ANNEXURE "B".

Chapter 2

DESCRIPTION OF PROPOSED DEVELOPMENT

2.1 OVERVIEW

The proposed development includes construction of bund walls and vegetation clearing prior to the staged extraction of sand from within Lots 1 and 2 DP 547255 Old Northern Road, Maroota. Extraction would commence from the west adjacent to the existing development and progress eastwards towards Old Northern Road. Non-extraction buffers would exclude areas of shallow groundwater, ecological significance or areas adjacent to lot boundaries. Once extracted, material would be trucked to the existing processing plant for washing and screening as required, prior to off site haulage using existing haulage roads and facilities. No additional buildings or processing facilities are proposed.

2.2 RESOURCE

Lots 1 and 2 and surrounding areas comprise Hawkesbury Sandstone overlain by a Tertiary deposit of fluvial sediments. The site generally comprises the deeply weathered upper units of the Hawkesbury Sandstone, referred to as Eluvial Sand, which vary in thickness between two and fifteen metres, comprising soft and friable rock that is easily ripped and crushed. The Eluvial Sand on the site extends to the water table at approximately 20 metres below ground level. Site geology is detailed in *Chapter 4,* which indicates that there are two general types of sandstone on the site; the orange/yellow upper layer and the finer, whiter layer beneath. These two types of material influence the extraction plan, which needs to expose both at the same time.

A preliminary resource assessment was provided by ERM to assist in determining the boundary buffer areas and the groundwater table buffer zone. This preliminary assessment was validated and updated by VGT Consulting using SURPAC software, taking into account buffer zones as described in *Section 2.4.1.* The first one metre of topsoil and residual soil was not included in the calculations. The resource calculations used vertical batters.

A volume to tonnage relative density factor was sourced from the *Field Geologists Manual* (Australian Institute of Mining and Metallurgy, 1995) which indicates that for dry sandstone, the average density factor of 2.24 kilograms/cubic metre is applicable. The

resource determination tables are presented in *Appendix C5,* a summary of which is provided in *Table 2.1*. The total estimated tonnage within Lots 1 and 2 able to be extracted is therefore approximately 3,038,500 tonnes. An estimated 150,000 cubic metres of waste overburden will be produced.

Table 2.1 RESOURCE SUMMARY

Area	(m^3)	(tonnes)
Lot 1	1, 155, 020	2, 587, 245
Lot 2 (west of ecology exclusion area)	72, 556	162, 525
Lot 2 - East of ecology exclusion area)	128, 863	288, 653
Total	1, 356, 439	3, 038, 423

2.3 PROPOSED LIFE OF OPERATION

Material extracted from Lots 1 and 2 will be trucked to the existing processing area and handled together with the material extracted from the existing operation. However, it is not proposed to increase the amount of processing or off site product sales, which are currently limited to a maximum of 60 laden trucks from the site per day. Therefore, it is envisaged that a twenty year consent will be required to enable all available resource to be extracted from Lots 1 and 2.

The existing consent for the processing plant and haul road to Old Northern Road is for ten years, based on the ten years of reserves on Lots 29 and 196. As this development application requires 20 years to extract the total resource, additional ten year consent is sought for the processing plant, office and amenities and haul road to Old Northern Road.

2.4 EXTRACTION, PROCESSING AND HAULAGE

2.4.1 Factors Influencing Extraction Plan

A number of factors have influenced the extraction plan, including setbacks, buffers, economic extraction limits, groundwater protection requirements and machinery and market requirements.

Baulkham Hills Shire Council's Extractive Industries Development Control Plan No. 500 (DCP 500) provides the following setbacks for quarries:

- 10 metres from adjoining property boundaries;
- 30 metres from Old Northern Road;
- 250 metres from the Maroota Public School;
- 100 metres from a residence not associated with extraction; and
- 50 metres from critical habitats or threatened species, populations, and ecological communities.

A population of *Tetratheca glandulosa* and an area of Shale-Sandstone Transition Forest are located on Lot 2. A 50 metre buffer has been reserved around these areas where relatively undisturbed native vegetation/woodland/heath forest abuts the threatened plants and community. Where the threatened plants and community abut grassland to the north in extraction strip 1 and 2, a 20 metre buffer from extraction is proposed. The purpose of the 20 metre buffer is to prevent direct impacts on the threatened plant and community from earthmoving plant and to minimise indirect effects such as dust and weeds, while still maximising sandstone available for extraction.

