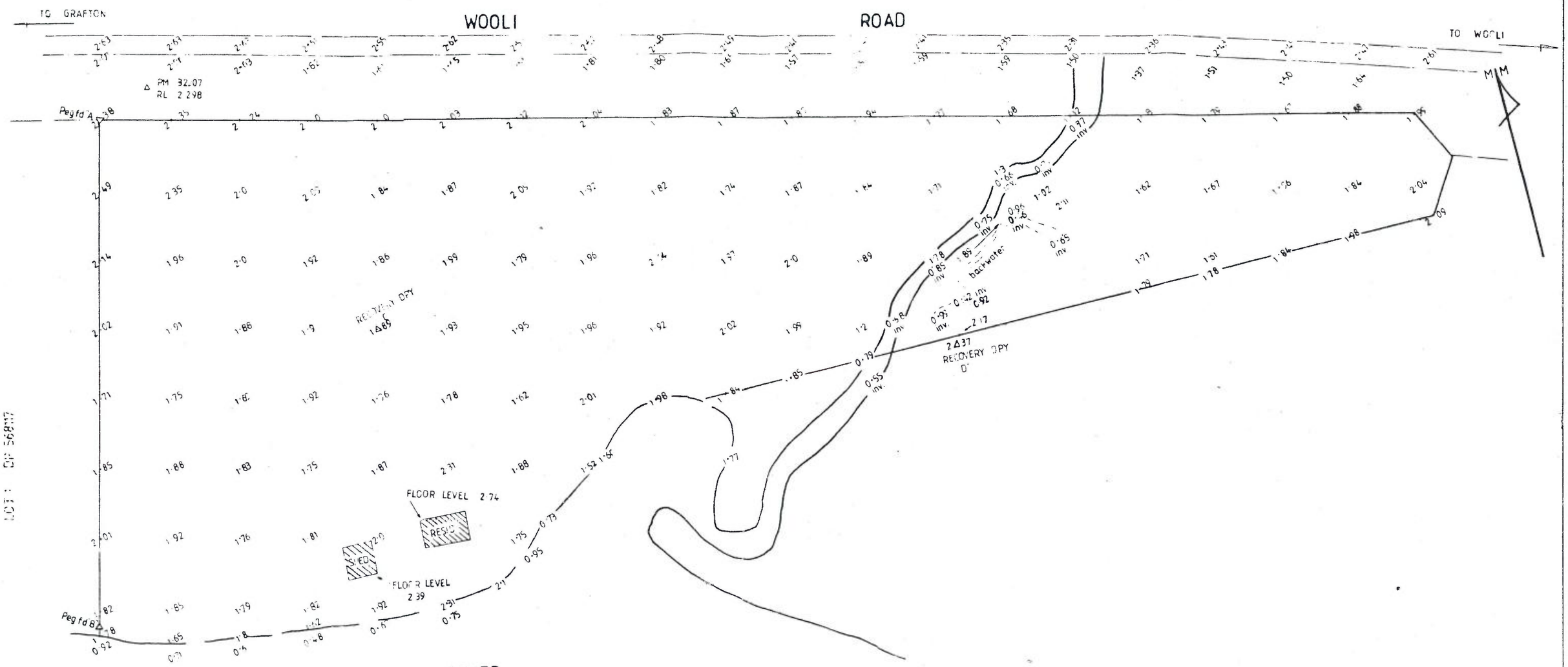
SITE OF AREA TO BE FILLED WITH SAND.
NOTE HOW THE DWELLING IS CONSTRUCTED ON A MOUND.
FILLING WILL BE PLACED TO WITHIN 100 M.M. BELOW
THE FLOOR LEVEL OF THE DWELLING.

STANDING AT THE ENTRACE TO THE SITE TO BE FILLED
LOOKING SOUTHWEST AT THE WOOLI HOTEL/MOTEL.
THE BUSHLAND CARAVAN PARK (MR. OLEN'S) IS LOCATED
ON THE OTHER SIDE OF THE HOTEL/MOTEL.



Note. See plan of proposed lease area

PLAN OF SITE TO BE FILLED WOOLI Rd. WOOLI



PLAN SHOWING LEVELS OF LOT 2 DP 568117

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PO BOX 468 GRAFTON 2461
PHONE (066) 424790

DATE 21.2.83
SCALE ~~1:800~~
REF NO 83001

NOTE 1. All levels on Aust. Height Datum.
2. B.M. = Lands Dept. PM 32207 RL 2.298
3. Date of field survey 14.2.83
4. Base line for grid = 'A'-'B'

3. CHARACTERISTICS OF SEDIMENT MATERIAL TO BE EXTRACTED

3. 1 ORIGIN OF SEDIMENTS

Conventionally, one should expect the bottom deposits on any tidal river bed to be derived from both terrestrial and marine transporting agencies, even though the relative percentages of these differing products is bound to differ grossly with respect to particular topographical characteristics of the environment. While the Wooli Wooli River estuary is similar to a large number of others along the eastern seaboard of Australia - typically possessing comparatively low terrigenous deposits - their percentage in this river is considerably lower. Not only is this due to topographical factors, but also to the fact that the Wooli Wooli River in its lower reaches has changed its course in the mid-Tertiary following subsidence of the general region, so that it now cuts through extensive sand dunes produced by the sea in more recent geological periods. The overwhelming percentage of both organic and inorganic deposits is thus of marine origin, with only about 6-8% to be traced to terrigenous agencies.

3. 2 CLASSIFICATION OF PARTICULATE MATTER

By conventional definition, river sands may be subdivided into very coarse (2000-1000 microns), coarse (1000-500 microns), medium (500-250 microns), fine (250-125 microns), and very fine (125-65 microns). If all the material is within the limits of 65-5 microns, the term silt is commonly used. Similarly, the texture of these deposits can be designated as follows:

Sand: More than 80% of the material coarser than 65 microns.

Silty sand: From 50-80% coarser than 65 microns

Sandy silt: More than 50% coarser than 5 microns and more than 20% coarser than 65 microns.

Silty mud: More than 50% coarser than 5 microns, and less than 20% coarser than 65 microns.

The texture of the siliceous sand deposits at the proposed excavation site has not been found to differ appreciably from that present elsewhere in this general region, even though some changes are bound to occur in the uppermost layers of the deposits by temporary disturbing actions of excessive flow rates, tidal surges, wind, and of course seasonal meteorological phenomena. Omitting this uppermost layer, subject to transitory and intermittent fluctuations by transporting agencies, the underlying strata display a fairly uniform grading, at the average ranging from medium to very fine, while only about 6% of the grains could be classed as coarse.

3. 3 TRANSLOCATION OF SEDIMENTS

In any river individual particles of the sediment are subject to translocation by various agencies such as mentioned above. Certain velocities will thus decide whether the substrate components will be eroded, merely transported, or settled, and furthermore will affect particles of differing dimensions in different ways. In this tidal river of rather low profile the effect of eroding velocities - usually during cyclonic depressions - have been found of insignificant consequences of strictly temporary nature, and any eroded material will inevitably be returned by tidal surges to places of similar topographical characteristics. Stratification of sediments on such occasions, studied over long periods, does not normally occur but laminations of material of differing particle size are not uncommon. Once the disturbing action of eroding velocities eases, transporting action will take over and the individual particles settled in those places as dictated by their size - and thus sinking velocity, while lamination often disappears.

3. 4 SUMMARY OF OBSERVATIONS

The sand deposits on the proposed site, which are chiefly of marine origin, display a fairly uniform grading from medium to very fine, while only a minor percentage can be classed as coarse. The uppermost layer, often consisting of silt including organic debris, is subject to translocation by various transporting agencies especially during adverse weather conditions, and therefore not necessarily present at all times in the one location.

* This section has been prepared by Dr. A. A. Racek

4. OBJECTIVES OF PROPOSED ACTIVITY

(i) To provide sand for land fill purposes for private purposes.

(ii) To provide sand at an economical price from a local supply.

(iii) To improve the bed of the Wooli Wooli River for recreational and commercial (fishing) purposes by the removal of some of the sand banks.

(iv) To reduce the current effect of erosion on the banks of the river by widening the bed of the main channel.

5. DESCRIPTION OF THE ENVIRONMENT

5. 1 The Physical Environment is to be considered in this section.
Dr. A. A. Racek in his report has covered other aspects of the environment.

5. 2 This area of the Wooli River has been affected to a large degree by mankind. The land owned by the applicant has been cleared and a large dwelling and shed have been erected near the bank of the river. A hotel/motel is adjacent to the western boundary of the subject property. Adjoining that to the west is a large caravan park.

5. 3 Within the river there are a number of oyster leases as shown on the attached plan. It is intended that dredging will not take place within 10 metres of any lease.
As mentioned in Dr. Racek's report, the effect of storms/floods result in rapid changes to the river in its lower reaches. It would appear that in "the mid-fifties when it used to be possible to navigate the river by local seagoing trawlers almost to the junction of its tributaries during high tides, the problem of the massive layers of shifting sandbanks may be around for sometime."
At the present time it would be extremely difficult if not impossible for these sea going trawlers to navigate in the area proposed to be dredged.
In addition the deepest part of the channel is currently located within some oyster leases.

5. 4 The Crown in its assessment of the E.I.S. for sand extraction for Mr. Olen has reported:-

> *"The Wooli Wooli River commences on the eastern side of the coastal range and enters the sea at the Village of Wooli. In view of its comparative low gradient the normal flow is rather sluggish and has a clearly defined tidal zone. Under normal weather conditions, the sluggish flow and shallow profile of the River*

gives rise to the formation of sand banks and bars which promote changes in its channel characteristics. Construction of a breakwall at the mouth of the River appears to have accelerated the formation of sand banks and increased navigation difficulties, particularly during ebb tides. With the consolidation of sandbank shoals, deeper and narrower channels have tended to develop close to the shore on the outside of the flow curve. This has caused significant shore erosion along both banks during flooding in the vicinity of the proposal. The River banks consist of sand beds overlying sheets of organically bound sands, which are susceptible to such erosion."

5. 5 The riverbank area to the east of the subject site is generally vacant land consisting of both dedicated Public Reserve and Crown land. On the southern side is Yuraygir National Park. This National Park was reserved in its present form in 1980 and now contains 14,000 ha in three sections stretching from Red Rock in the south to Angourie in the North. Because of the need to investigate any possible impact on the National Park and its environs Dr. A. A. Racek was engaged to determine the ecological and hydrobiological aspects of the proposed dredging.