Dust modelling has predicted very small differences in PM_{10} dust concentrations for points 50 and 20 metres north of the northern end of the *Tetratheca* population and transition forest. The sixth highest 24 hour PM_{10} predictions are 62 and 65 micrograms per cubic metre respectively, indicating little effective difference in buffer dimensions regarding dust emissions. Similarly, dust deposition modelling predicts 1.275 and 1.321 grams per square metre per month due to quarrying at 50 and 20 metres respectively. Background monitoring indicates levels of 1.8 grams per square metre per month on average, which would indicate a total predicted deposition in the order of 3 grams per square metre per month. Mentor Consulting (1993) prepared a literature review of the impacts of mine generated dust on agriculture that cited Yang (1988, Effects of dust pollution from open-cut coal mining on farmland ecological environment. *Journal of Ecology China* 7(1):9-12), who noted that there would be no adverse effects on plant production unless dust deposition exceeded 22 to 45 grams per square metre per month.

In addition, DCP 500 limits quarrying to two metres above the wet weather high groundwater level. In developing this quarry plan, it has been assumed that the top two metres of material would be overburden and therefore the minimum economic extraction depth would be approximately four metres above wet weather high groundwater level. That is, if the available depth of resource between the wet weather groundwater level and two metres below surface were less than four metres, extraction would not occur. The area

excluded from extraction due to its shallow groundwater depth is to the east of the Shale-Sandstone Transition Forest, as shown on *Figure 2.1*.

A drilling program and resource assessment determined groundwater levels and resource depth. Ongoing groundwater depth monitoring would continue to ensure extraction did not occur below this level. This monitoring may also alter the proposed extraction areas in the future.

All the above buffers and exclusion areas are shown on *Figure 2.1*.

The other factor influencing the extraction plan is the desire to provide a uniform rehabilitated landscape. Although this extraction plan is not able to link all extraction areas together to provide a completely uniform landscape, as adjacent extraction areas are operated by other companies, this plan provides opportunities for future discussions with adjacent landowners to provide a uniform landscape.

The total area of Lots 1 and 2 is approximately 26 hectares. Approximately 10 hectares of this area is to be retained within buffers (including six hectares within the buffer to Maroota School).

2.4.2 Extraction Plan

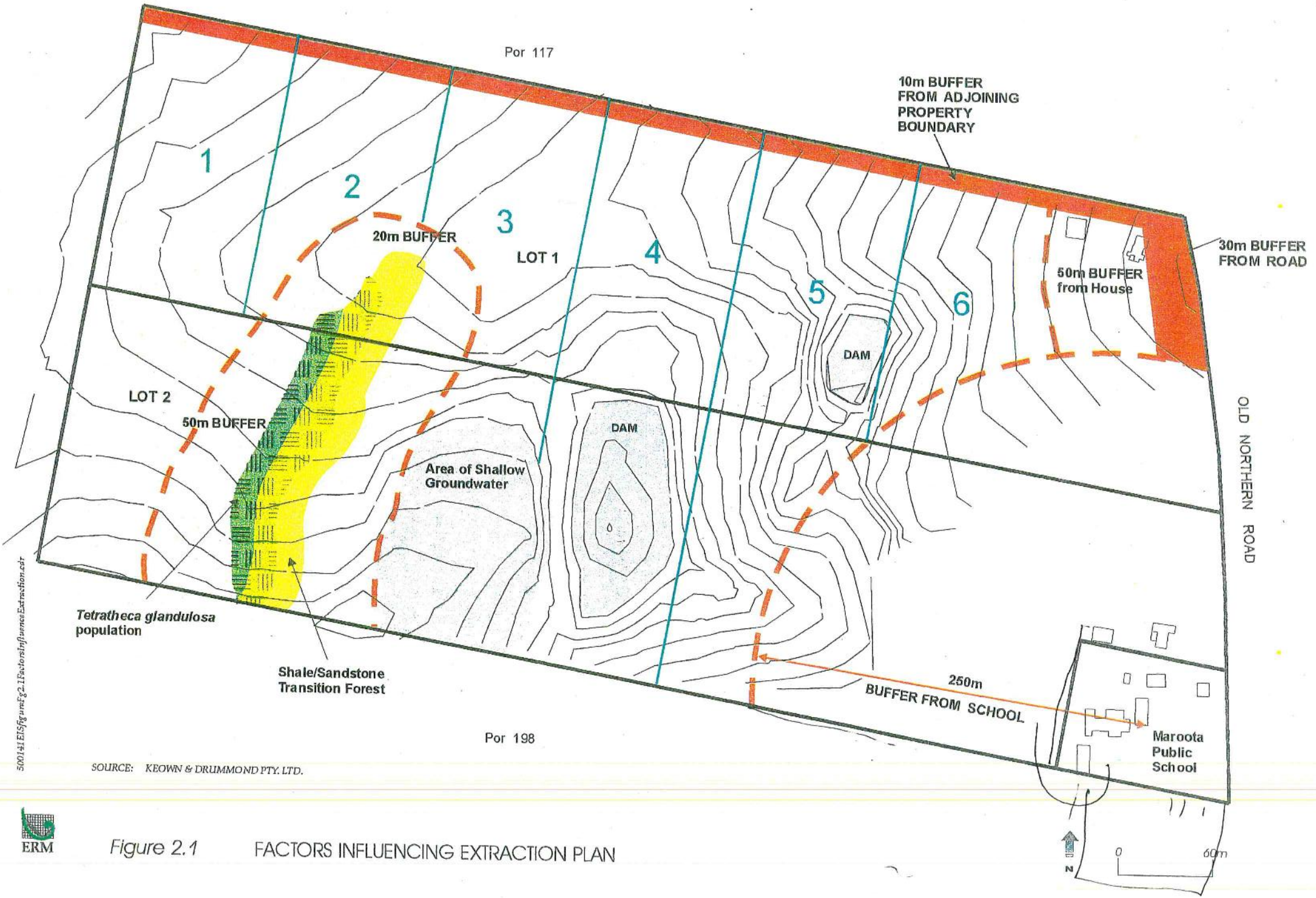
The proposed extraction plan is shown on *Figures 2.2 and 2.3*. This plan shows required setbacks, buffers and areas of resource.

The plan shows a series of nominally 100 metre wide strips extending across Lots 1 and 2. Quarrying in sequential strips allows efficient quarrying with progressive clearing and rehabilitation, therefore limiting the area active at any one time and reducing various environmental impacts.

Each strip will be benched to allow progressive quarrying to the east and to expose the different resources available in the geological sequence. For instance the upper benches of strip 1 will expose the orange/yellow sandstone material while the lower benches will supply the white sandstone.

Figure 2.1 shows areas of the two lots that have no accessible resource due to the required buffers or shallow groundwater. The school buffer and threatened community and species area restricts extraction in Lot 2. Where the strips are not able to extend the full width of the two lots, quarrying would occur over a shorter time period than the longer strips.

Three to five metre high acoustic bunds will be constructed along the northern boundary of Lot 1, on the 250 metre Maroota school buffer boundary and on the 50 metre buffer from the Lot 1 residence near Old Northern Road.



SOURCE: KEOWN & DRUMMOND PTY. LTD.