The northern riverbank is generally grassed and has some scattered mangroves along the length of the area to be dredged. The area to be dredged ranges between 60-110 metres from the northern bank of the river. There will be no impact on the riverbank nor on the mangroves created by the dredging. The filling of the land will not affect any of the scattered mangroves as directly behind the house and shed the riverbank is relatively high and sand fill will not be placed within 10

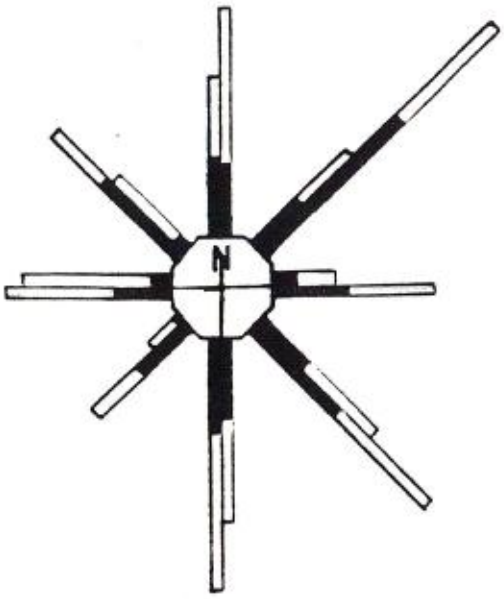
metres of the riverbank for the length of the property.

To the east of the residence is a dedicated public reserve and sandfill shall not be placed on that reserve.

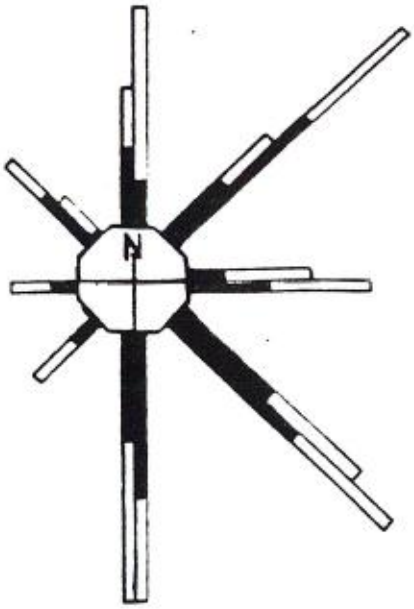
5. 6 The Wooli River is subject to flooding. The Public Works Department has completed a study on the Wooli Wooli River and verbal information from the Coffs Harbour Office indicates that the 1 in 100 year flood frequency would have a level of approximately R.L. 3.2m Australian Height Datum. The plans attached to this Statement shows the existing levels over the applicants land and the riverbed. It is intended to fill the land to approximately R.L. 2.64m and taper the level off to the existing level near the bank. The details of the Public Works flood plain management policy have not been released, however the Ulmarra Shire Council has issued development consent for the filling of the land.

5. 7 The climate for Wooli is very similar to that of Yamba. Statistics provided by the Bureau of Meteorology show that the mean rainfall is 1453 m.m. with March being the wettest month having 180 m.m. over 15 days, with September being the driest month having only 62 m.m. over 9 days. The most frequent wind is generally from the north east and south east and becoming more frequent in summer. In autumn the more frequent and stronger winds tend to be from the south east and south whereas in winter the afternoon winds come more from the southwest and west. The seasonal information on wind direction, frequency and speed is shown on the graph included in this statement.

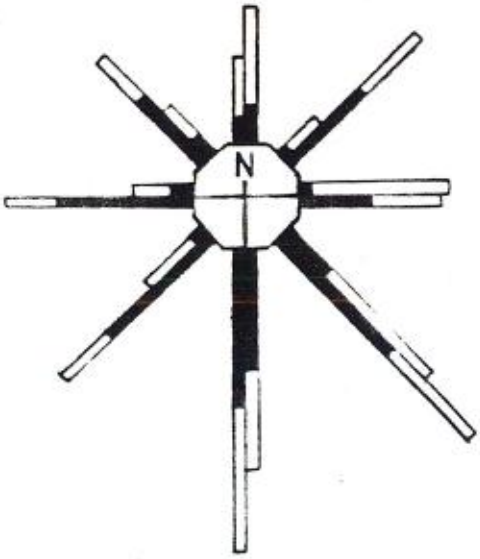
YAMBA : — WIND INFORMATION



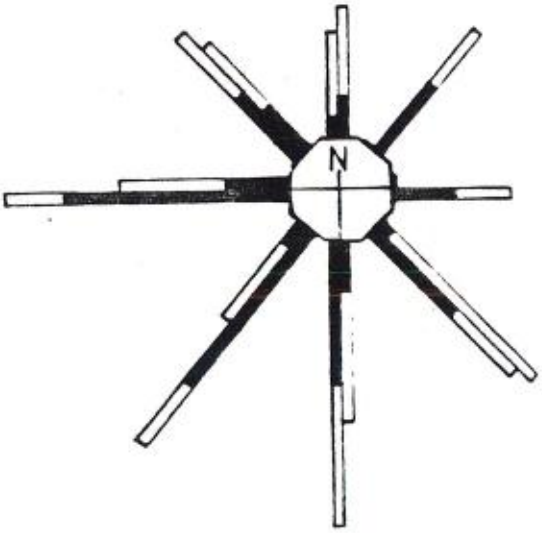
SPRING



SUMMER

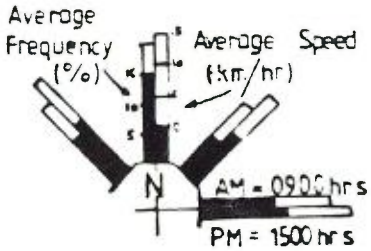


AUTUMN



WINTER

KEY :



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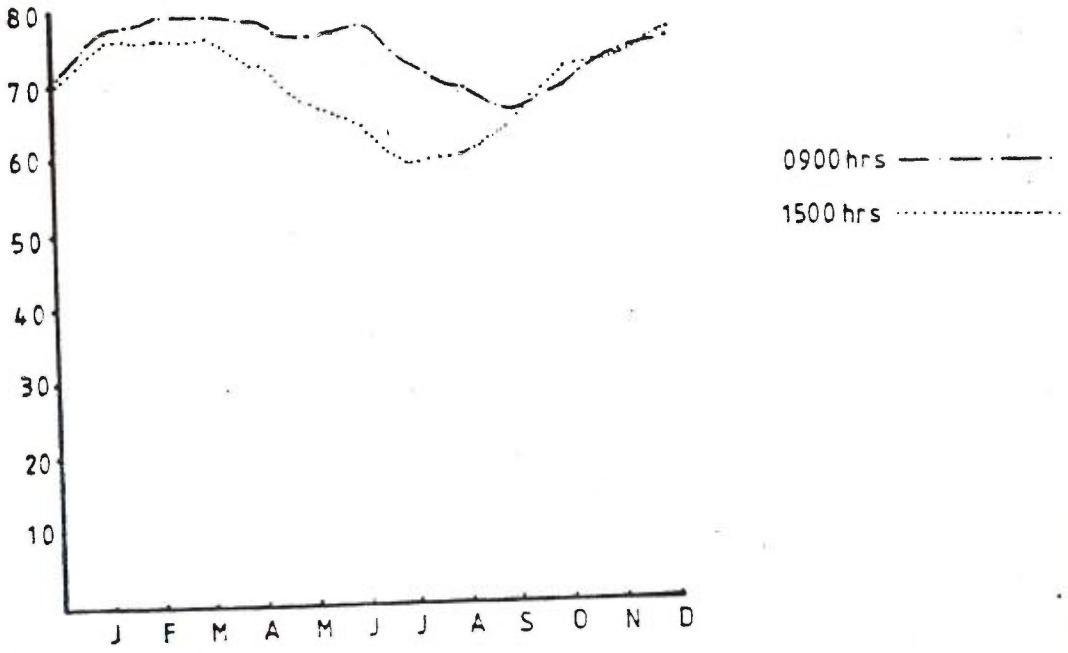
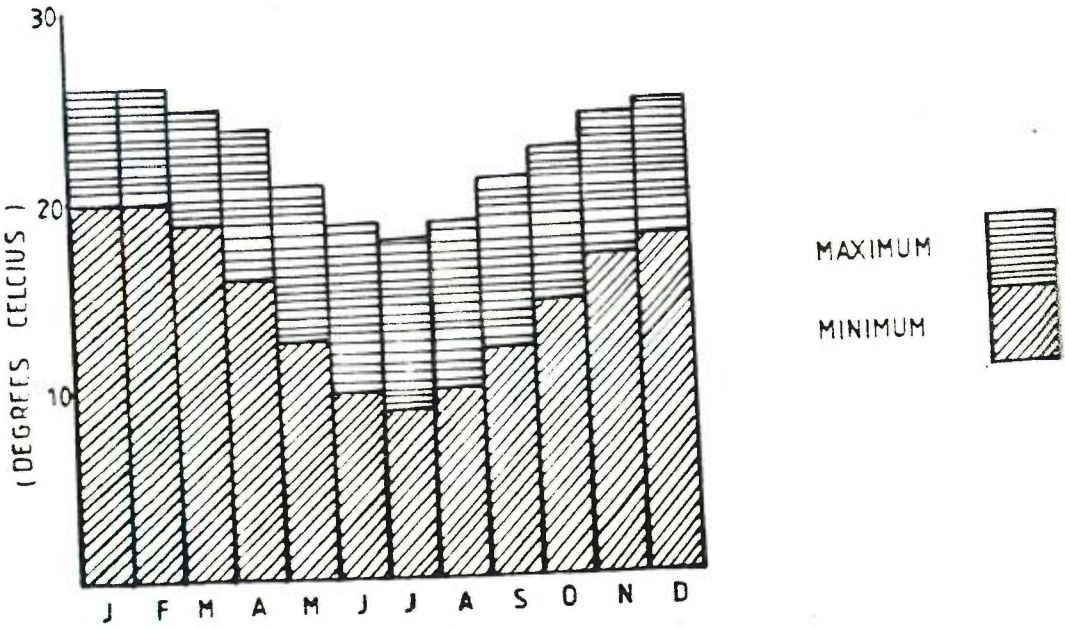
MEAN RELATIVE HUMIDITY



DAILY MEAN MINIMUM AND MAXIMUM TEMPERATURES



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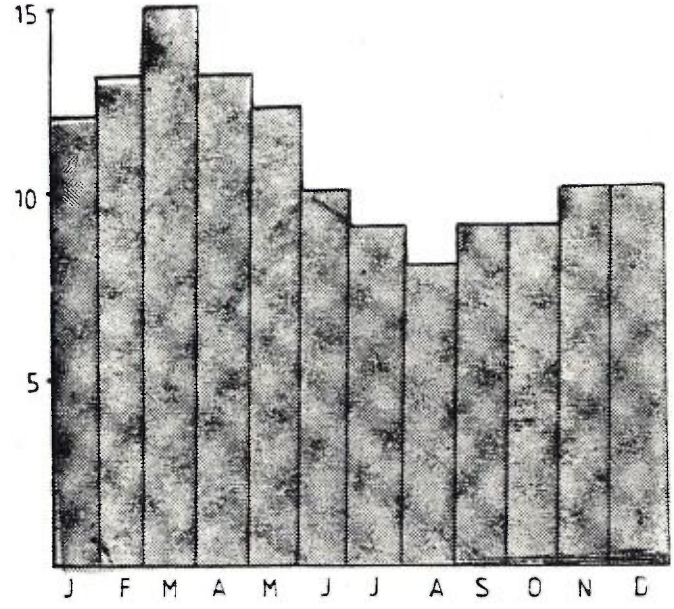
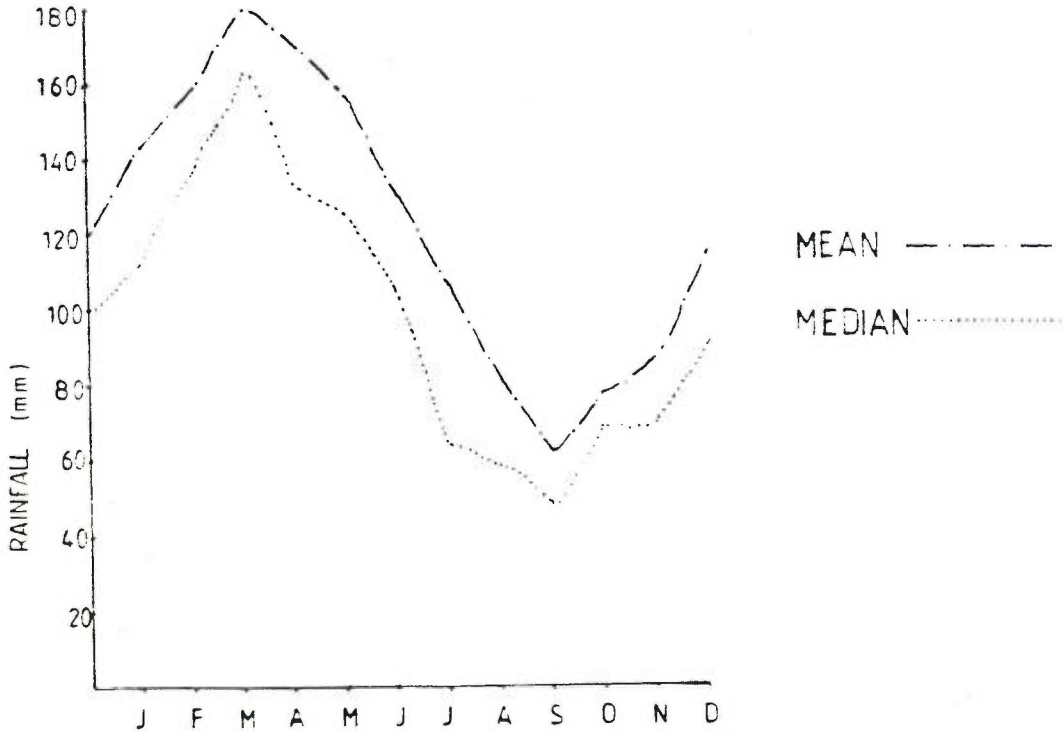
MEAN NUMBER OF RAINDAYS PER MONTH



MEAN AND MEDIAN RAINFALL PER MONTH



5. 8 Oyster Leases.

In complying with the requirements of the Dept. of Agriculture (Dept. of Fisheries) the following persons were contacted:-

1. B. P. & M. D. Shanahan - Oyster leases No. 71.318, 73.47.
   Reply - No objection if dredging is within area of original proposal.
2. J. & B. Myers - Oyster lease 71.176
   Reply - No objection - dredging "may even be slightly beneficial". However if any build up of silt did occur in lease area they "would expect the damage to be made good".
3. S. Young - Oyster leases No. 71.366, 71.394, 76.102.
   Reply - No objection "to R. A. Ronlund removing sand from the Wooli River."

It should be noted that the above replies referred to the original proposal to extract 130,000m^3 of sand. The current proposal now is such that it is further away from four of the oyster leases referred to above.

B. W. McCLOSKEY

Land, Mining, Engineering &
Photogrammetric SURVEYOR
Town Planner

Registered under the
Surveyors Act, 1929

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FOR THE USE OF ITS MEMBERS ONLY

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'Phone: (066) 42-4790
P.O. BOX 468, GRAFTON 2460
BRANCH OFFICE:
SHOP 17, 1ST FLOOR
221 RIVER ST., MACLEAN
066 45 3033

Reference 83001/10

27th September, 1984

COPY OF CORRESPONDENCE FORWARDED TO HOLDERS OF OYSTER LEASES NEAR THE SITE OF PROPOSED DREDGING IN THE WOOLI RIVER.

Dear Sir,

Reference: Proposed dredging of Wooli
Wooli River - Mr. R. Ronlund

My client Mr. Ronlund proposes to dredge part of the Wooli Wooli River using the same or similar dredge as that currently being used by Mr. R. Olen. As the extraction of sand from the River is classified as "designated development", I am required to prepare an Environmental Impact Statement which will be placed on exhibition and comments for and against the proposal will be able to be submitted to the Lands Dept. at that stage.

It is intended that the dredged area will have a side batter of less than 1 in 10 and that the level of the bed of the river will not be less than R.L. -2.0. I have a copy of a report by a marine biologist who has reported that the dredging should have no adverse effect upon the river and based on past experience the dredging should improve the present marine environment and ecosystems.

Agreement has been reached with the Fisheries Branch on the extent of the lease which is shown by the heavy broken line. This agreement is subject to:-

"Confirmation from the lessees of the adjacant oyster leases that they have no objections to the proposed dredging."

In order that I may proceed with the finalization of the E.I.S I would appreciate receiving your comments in writing on whether you agree or disagree with the proposed dredging.

Yours faithfully,

.....

B. W. McCloskey

Oyster Lease No.

S.YOUNG
RIVERSIDE DRIVE
WOOLI 2462.

TO WHOM IT MAY CONCERN.
RE. OYSTER LEASES NO.7I-366 7I-394 76-I02.

I/WE THE UNDER SIGNED OPERATE THE OYSTER LEASES SHOWN IN THE APPROXIMATE POSITION ON THE DREDGING PLAN.
I/WE HAVE NO OBJECTION TO R.A.RONLUND REMOVING SAND FROM THE WOOLI RIVER.

YOURS FAITHFULLY, S. Young

S. YOUNG

B. P. & M. D. SHANAHAN
OYSTER FARMERS
P.O. BOX 3, WOOLI 2462
PHONE. STD 066-497537

MR.B.W.McCLOSKEY.
P.O.BOX 468.
GRAFTON.2460.

I2th OCTOBER I984.

Dear Sir,

Your letter dated 27th September.I984 to hand.
Ref.8300I/I0 Re.Oyster leases No.7I.3I8, 73.47

I would like to advise that I have no objections to the proposed derdging of the Wooli Wooli River by Mr.R.Ronlund, as it should not effect the Oyster Leases which are within the approximated marked plan.

Yours faithfully,

J. & B. MYERS
122 MAIN STREET,
WOOLI 2462
Phone:
066 – 49 7685

2nd Oct. 8

B.W. McCLOSKEY
SURVEYORS,
GRAFTON

YOUR REF 83001/10
27.9.84

PROPOSED DREDGING OF WOOLI RIVER by R. RONLUN

As lessees of oyster lease 76 176, we don't have any objection to your client's dredging scheme.

We agree that dredging in the area proposed, in the manner proposed, is unlikely to have much effect at all and may even be slightly beneficial.

However – in the unlikely event that W. Rowlund's work has the adverse effect of building up silt on our lease, we would expect the damage to be made good.

Yours truly,

Myers.

6. IDENTIFICATION & ANALYSIS OF THE LIKELY ENVIRONMENT INTERACTIONS BETWEEN THE PROPOSED ACTIVITY AND THE ENVIRONMENT

6. 1 The reader of this Statement is requested to refer to hydrological, hydrobiological and birdlife aspects in "A Critical Assessment of Ecological & Hydrobiological Factors of Concern" by Dr. A. A. Racek.

Under the various heads of consideration Dr. Racek has included:-

(i) HYDROLOGICAL CONSIDERATIONS

- Type of River
- Nature of Bottom Sediments
- Salt Marshes
- Meteorological Influences
- Available Nutrients
- Application of Information to Site

(ii) HYDROBIOLOGICAL CONSIDERATIONS

- General Aspects
- Submerged Flora
- Salt Marshes
- Mangrove Belts
- Plankton, Nekton and Benthos
- Oyster Cultures
- Fish Populations and Movements
- Application of Information to Site

(iii) CONSIDERATIONS REGARDING BIRDLIFE

- General Aspects
- Birds of Prey
- Mangrove-dependent Birds
- Water Birds
- Waders
- Application of Information to Site

(iv) MONITORING STUDIES NEARBY

(v) CONCLUDING SUMMARY

With the extraction of sand as proposed on the plan one will see the widening of the channel. This should result in a reduction of erosion of the northern bank of the Wooli Wooli River.

6. 2 Special consideration has been given to a possible adverse effect on the oyster leases in the immediate vicinity. This aspect has been referred to the Dept. of Fisheries and the lease area has been determined as a result of those consultations. The lease area has been substantially reduced since those negotiations.

6. 3 As previously stated whilst the dredging should not cause any adverse effect on the oyster beds, the proponent should be required as a condition of consent to cease work in the vicinity of the oyster beds if a silt area is encountered and silt becomes suspended in the water to such an extent that there is likely to be an adverse effect on the beds. A report by C.P. Ellway & E. J. Hegerl on "Fishes of the Tweed River Esturary" refers to the effect of sand dredging in the Tweed River with 70 percent of the bethnic flora dead or dying 450 metres downstream within 3 weeks of the operations commencing. The dredging operation proposed by Mr. Ronlund varies considerably from that in the Tweed. The proponent will be using a suction dredge as opposed to a "bucket" type and the composition of the bed of the Wooli Wooli River has very little silt compared to the Tweed River. In view of the findings by Dr. Racek and the experience gained from the dredging by Mr. Olen, there should not be any adverse interaction created by the use of a suction dredge within the Wooli Wooli River.

6. 4 Consideration has been given to the possible effect of mass movement of sand from either upstream or downstream into the dredging site once operations begin. A study on the lower section of the Wooli Wooli River - downstream of the subject area - shows that "A *study of the sediments in the river system shows that not much river sand is reaching the coast, nor is marine sand moving far upstream.*" (Bed Changes & Sediment Distribution in the Lower Wooli River, Northern New South Wales by P.S. Roy

& E. A. Crawford). It would appear that the change in the location of sand banks and the apparent sand accretion in the subject area is created by the changes in the channel as a result of storms. These changes have resulted in increased erosion near the channel and sand deposits increasing in areas of low velocity.

6. 5 Based upon the findings of Roy & Crawford one would not expect any large movement of sand either upstream nor downstream into the site to be dredged.

Whilst there appears to be no major movement of sand created by dredging in itself, storms have resulted in movement of sand in the Wooli Wooli River. A recent survey of Olen's lease site showed that 11,500m^3 of sand had apparently been excavated. However it is known that Mr. Olen had spread 19,220m^3 of sand over his caravan park - the sand having come from the Wooli Wooli River. This difference of 7720m^3 of sand has resulted in sand being deposited by storms in the excavated area. If the sand had not been deposited in the dredged area it would have most likely caused some movement in the sand banks elsewhere in the river.

6. 6 There is no known sites of aboriginal archaeological significance within the area to be dredged nor on the area to be filled. The latter has been cleared of timber for many years, levelled and partly developed.

7. ANALYSIS OF LIKELY ENVIRONMENTAL IMPACTS OR CONSEQUENCES OF CARRYING OUT THE PROPOSED ACTIVITY

7. 1 It is considered that the dredging of the Wooli Wooli River will not cause any adverse environmental impacts provided the normal requirements of the authorities are adhered to.
There should be however, beneficial environmental results of the dredging e.g.

1. Improved supply of nutrients being released into the water system resulting in the creation of additional eel grass beds, food for school prawns and a general improvement in the marine environment.
2. There will be improved navigation for boating by having a wider and deeper channel.
3. An economic method of obtaining sand fill for the future urban area of Wooli will become available.
4. The widening of the channel should reduce the scouring or erosion which is created by the narrow channel.

8. JUSTIFICATION OF THE PROPOSED ACTIVITY

The proposed dredging appears to be justified on a number of reasons.

1. The creation of the Yuraygir National Park has reduced areas from which land based sand can be obtained. Sand is not available from Minnie Water at present according to the Crown - refer to correspondence. The only alternatives for sand fill are to either truck the sand in which is not economical, or to obtain the sand from the river.
2. In order that the village area of Wooli may expand it is necessary that the land be filled economically - provided that there is no significant adverse environmental effect.
3. Dr. Racek in his summary states "*the writer of this report is unable to find any justifiable objections to the proposed sand extraction from the hydrological, hydrobiological, and general biological points of view, naturally assuming the strict adherence to all regulations by the various authorities governing such an operation.*"

New South Wales Government

Lands Office

P.O. Box 11
GRAFTON. N.S.W. 2460

29 APR 1983

Mr B.W. McCloskey,
Consulting Surveyor,
P.O. Box 468,
GRAFTON. N.S.W. 2460

Our reference GF81 H 2734 JD:JAC

Your reference

Telephone. 420545

Dear Mr McCloskey,

I refer to your letter of 22nd April, 1983, concerning the availability of sand for removal in the Wooli--Minnie Water area.

There are no areas of Crown land in the abovementioned locality where there are supplies of sand immediately available for removal purposes.

Yours sincerely,

J Perry

Officer-in-Charge

9. MEASURES TO BE TAKEN IN CONJUNCTION WITH THE PROPOSED ACTIVITY TO PROTECT THE ENVIRONMENT

1. The proponent will be required to adhere to the requirements of the the state authorities.
   Failure to comply would result in the cancellation of the proponent's lease.
2. The effects of the dredging beneficial and/or adverse will be monitored, and suitable action taken when considered advisable.
3. A levee will be constructed around any areas to be filled to enable any suspended silt to settle. If necessary sedimentation/detention dams will be constructed to prevent the return of the silt to the river.
4. No dredging will take place within 10 metres of any oyster lease nor in the vicinity of the riverbanks. Should there be any evidence of likely effect on the oyster leases, the operations will be relocated to an area where there will be no adverse effect.

10. ENERGY REQUIREMENTS OF THE PROPOSED DEVELOPMENT

10. 1 The use of a filling source located near to the site will reduce the energy requirements of having to truck in fill from beyond the western side of Yuraygir National Park. The actual dredging operations will not be a major energy user. The pump will consist of 130 horsepower 6 cylinder diesel engine. The only other energy requirements will be for the clearing of topsoil of areas to be filled, the building of levees, the final spreading of sand and the rehabilitation of the site.

10. 2 The filling of land will reduce the need for people to build 2 storey homes to have the main floor above flood level. This could save up to $8,000 per dwelling. The property when subdivided will produce approximately 20 building blocks. The saving in building costs will be in the order of $160,000.

11. FEASIBLE ALTERNATIVES

11. 1 Due to the fact that the village of Wooli is surrounded by National Park and there is no known suitable sand deposit available within the Wooli area apart from the river - there appears to be no feasible alternative which is both environmentally acceptable and economic.

11. 2 Mr. Olen has completed the dredging that he required. A total of 19,220m^3 of sand has been spread over his property. Mr. Olen has sold his dredge to the applicant. There would be a reserve of approximately 6280m^3 left from the original design quantity. However due to movement of sand it is known that there are 14,000m^3 of sand available based on the river bed survey carried out by my firm on 18th June 1985. The dredging carried out by Mr. Olen has improved the river flow as there appears to be less velocity in the river near the bank due to the widening of the channel - and hence most likely a reduction in the erosion problem that had been previously experienced. It would be possible to dredge from Mr. Olen's site however this would mean that the applicant would have to hire or purchase a second dredge because of the increased distance the sand would have to be pumped. Whilst this is an alternative proposal it would not be economic and there is not sufficient sand available being a shortfall of 13,000m^3.

12. CONSEQUENCES OF NOT CARRYING OUT THE PROPOSED ACTIVITY

12. 1 It will not be economic to fill land to satisfy Ulmarra Shire Council's requirements to have the floor level of new dwellings 500 m.m. above flood level unless river sand is used. New roads would be below flood level and would be affected by flood waters resulting in major maintenance costs for the ratepayers.

12. 2 The build up of sand banks within the Wooli Wooli River will reach the stage where even small pleasure boats may not be able to navigate the river. Even now the main channel is within some oyster leases. Whilst the proposed dredging will not completely overcome this problem, it will assist in alieviating the problem in the immediate area.

13. AUTHORITIES CONTACTED FOR THE EXTRACTION OF SAND

Director of Dept. of Environment & Planning
Lands Office (Grafton)
Dept. of Mineral Resources
Dept. of Public Works
Ulmarra Shire Council
State Pollution Control Commission
Maritime Services Board of N.S.W.
Dept. of Agriculture (Fisheries Dept.)

ENVIRONMENTAL PLANNING & ASSESSMENT ACT, 1979

ENVIRONMENTAL IMPACT STATEMENT

This Statement has been prepared by or on behalf of Mr. R. Ronlund being the applicant making the development application referred to below.

The Statement accompanies the development application made in respect of the development described as follows:-

The dredging and extraction of 27,000m^3 of sand from the Wooli Wooli River

The development application relates to the land described as follows:-

No. ..... Street .....
Locality/suburb Wooli Wooli River at Wooli
Real property description Bed of part of the Wooli Wooli River
(e.g. Lot, D.P./M.P.S., vol./fol., Parish, Portion)

The contents of this Environmental Impact Statement has been prepared under Section 112(1) of the Act and has been prepared inaccordance with Clauses 57 & 58 of the Environmental Planning & Assessment Regulation 1980 and are set forth in the accompanying pages.

Name, Qualifications and Address of person who prepared Environmental Impact Statement

B. W. McCloskey
Reg. Surveyor
Dip. T & CP (Syd)
L.G.T.P. Ord. 4 (No. 399)
P. O. Box 468,
GRAFTON, 2460

Certificate.

I, Brian W. McCloskey, of 11 Duke Street, Grafton, hereby certify that I have prepared the contents of this Statement in accordance with clauses 57 and 58 of the Environmental Planning and Assessment Regulation, 1980.

.....
Signature

8th July 1985
.....
Date

New South Wales Government

Department of Environment and Planning

Mr. B.W. McCloskey,
P.O. Box 468,
GRAFTON. N.S.W. 2460

Remington Centre
175 Liverpool Street, Sydney, 2000
Box 3927 G.P.O. Sydney, 2001
DX 15 Sydney
Telephone (02) 266-7590

Contact R. Jordan
Our reference 83/1220
Your reference 83001/10

Dear Sir,

Proposed Sand Extraction by Mr. R. Ronlund in the Wooli River Estuary, Wooli.

Thank you for your letter dated 7th November, 1983, which indicates that you are consulting with the Director with regard to the preparation of an environmental impact statement for Mr. Ronlund.

2. The basic requirement for an environmental impact statement that relates to an activity referred to in Section 112(1) of the Environmental Planning and Assessment Act, 1979, is that it shall be prepared in accordance with Clauses 57 and 58 and bear a certificate required by Clause 59 of the Environmental Planning and Assessment Regulation, 1980.

3. With regard to the form and content of the environmental impact statement it is advised that there are legislative requirements for the preservation of relics and Aboriginal places. Where there is a possibility of these being encountered in development the incorporation of an aboriginal archaeological survey as part of an environmental impact statement may be necessary. Where aboriginal archaeological surveys are needed, it is a requirement that they be undertaken by persons who are professionally qualified archaeologists or anthropologists, or who are members of the Association of Consulting Archaeologists. If in doubt on this matter a proponent should consult with the National Parks and Wildlife Service.

4. The Director requires that you should take into account the matters specified in the attachment to this letter. These matters are to be adequately addressed in the environmental impact statement, and should be taken into account in the determination of the proposal by the determining authority with whom we suggest you confer.

5. Where matters are likely to come within the scope of legislation relative to air, water and noise control as administered by the State Pollution Control Commission, the view of the Commission should be sought and if aspects of the proposal would significantly affect agricultural land or agricultural industry, the views of the Department of Agriculture should also be sought and appropriately addressed in the environmental impact statement.

6. Should you require any further information regarding this matter, please do not hesitate to contact us again.

Yours faithfully,

D. Bosward 19/12/83
Executive Officer
Environment Protection Division.
As Delegate for the Director.

83/1220

NEW SOUTH WALES DEPARTMENT OF ENVIRONMENT AND PLANNING

ATTACHMENT

PROPOSED SAND DREDGING FROM THE WOOLI RIVER ESTUARY AT WOOLI BY MR. R. RONLUND.

A comprehensive environmental impact statement should adequately cover all the matters specified in Clause 57 of the Environmental Planning and Assessment Regulation, 1980.

These matters should be clearly and succinctly outlined in the text and where appropriate supported by adequate maps, plans, diagrams or other descriptive details to enable all concerned to gain a clear understanding of the full scope of the development and its likely impact on the environment.

The following particular matters should be included in its coverage:

1. Background information.
.Location of works.
.Broad nature and extent of works proposed.
.Land tenure, boundaries, site details in relation to environmental planning instrument zonings and any other land use constraints.

2. Detailed description of the proposal.

This description should not only describe the proposal at the site but also describe any associated operations such as winning and transport of materials, processes involved (highlighting any proposed crushing or blasting), disposal of wastes, rehabilitation, landscaping and use of the end product if likely to have environmental implications.

Particular matters to be covered include:

.Characteristics and economic significance of the resource.
.Methods of extraction/plans of operations.
.Type of machinery and equipment to be used.
.Expected life of the operation.
.Number of persons to be employed.
.Hours of operation.
.Details should include dredging depths, proposed underwater slopes, nature and quantity of spoils and proposals for handling/disposal of same
.Location and quantity of any necessary stockpiling.
.Access arrangements - truck routes and number of truck movements.
.Noise levels.
.Any changes to existing land surfaces; property boundaries; Mean High Water Mark; adjacent roads and/or facilities as a result of the works.
.Proposals for rehabilitation and assurances of effective completion.

3. Description of the environment.

This description should provide details of the environment in the vicinity of the development site and also of aspects of the environment likely to be affected by any facets of the proposal. In this regard, physical, natural, social, cultural, archaeological and economic aspects of the environment should be described to the extent necessary for assessment of the environmental impact of the proposed development.

4. Assessment of environmental impact and measures to be taken to reduce the impact especially with respect to:

.Effect of extraction on sediment transport rate of the river.

.../2

.Bed and bank stability of the river during and after the operations.
.Details of sediment and material gradings and any likely changes due to extraction.
.Possible siltation, sedimentation or downstream effects (including turbidity) of the extraction.
.Any likely cumulative effects of the proposed operations in the vicinity.
.Details of floods and any likely effects of the operation on flood liability of surrounding lands.
.Possible effects of flooding on the operations.
.Effects on aquatic fauna, flora, oyster leases and on bank vegetation.
.Likely noise disturbance caused by the operations, including transport operations, on nearby residences.
.Other impacts of trucking movements.
.Dust control and any nuisance likely to be caused.
.Water treatment and other pollution control measures.
.Disposal of waste material.
.Landscaping measures and effects on the visual environment.
.The proposed final use of the site and likely effectiveness of rehabilitation.

5. Authorities contacted.

The names of authorities contacted should be listed with particular reference to the Ulmarra Shire Council; the Department of Mineral Resources (embodying Council's views upon the desirability or otherwise of natural accretion of sediments), Department of Agriculture, Division of State Fisheries; the Maritime Services Board; the State Pollution Control Commission and in particular the Public Works Department. Any comments relating to specific matters of interest raised by such authorities should be declared, including those in relation to possible cumulative environmental problems.

19/1/83

New South Wales Government

Lands Office

P.O. Box 11
GRAFTON. N.S.W. 2460

Our reference GF83 H 709 JD:JAC

Your reference

Telephone: 420545

Mr R.W. McCloskey,
Surveyor,
11 Duke Street,
GRAFTON. N.S.W. 2460

Dear Mr McCloskey,

PROPOSED SAND DREDGING IN THE WOOLI WOOLI RIVER--R. RONLUND

The Director, Department of Environment and Planning has advised this Office that you have consulted that Department concerning the preparation of an Environmental Impact Statement for Mr Ronlund.

Please find attached copies of conditional consents received in this Office.

It would be appreciated if you could advise this Office whether Development Consent has been granted in respect to the land based development, or whether this matter will be considered in liaison with the Illawarra Shire Council and covered in the Environmental Impact Statement.

Yours sincerely,

J. Dickson,
for Officer-in-Charge.

New South Wales Government

Department of Mineral Resources

C.A.G.A. Centre
8-18 Bent Street
Sydney
Postal Address:
GPO Box 5288
Sydney, NSW 2001
Telex ~~AA21708~~ AA74875

The Officer in Charge,
Grafton Lands Office,
P.O. Box 11,
GRAFTON. NSW. 2460. 94.

RECEIVED
-6 MAR 1984
GRAFTON

Our reference: M83-4258

Your reference: GF83 H 709

For further information ring: J.Dunnell

Telephone: 231 0922
Extension: 4680

Proposed Quarry Licence by R.Ronlund
Wooli Wooli River
Parish Wooli Wooli County Clarence

Reference is made to your letter of 13th December, 1983, concerning the subject proposal.

There are no objections to the proposed quarry licence over the red tinted area on the attached diagram and there are no special conditions required to be incorporated in the Quarry Licence if offered.

Economic concentrations of heavy mineral sands have been proved to the south and east of the subject area and it is considered that the subject area could contain similar concentrations. Although the area and tonnages to be extracted are small, it could be feasible for the heavy minerals to be extracted before sale of the sand for construction and fill purposes. The feasibility of so doing could be examined by the proponent.

J.Dunnell,
for SECRETARY.

SW/DW

Public Works Department
COFFS HARBOUR DISTRICT OFFICE

359 High Street,
Coffs Harbour Jetty N.S.W.

Postal Address:
Box 63J P.O.,
Coffs Harbour Jetty 2451

Officer-in-Charge,
Land Board Office,
P.O. Box 11,
GRAFTON. 2460

RECEIVED
PR
13 JAN 1984
10
GRAFTON

Our reference: FM 151

Your reference: GF83 H709

Telex: 66922

Telephone: (066) 52 0411

Contact: Mr. Wyllie

11 JAN 1984

Application to Remove Sand from the
Wooli Wooli River by Mr. R. Ronlund

Reference : Your letter dated 13th December 1983

The Department raises no major objections to the proposal but several aspects will be required to be discussed in the Environmental Impact Statement (E.I.S.) before concurrence is given and the Departments conditions for dredging are issued.

To analyse the dredging proposal, a comprehensive survey by a registered surveyor to Australian Height Datum (A.H.D.) extending 200 metres upstream and downstream of the proposal is required. The survey is to be of sufficient detail so that 0.5 m contours can be confidently drawn over the bed of the river and along the banks extending approximately 40 metres from mean high water mark.

In absence of the above survey, the Department generally considers that excavations are to be no deeper than the existing natural river bed channel and are not to be within 10 metres of mean high water mark. The latter condition depends on the site in terms of existing bank stability and vegetation.

In relation to filling using the excavated material, the site needs to be identified as is the case for any proposed site for stockpiling. If in the instance whereby one or both sites are inundated by a 1:20 or 1:100 year flood then an assessment of the proposals is required in terms of the potential effects on the flooding characteristics of the Wooli Wooli River.

The Department reserves the right to make final comment once the E.I.S. has been officially received.

H.R. COLLEY
District Engineer,
Coffs Harbour.

ULMARRA SHIRE COUNCIL

P.O. BOX 13
PHONE 44 5303

ALL COMMUNICATIONS MUST BE ADDRESSED TO THE SHIRE CLERK

COUNCIL CHAMBERS,
15 COLDSTREAM STREET,
ULMARRA, 2462.

17th January, 1984

Officer in Charge.
Department of Lands,
P.O. Box 11,
GRAFTON. 2460

Dear Sir,

Quarry Licence Application - R Ronlund, Wooli

I refer to your letter of 13th December, 1983 reference GF83 H 709 JD:JAC and advise that this Council does not have any initial objection to this proposal.

Yours faithfully,

P. J. Tarrant

P. J. Tarrant,
Shire Clerk.

66:PJT:PC

Coffs Harbour.

State Pollution Control Commission

157-167 Liverpool Street
Sydney 2000
G.P.O. Box 4036
Sydney 2001

Officer-in-Charge,
Grafton Lands Office,
P.O. Box 11,
GRAFTON N.S.W. 2460 94

Our reference 706404 TS:AO

Your reference GF83 H 709 JD:JAC

Telephone 266 0661
Telex Head Office AA 72234

Dear Sir,

QUARRY LICENCE FOR R. RONLUND, WOOLI

I refer to your letter of 13th December, 1983, concerning the above matter and am pleased to submit the following comments.

Careful consideration needs to be given to controlling water runoff from the sand stockpiling operation. Settlement ponds may be required to produce a clarified effluent suitable for discharge to waters. Details of the sand extraction method and effluent treatment will need to be incorporated in the environmental impact statement. Accordingly, the applicant will need to apply to the Commission under Section 19 of the Clean Waters Act for permission to proceed with the project. The location of all water treatment facilities must be clearly marked on a map and details of flood levels should also be included.

It is unlikely that our approval under the Noise Control Act will be required. Nevertheless, noise levels relating to the operation will need to be listed and a location plan showing distances of residences in the vicinity of the operation, with calculated noise levels at the nearest residence, will be required.

While it is not likely that the development will cause any air pollution problems and that the Commission's approval under the Clean Air Act will be necessary, all matters relating to air pollution should still be considered.

If you would like to discuss this matter further, please feel free to contact Mr. Vic Majury of our Grafton office on telephone 420535.

Yours faithfully,

D.B. O'CONNOR
Secretary 16/2/84

THE MARITIME SERVICES BOARD OF N.S.W.
CIRCULAR QUAY WEST,
SYDNEY.

Telephone No. 240-2111 (All Hours)
Telex No. AA24944
Telegraphic Address
'Marboard Sydney'
OFFICE HOURS 8.30am - 4.00pm
Address Correspondence to
The Secretary,
Box 32 G.P.O.,
SYDNEY 2001

Please Quote No. 84/52116
DT:KD

The Officer-in-Charge,
Land Board Office,
P.O. Box 11,
GRAFTON. N.S.W. 2460

2 April 1984

Proposed Disposal of Crown Land.

Your letter of 13 December 1983 (GF83 H709 JD:JAC)

Applicant: R. Ronlund

Purpose : Quarry License Location: Wooli Wooli

This Board will not raise any objection to the granting of the abovementioned application, subject to inclusion of the following conditions in the general conditions applicable to the disposal of Crown Land :-

(1) The Tenant shall not be exempted from the provisions of the Management of Waters and Waterside Lands Regulations - N.S.W. and shall at all times comply with the requirements of all Acts and Regulations administered by the Maritime Services Board.

(2) The Tenant shall at all times comply with any directions given by the Board or an officer of the Board in regard to painting, lighting or use or alteration of any structure as may from time to time be required in the interests of safe navigation, equitable use of and conservation of waterways and the prevention of pollution.

(3) All operations shall be carried out in accordance with the Board's Acts and Regulations and any special conditions which may from time to time be required.

(4) Only anchors and mooring arrangements approved by the Board shall be used and plant not working is to be hove clear of navigation or to the bank in restricted areas.

The lights and shapes to be displayed by vessels, plant and pipelines associated with dredging operations are as prescribed in the Navigation (Collision) Regulations 1983, Rule 27(d)(i), (ii) and (iii) or as otherwise directed.

No outlying wires, cables or pipes shall be used unless with the approval of the Board.

(5) Any required depth shall be evenly maintained and the bottom left clear of debris, rubbish, potholes, etc. No slope to be steeper than 3 in 1.

.../2.

(6) No dredging shall be permitted closer than 9m from any shore, jetty structure or navigation mark.

(7) Any licensed structure or occupation and/or apparatus licensed by the Board, if affected by dredging operations, shall be moved, re-aligned temporarily or permanently, re-built or replaced with additional equipment, if required, to the Board's satisfaction and without cost to the licensee.

(8) No dredged material shall be deposited in any lake, river or waterway.

T.C. Page

T.C. PAGE,
Secretary.

ULMARRA SHIRE COUNCIL

P.O. BOX 13
PHONE 44 5303

ALL COMMUNICATIONS
MUST BE ADDRESSED
THE SHIRE CLERK

COUNCIL CHAMBERS,
15 COLDSTREAM STREET,
ULMARRA, 2462.

NOTICE TO APPLICANT OF DETERMINATION OF A DEVELOPMENT APPLICATION
Environmental Planning and Assessment Act, 1979.

To: ...B.W. McCloskey..... Applicant's reference No. 83001

of: ...P.O. Box 468, GRAFTON...2460.....

being the applicant in respect of Development Application No. 19/85.

Pursuant to Section 92 of the Act notice is hereby given of the determination by the above Council of the Development Application No. 19/85 relating to the land described as follows:

Lot 2 D.P.568117 Parish of Wooli Wooli (R. Ronlund)

The Development Application has been determined by - (b) granting of consent subject to the conditions specified in this notice.

The conditions of consent are set out as follows:

1. Approval being granted by the Crown Lands Office to obtain fill from Wooli River.
2. Land formation is designed so as not to adversely effect the drainage of Wooli Road in the vicinity of the fill.
3. The owner acknowledging that this approval does not indicate that approval has been considered in relation to any future rezoning or subdivision of the land.
4. That a plan showing proposed fill levels be submitted and approved by the Shire Engineer prior to commencement.

THE REASONS FOR THE IMPOSITIONS OF THE CONDITIONS ARE SET OUT AS FOLLOWS:-

To comply with Councils Deemed Environmental Planning Instrument; Environmental Planning & Assessment Act, 1979; Council's subdivision code and Council policy.

Endorsement of date of consent 17th May, 1985

On behalf of the above Council ..... Date 17th May, 1985

P. J. Tarrant,
Shire Clerk.

NOTES: (1) To ascertain the date upon which the consent becomes effective refer to Section 93 of the Act.

(2) To ascertain the extent to which the consent is liable to lapse refer to Section 99 of the Act.

(3) Section 97 of the Act confers on an applicant who is dissatisfied with the determination of a consent authority a right of appeal to the Land and Environment Court exercisable within twelve months after receipt of this notice.

R. RONLUND - PROPOSED SAND EXTRACTION
WOOLI WOOLI RIVER

A CRITICAL ASSESSMENT OF ECOLOGICAL AND HYDROBIOLOGICAL FACTORS OF CONCERN

SCIENTIFIC BACKGROUND TO THE ENVIRONMENTAL IMPACT STATEMENT PREPARED BY Mr.B.W. McCLOSKEY

A. A. RACEK, Dr. rer. nat.
Senior Lecturer in Biology (Hydrobiology)
University of Sydney (retired)
P. O. Box 74
WOOLI N.S.W. 2462

10th June, 1984

TABLE OF CONTENTS

1. INTRODUCTION

1.1 PURPOSE OF REPORT

Comprehensive additional information on the various facets of hydrological, hydrobiological, and general biological implications connected with the proposed sand extraction from the Wooli Wooli River is herewith provided in order to augment the detailed E.I.S. prepared by Mr. B. W. McCloskey with respect to environmental factors of possible concern. The data gained during specialised surveys on the proposed site and its immediate surrounds are hereby conveyed fully objectively and with the utmost care of accuracy and details involved. They also include most of the results of monitoring studies carried out during 12 months of dredging activities already permitted nearby (Mr.R.Olen) which provided highly valuable information.

1.2 SOURCES OF INFORMATION

Mr. B. W. McCloskey, Grafton;
Mr. and Mrs. R. Ronlund, Wooli;
Mr. R. Olen, Wooli;
Mr. B. Shanahan, Wooli;
Comprehensive field studies by the writer, as professional hydrobiologist, in and along the river during 1954, 1955, 1973, and then almost continuously since early 1974 when he became a permanent resident at Wooli;
A special field survey on the site and surrounding parts of the Wooli Wooli River, May 1984;
Data obtained by monitoring the effects of dredging activities in the Wooli Wooli River, while in operation, a separate and own-time study;
Investigations by the writer for the assessment of dieback of mangroves in this general region;
Comparative impact studies by the writer, chiefly dealing with canal dredgings in the estuaries and swamp belts of South Carolina, U.S.A., 1965 and 1971;
Geological data, in particular those concerning the substrate to be removed, were assessed from the Geological Map of NSW, Section New England, 1972

2. HYDROLOGICAL CONSIDERATIONS

2.1 TYPE OF RIVER

The Wooli Wooli River arises from two different major tributaries, as well as from a small number of minor ones, all draining areas overlying Silurian Fitzroy Beds of shales, slates, and phyllites, while in its lower section it runs through a depression of siliceous sand dunes of recent formation. In view of its comparatively low gradient its normal flow is rather sluggish apart from the lower section, where it is exposed to the fluctuating impact of the tides. Generally, the river therefore represents under normal weather conditions a rather shallow through, widening in its lower parts, and cutting in places of faster flow a system of channels through accumulating sand flats, some of which change their nature and position quite unpredictably, chiefly due to meteorological and tidal factors. Apart from its own drainage, the river receives additional drainage from extensive freshwater and brackish swamps, chiefly in the NW of the upper reaches, as well as the freshwater drainage of the Lake Hiawatha complex, reaching it through swampy or marshy areas from the east at two places in the vicinity of Wooli.

2.2 NATURE OF BOTTOM SEDIMENTS

The Wooli Wooli estuary differs from comparable locations on the entire north coast of New South Wales in possessing characteristically little quantities of mud, disregarding periods of excessive meteorological influences. Its natural characteristics are such that considerable layers of sand are deposited in the centre of the lower run, while suspended silt is delivered by centrifugal forces to the shore regions, where it is trapped by sand and vegetation. All these significant sand layers are moreover typical for the entire region in possessing an underlying sheet of organically-bound sand which forms an extensive impermeable layer throughout the sand dunes - including the bottom of Lake Hiawatha - and probably acts as a water table being responsible

for the retention of water between the dunes. Although these organically-bound sand layers display a characteristic dark colour, they should not be mistaken for heavy mineral sands, such as present along the ocean shores in the general region.

2.3 SALT MARSHES

These occur on different places along the river and are not distinctly affected by the river, but rather play an important role in affecting it themselves. Their cover of vegetation traps fine silt so that the substrate is typically muddy. During heavy rainfalls their salinity drops significantly to contain almost fresh water on such occasions. In some localities along the river bed these salt marshes tend to be inundated by the river during exceptionally high spring tides, often reinforced by flood conditions, but generally their water level is influenced by the height of the water table. Thus they represent nutritional drainage to the river, not vice versa

2.4 METEOROLOGICAL INFLUENCES

With respect to the brute forces of nature periodically acting on the entire estuary during cyclonic depressions and associated high winds, the Wooli Wooli River is particularly vulnerable to rapid changes, being rather shallow and wide in its lower reaches. Combined with exceptionally high spring tides, cyclonic winds - themselves subject to lunar and thus tidal periodicity - usually alter channels and sandbanks in the shortest time, often with long-lasting aftereffects. This vulnerability seemed to have been aggravated by the construction of the breakwalls which has significantly altered the nature of the river to an extent that it became rather flood-prone. Since the latest major meteorological disturbance in 1974 a further imminent flood danger was alleviated by the construction of a low-level overflow just north of the breakwalls, and there are signs that the river now slowly reverts to its previous natural condition. However, as documented by field studies of the mid-fifties when it used to be possible to navigate the river by local

sea-going trawlers almost to the junction of its tributaries during high tides, the problem of the massive layers of shifting sandbanks may be around for quite some time. During floods, the grossly increased flow rate will initially remove accumulated sand and deepen the channels, but these conditions will be reversed by the action of high tides. On the other hand, prolonged dry spells, such as experienced a few years ago, will deprive the river of normally received drainage water, thus causing a much decreased flow rate and a resulting exposure of the sand flats to high-velocity winds, at present making parts of the river even more shallow, thus presenting difficulties for navigation during ebb tides along most of its tidal run. The present deposition of shifting sandbanks in the centre of the river bed not only will deprive populations of larger fish of unrestricte movements further upstream, but also result in the development of some deeper channels close to the banks on the outside of the flow curve, thus causing significant shore erosion during wet periods.

2.5 AVAILABLE NUTRIENTS

The geological formations, as mentioned above, over which the proper river drains, would explain the comparative paucity of normally available nutritional values, so that a noticeable enrichment can only be expected from the drainage of extensive swamps in the NW of the upper reaches. The other major drainage contribution from the Lake Hiawatha complex, in view of its pronouncedly acidic water, would be even less profitable were it not for the fact that during drainage of this water through a chain of extensive swamps and marshes some enrichment takes place. At the source of these drainage waters the amount of dissolved solids in p.p.m. averages about 68, with sodium and chlorine dominating the cations and anions, respectively, and the pH reading averages 6.4, while the water delivered to the river has only somewhat higher values of both dissolved solids and pH. The best producers of valuable

nutrients, however, must be considered the periodically occurring extensive rain depressions, in spite of the grossly disturbing effects of river floods which they inevitably cause. This enrichment will be brought about by a wide drainage over fertile land, as well as by the liberation of present nutrients, trapped before under massive layers of now shifting sand. The best documentation of such an enrichment is the rapid expansion of the biota in and along the river which follows such natural disturbances. Naturally, further sources of significant contributions of nutrients are derived from the floor of the mangrove belts along the river, as well as twice a day by the tidal rhythm. As to the availability of these nutrients to submerged life, this has been more or less restricted to the shallow shore regions, while in midstream they now tend to be covered by deep layers of sand, thus being unreachable to most of the food-web organisms.

2.6 APPLICATION OF INFORMATION TO DREDGING SITE

The above hydrological information must make it obvious that those gigantic forces of nature, to which the river has periodically been exposed over many millenia, not only were unable to destroy or even permanently damage it in a major sense, but that these natural forces play a most important part in the distribution of essential nutrients as well as in the stabilisation of the flow regime. Considering hydrological characters alone, therefore, it is highly unlikely that man's impact - especially by such a comparatively minor operation as proposed - could leave a noticeable mark on the present condition of the river itself. The suction dredge to be used - i.e. the same as already operated nearby - has established its efficiency and lack of environmental disturbance of any kind, and in view of the paucity of estuarine mud contents has shown to pose no operational hazards with respect to harmful siltation. Cronin's (in Detwyler, 1971) statement that "Deleterious effects are real but localised, and nutrient release may offset

the damage done" has now been fully documented by monitoring the effects of the previous dredgings nearby, the results of which will be briefly discussed in a separate section below.

3. HYDROBIOLOGICAL CONSIDERATIONS

3.1 GENERAL ASPECTS

The Wooli Wooli River, while displaying the major facies of all estuaries, i.e. the periodical interaction of tides and drainage which constantly change the physical and chemical properties of the water, has already been demonstrated to be rather atypical with respect to its substratum and the characteristics of its water, normally derived from acidic drainage typifying this particular region. Under normal meteorological conditions one can define a zone of distinct marine influence reaching well upstream, to be replaced by an estuarine or brackish water zone of additional extensive length, and a comparatively short zone of true freshwater characteristics. In view of the shallow nature of the river these zones will shift considerably downstream after excessive rainfalls or cyclonic depressions, while in its lower run the marine regime will prevail. Organisms present during such natural disturbances will either adjust to the resulting environmental change, or move to their suitable niche, but eventually they are bound to benefit from the overall productivity, highest during floods and/or spring tides. Long-term field observations have indicated that the construction of the breakwalls at the entrance has had a limiting effect on the occurrence and abundance of estuary-dependent aquatic biota which, together with the inherent low productivity of the river, has led to the almost complete absence of some biota formerly present, especially penaeid prawns. Thus food-web deficiencies apparently peculiar to this river could be reasonably assumed, conditions which since have slightly improved by the artificial overflow after 1974, and most likely by the recent dredging activities monitored over 12 months.

3.2 SUBMERGED FLORA

Prior to the present survey, aquatic algae and higher plants such like the eelgrass (Zostera capricorni) have been found to be comparatively rare, and if present to be restricted to shallow slopes along the shore line in the lower reaches of the river, while being much better developed in the brackish zone, where they extend even into the channels. More recent investigations were able to demonstrate an increase in their abundance and dispersal, particularly that of the eelgrass which now shows signs of recolonisation, although still forming only incoherent patches in midstream.

3.3 SALT MARSHES

Generally speaking, they represent areas of shaltered water where flowering plants, mainly grasses, have taken over the role of the larger algae to a great extent, and form an almost complete surface cover. In the Wooli Wooli River these marshes are also more or less restricted to upper brackish reaches, continuing above high water line into extensive swamps.

3.4 MANGROVE BELTS

In this as yet remote and undisturbed location, mangroves line most of the tidal length of the river, and thus play a decisive role in the supply of highly valuable nutrients, producing detritus which becomes part of the forest floor and which forms the basic component in the diet of primary marine consumers. All animals living in the mangrove community are an integral part of the mangrove ecosystem, and among them the herbivores and detritivores have been shown to be important in the transfer of energy from the mangroves to the estuary (Hutchings and Recher, 1982). Two of their species, i.e. Avicennia marina and Aegiceras corniculatum abound in most areas of the river bank, while a third i.e. Rhizophora stylosa occurs discontinuously higher upstream. A recent survey has shown their condition to be healthy, and that they display no dieback symptoms as experienced in other parts of this State.

3.5 PLANKTON, NEKTON AND BENTHOS

Recent investigations have established a slight but quite noticeable improvement in the abundance as well as diversity of planktonic organisms since the last detailed survey of about a year ago. This refers to both micro- and macroplankton, mostly consisting of protozoans, the "algal bloom" Trichodesmium, an array of larvae of various crustaceans and molluscs, adult arrowworms, with an occasional influx of the small adult shrimp Acetes. For the first time since about 15 years larval and postlarval stages of the school prawn Metapenaeus macleayi have been found moderately abundant, indicating the return of this prawn to the riverine environment, where it used to be present before. In the upper brackish zone the abundance and species diversity drop significantly due to reduced salinities, with the exception of postlarval prawns, whose diet at these stages consists normally of algae. Apart from fishes, which will be discussed in a separate section below, the nekton is still quite poorly represented, mainly consisting of a limited number of shrimp species. In view of the present characteristics of the river, most of the benthic biota are more or less restricted to muddy patches along the banks, in particular on the mangrove floor. They range from worms to the well-known yabbies and the mud crab, which latter has an extensive range right up to the upper reaches.

3.6 OYSTER CULTURES

There are several oyster leases operating in the river, all carefully cultivated by conscientious oyster farmers, so that health and abundance of these commercially important molluscs are fully safeguarded. With respect to any possible silt release, found to be of quite immaterial impact, it should be noted that commercial species all over the world are remarkably silt-tolerant, while the local species seems particularly well adapted to adverse turbid conditions when the river is in flood.

3.7 FISH POPULATIONS AND MOVEMENTS

From extensive data collected by the writer, ranging back to the mid-fifties, it appears that the structure of the population densities in the Wooli Wooli River has not appreciably changed over about 30 years, although the availability to the fishermen may have done so on occasions of prolonged adverse conditions by drought and floods. Apart from a few non-commercial species like the gudgeons, blue-eyes, and others, most fishes frequenting the river are of marine origin, or represent estuarine developmental stages of these. In view of their diverse seasonal preferences, weather conditions, lunar periodicities, tidal variations, and in particular the availability of food, it is rather difficult to assess their normal order of presence and abundance. Among the most important regular inhabitants of the river are mullet (with 2-3 species), garfish, black bream, sand whiting, trumpeter whiting, luderick or blackfish, leatherjacket (2-3 species), dusky flathead, as well as some other commercial species of strictly seasonal or periodical occurrence. Of the true bottom-dwelling marine fishes present in the lower reaches, soles and flounders, as well as stingrays are quite common at times, while typical estuarine species like the estuary catfish, bullrout, and long-finned eel range far upstream, the latter two even entering the freshwater zone. There is also an occasional influx of normally freshwater minnows (Galaxias spp.) which periodically move via the estuary to the marine environment, and return as juveniles upstream to their freshwater habitats, usually during flood periods. The occurrence and abundance of marine fishes present is decidedly governed by a great range of conditions, which they will seek or evade in ever changing patterns. Some of the fishes not only are silt-tolerant during prolonged wet periods, but even seem to find improved feeding conditions on such occasions, while others simply move out to sea. Normally herbivorous species like luderick and some mullets are bound to be restricted to such locations where algal growth or other

submerged vegetation is available, thus being in rather sheltered positions when turbidity is high. The movement of all these fishes upstream is at present unrestricted in most of the lowest part of the river irrespective of tidal heights to about a point just NW of the original village of Wooli, where extensive sand barriers make it difficult for larger fish to enter upstream habitats or to remain there for prolonged periods save during high tides.

3.8 APPLICATION OF INFORMATION TO DREDGING SITE

Taking all impact possibilities of hydrobiological effects, derived from the proposed sand extraction activities, into most careful consideration, it is the qualified opinion of the writer of this report that no perceptible or permanent damage to any aquatic organism discussed can be caused, provided that all the regulations of the various authorities governing such an operation are strictly adhered to. The area of the proposed sand extraction is comparatively insignificant, and the intended sand removal in stages over a prolonged period will make it possible for the inherent resilience of all estuaries to heal little scars quickly. In any case the possible impact of the proposed project is fully incomparable with that of the gigantic natural forces to which the environment is periodically exposed, which all present biota are genetically conditioned to tolerate. The intended dredgings will avoid all areas where Zostera beds form coherent mats, or where mangrove pneumatophores emerge from the ground. Since the very few eelgrass colonies present on the general site outlined for sand removal represent only insignificant and widely scattered patches, and regulations disallow dredging close to any shore, both eelgrass and mangrove aerial roots will not be endangered in any perceptible way. The characteristic paucity of mud deposits in the river, already commented on in the hydrological section, makes accidental siltation during work unlikely, particularly when using the type of dredge the action of which has alread been closely monitored. Even should such highly localised siltation

occur by accident, extremely little plant life exists on or near the site to be affected, and both the benthos as well as the mangroves lining the shore would only benefit from released nutrients. Any possible mud release should only be avoided when working in the close vicinity of oyster leases, although the full consent to the project by the oyster farmers involved documents the insignificance of such an unlikely impact on the oyster's pronounced silt tolerance. With respect to the influence of the proposed operations on the usual pattern of fish movements temporary initial disturbances may be expected, even though the monitoring studies during previous dredging activities have demonstrated their short-lived nature.

4. CONSIDERATIONS REGARDING BIRDLIFE

4.1 GENERAL ASPECTS

In view of the great importance of estuaries to a significant variety of water- or mangrove-dependent birds, and also considering the proximity of the Yuraygir National Park of which stretches of the Wooli Wooli River are an integral part, special care has been taken in the assessment of any possible impact of concern the operation on the proposed site are likely to exert on the avifauna in this remote and as yet quite undisturbed area. The birds discussed, being the most important species present, or likely present, in the general area, are here dealt with without consideration of taxonomic arrangements but rather placed into groups of differing estuary dependence, as well into those of similar functional habits.

4.2 BIRDS OF PREY

The Osprey, Brahminy Kite, Whistling Kite, White-bellied Sea Eagle, Spotted Harrier, and Marsh Harrier, though normally typical for estuarine regions and often nesting there, do seek their prey over vast stretches of land or the seashore, so that they cannot be considered to be directly associated with the river itself, making human impact apart from tree-felling impossible.

4.3 MANGROVE-DEPENDENT BIRDS

These comprise a great assemblage of species, which are not specifically mentioned here since their preferred natural habitat are the mangrove forests with an only very limited dependence on the river itself. In this general undisturbed area they are fully protected from any of Man's impact on the aquatic environment by frequenting the dense canopy of the mangroves, thus always remaining in an efficiently sheltered position.

4.4 WATER BIRDS

a) Fish consumers: Of these the Pelican and the group of cormorants, i.e. Great Cormorant, Pied Cormorant, Little Black Cormorant, and Little Pird Cormorant, as well as the related Darter are widely distributed in our estuaries, and thus also common on the Wooli Wooli River. According to their specific fishing habits they are here restricted to stretches of deeper open water unaffected by tidal conditions.

b) Herons and Egrets: This generalised group of birds, usually frequenting remote shallow baylets with a good cover of vegetation, feed on nektonic or benthic organisms, their long legs enabling them to disregard tidal height differences. To this group belong the Pacific Heron, White-faced Heron, Striated Heron, Great Egret and Little Egret, all periodically common along the river.

c) Jabiru, Ibis, and Spoonbill: Again an artificial grouping of water birds displaying similar feeding behaviour. The Jabiru, or Black-necked Stork, usually frequents the middle to upper part of the brackish zone, although extending its feeding activities close to the entrance on some occasions, where it appears to take little notice of human proximity. Both the White and the Straw-necked Ibis are other birds most likely genetically adjusted to the proximity of Man, often feeding in gardens, vacant allotments and marshes along the road during wet spells. The Royal Spoonbill is a common sight

along the river, feeding on benthos in muddy baylets of low flow velocity. When closely approached, it will make evasive movements, only to form large flocks in treetops nearby without taking further notice of Man's activities below.

d) Ducks: The Pacific Black Duck, the Chestnut Teal, and the Musk Duck are seasonally quite abundant on this river, but lead a distinctly sheltered life far away from human activities. Usually they are found to frequent the upper brackish zone, at occasions even entering freshwater sections, while being extremely rare in the lower reaches.

e) Black Swan: In contrast to its common occurrence in other estuaries of the east coast, it is a rather rare sight on the Wooli Wooli River in all its sections. When sporadically present, usually during prolonged wet seasons, it seems to share the sheltered habitats of the ducks.

4.5 WADERS

A general term used here for not necessarily related species of birds, of which some are sedentary while a number of others represent seasonal holarctic immigrants to the general region, originating and even breeding in various parts of the Northern Hemisphere. As a rule the migratory species display a strong fidelity to certain areas and certain estuaries to which they always contemplate to return, while others are typically associated with the shores of rivers regardless of salinity values, and sometimes with ocean shores. All these species are fully dependent on benthic food provided by the environment, which they typically seek during low tides on then often fully exposed sand and mud flats. Since the occurrence of benthos used for their food, in the river or anywhere else, is directly dependent on significant mud deposits, these birds are often reliable indicators of mud patches on the exposed river bed. Thus they may be present in one particular section of the estuary, only to be found in quite another area when meteorological changes occur. A considerable number

are present during various times on the sandflats of this river of which the following were taken into consideration: Pied Oystercatcher, Sooty Oystercatcher, Masked Lapwing (Spurwing Plover), Grey Lapwing, Lesser Golden Plover, Red-capped Plover, Mongolian Plover, Black-winged Stilt, Red-necked Avocet, Ruddy Turnstone, Eastern Curlew, Whimbrel, Grey-tailed Tattler, Greenshank, Bar-tailed Godwit, Curlew Sandpiper, White-winged Tern, Caspian Tern, Little Tern, and Crested Tern. While the majority of these, as already mentioned, are benthos feeders on riverine sandflats, the Masked Lapwing seems entirely restricted to marshland, and at Wooli invariably feeds around human habitations, while the Ruddy Turnstone frequents ocean beaches.

4.6 APPLICATION OF INFORMATION TO DREDGING SITE

With respect to the above grouping of members of the avifauna in this locality it is obvious that some cannot even be considered exposed to any disturbance by the proposed project, at least not more than any other wildlife in the vicinity of the village, in particular not those enjoying the effective shelter of the mangrove canopy. Others, like the fish consumers can be similarly dismissed from consideration for reasons of their special feeding habits which restricts their optimal habitat to rather open stretches of water, completely lacking in the vicinity of the site. Herons and Egrets, although displaying differing feeding habits, find their favoured feeding grounds in rather sheltered baylets of low flow velocities, permitting the accumulation of mud deposits, situations which also are absent in the close vicinity of the site except on rare occasions. The two species of Ibis are pronouncedly tolerant of human proximity, normally feeding on wetland or in paddocks, and the slightly more cautious Spoonbill usually shares the feeding habitats of the Herons and Egrets and when disturbed forms large arboreal congregations which seem to fully disregard Man's activities under the trees used. The Jabiru is particularly confiding, almost oblivious

of the close presence of Man, and just moves away almost at whim to another site when closely approached. The ducks cannot possibly be exposed to any form of impact by the proposed dredging since their natural shyness restricts them to remote habitats, some miles away. This would leave only the majority of waders to be considered, which have the inherent disadvantage of foraging on open and exposed sandflats which do not protect them from being readily seen. However, the larger interspecific associations of waders normally are much more pronounced on the western banks of the river in its lower reaches, where they are much more likely to be disturbed by boating or fishing activities than by the sand extraction operation. It is thus quite obvious that the proposed project could not possibly exert a noticeable impact on the frequenting habits of the entire avifauna present on and near the river, while the hydrobiological section of this report has already demonstrated that the proposed operation is highly unlikely to have any perceptible detrimental effect on the continuity of their available food supply.

5. MONITORING STUDIES DURING DREDGINGS NEARBY

The granting of a quarry licence for riverine sand extraction to Mr. R. Olen early last year in the close proximity of the presently proposed project offered a most welcome opportunity for a series of more or less regular and detailed monitoring tests during about 12 months of dredging operations. These tests, carried out in an own-time study by the writer of this report at an average of two per week, were aimed at the gain of scientific evidence as to the true effects such an operation may have on the general environment over a prolonged period of time. All short-term and long-term changes of the river characteristics - as hydrological and hydrobiological facets - have been carefully compiled and the possible interaction of meteorological excesses taken into consideration. The results of these monitoring studies

may as yet not be complete, nor do they pretend to provide a fully convincing insight into all phenomena and problems encountered, but they certainly provided valuable information in many regards, apt to replace well-founded scientific assumptions with convincing evidence.

This may not be the proper place or occasion to elaborate in detail all the findings obtained, but it is thought that at least some would deserve being briefl mentioned here for a better understanding of often only anticipated effects of Man's impact on the environment.

a) Siltation during dredging

Mud release during the operations, as could be rightly expected from the type of river, presented no particular problems except in the initial stages of work, when transporting surges of the tidal flow appeared to have been underestimated, thus causing slight dispersal. However, even then suspended silt was not being dispersed more than about 2 m from the work.

b) Indices of nutritional enrichment

Any enrichment in the values of available nutrients, whether by natural drainage or by liberation, is best documented by the rapid expansion of both zoo- and phytoplanktonic organisms which follows such a release. Usually this surge in population densities and species diversities is brought about in the aftermath of extensive floods by both draining and liberating actions. In considering the possible effect in this regard by the liberating action of the dredge joint meteorological influences must also be accounted for. It is true that the rainfall in the period of observations was higher than in other years, yet extensive floods did not occur to account for the present extremely well developed planktonic community.

Moreover, these communities could at first be observed in the close vicinity of the work after about 5 months of dredging activities later to be dispersed by the action of flow and tides within a radius of 1 km. Other indices in this regard are the occurrence on three separate occasions of large populations of Trichodesmium in the proximity of the work, as well as a noticeable increase of algal communities just upstream. But perhaps the most exciting phenomenon is the influx of postlarval stages of the school prawn, after a total absence over about 15 years. Since in this stage the postlarvae are known to be distinct herbivores, seeking particular algae in the brackish zone of the estuary, it seems obvious that the food-web deficiencies, which were recorded previously as being typical for this river, are perceptibly improving. At this stage of the monitoring tests it would seem irresponsible to single out the merits of the dredging operations with respect to the nutrient enrichment readily observed, since meteorological conditions could have played a larger role than anticipated from simultaneous weather observations. However, the tests have at least fully documented the fact that any sand extraction in the present condition of the Wooli Wooli River and using this particular suction dredge cannot have any harmful consequences, while providing at least some part of liberated nutrients so beneficial to the environment.

6. CONCLUDING SUMMARY

After the evaluation of all the detailed data available for this specialised study, and having given most careful consideration to all possible factors of ecological concern involved, the writer of this report is unable to find any justifiable objections to the proposed sand extraction from the hydrological, hydrobiological, and general biological points of view, naturally assuming the strict adherence to all regulations by the various authorities governing such an operation.

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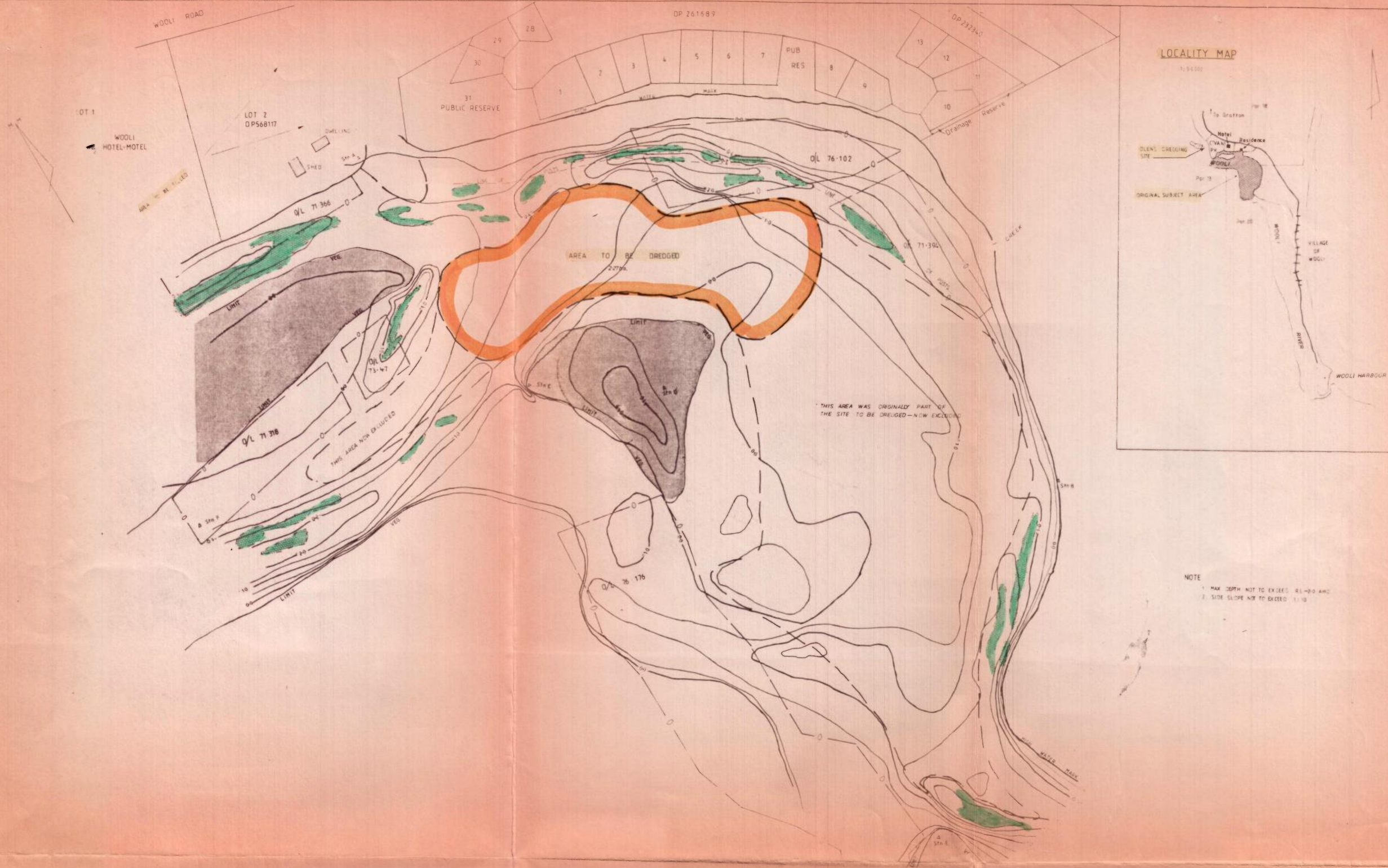
N. A. Kacek

10th June, 1984



LOCALITY MAP

NOTE

1. MAX DEPTH NOT TO EXCEED RL −2·0 AHD
2. SIDE SLOPE NOT TO EXCEED 1:10

AREA TO BE DREDGED

EXISTING WATER BANKS

—0— SYSTEM LEASE

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PLAN OF PART OF THE BED OF THE WOOLI WOOLI RIVER

SURVEY BY R WALSH
DESIGN BY B McCLOSKEY
DRAWN BY R NICHOLLS
CHECKED BY B McCLOSKEY
FIELD BOOK No 11

SHEET 1 OF 1 SHEETS
REF No 83001/10
AMENDMENT No 1
DATE 4·7·84 AMENDED 24·4·85
SCALE 1:2500

RONLUND, R

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Proposed dredging of Wooli Wooli
River for sand extraction