ERM

Figure 2.1 FACTORS INFLUENCING EXTRACTION PLAN

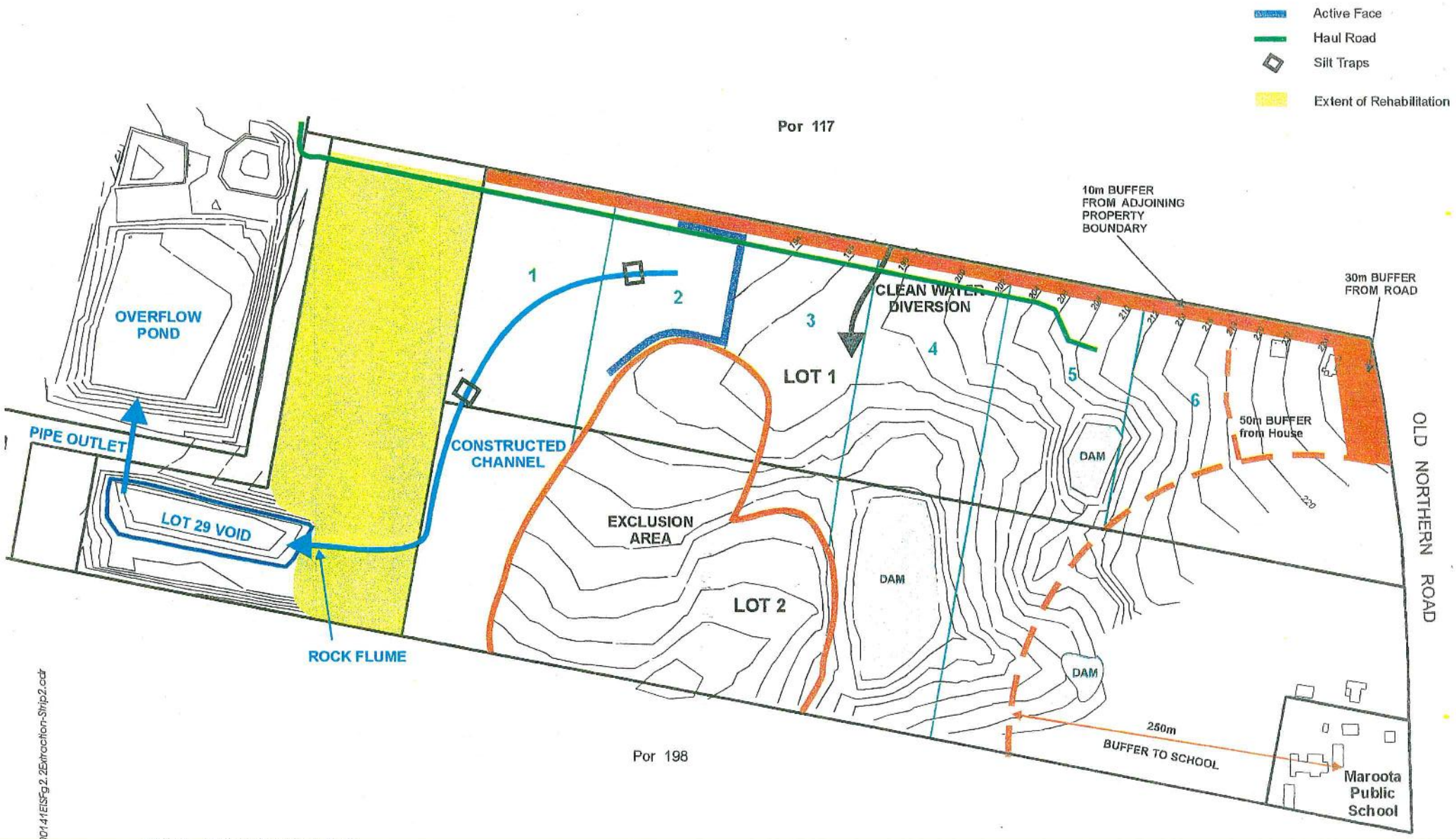


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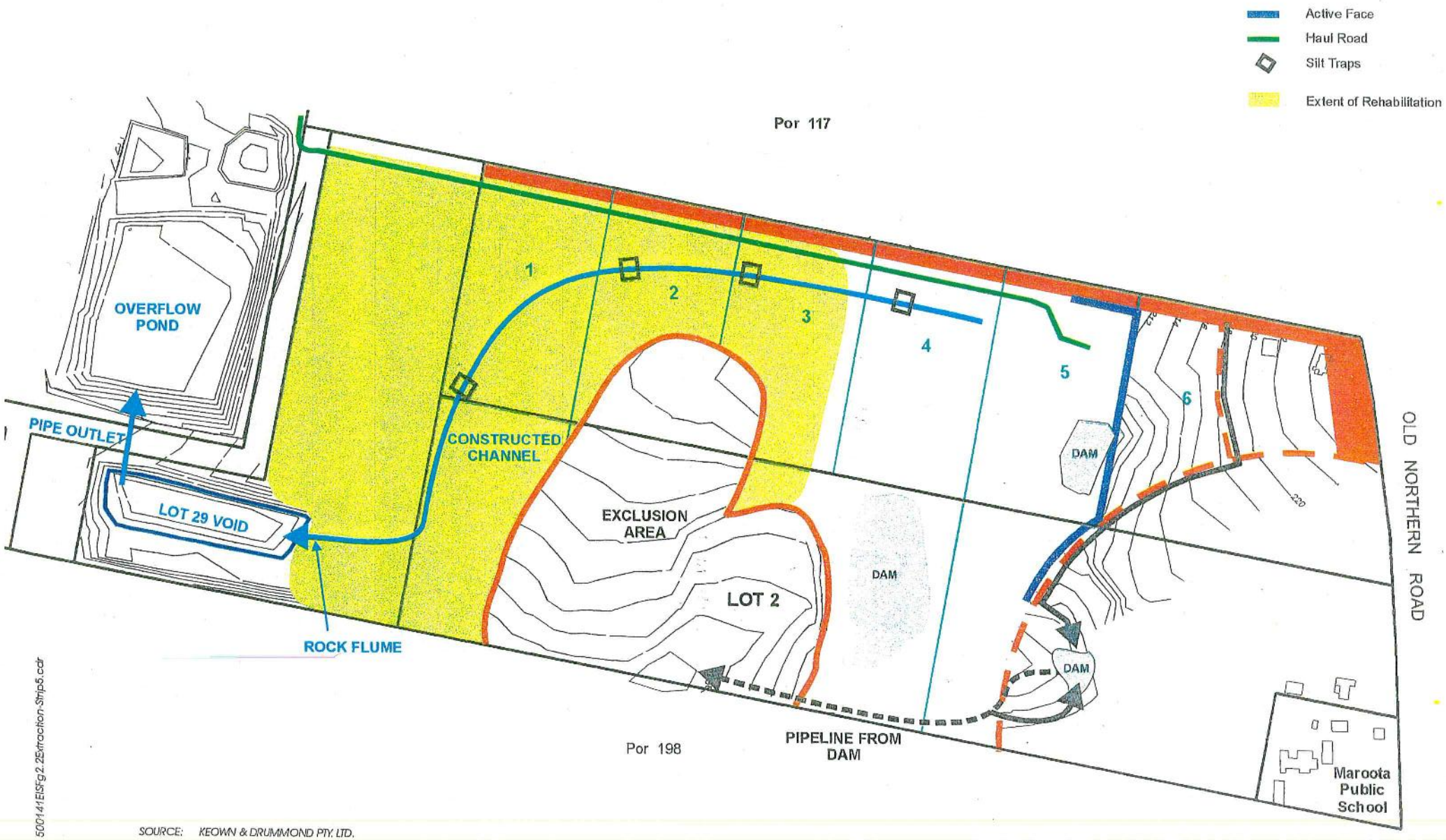
Figure 2.2 EXTRACTION PLAN - STRIP 2



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SOURCE: KEOWN & DRUMMOND PTY. LTD.

ERM

Figure 2.3 EXTRACTION PLAN - STRIP 5

The general quarry process in each strip will be:

- chainsaw down habitat trees outside threatened arboreal animal's roosting and breeding times;
- with dozer, strip and use or stockpile vegetation and groundcover for rehabilitation. Larger stumps, logs and branches will be shredded or mulched and used for rehabilitation as required. Areas of native vegetation will be stripped and used or stockpiled separately from grassed areas. Note that as habitat trees will already have been cut down outside roosting and brooding periods, no seasonal limitations will apply to this clearing;
- with dozer, excavator and trucks, strip and use or stockpile topsoil. Topsoil from areas of native vegetation will be stripped and used or stockpiled separately from topsoil form grassed areas;
- with dozer rip and push overburden into an acoustic bund at the eastern edge of the strip;
- with dozer, excavator and truck, rip and remove surplus overburden for shaping rehabilitation areas either on Lots 1 and 2 or 29; and
- commence quarrying with dozer, excavator and trucks. A dozer will rip, blend and stockpile either on the benches or the quarry floor. An excavator will load from these stockpiles into a single articulated dump truck for haulage to the processing plant. An additional dump truck may be used in the eastern strips due to the longer haul distances to the plant.

2.4.3 Plant and Equipment

The following major plant will be used on Lots 1 & 2. In some instances similar alternative plant may be used:

- one Komatsu 375A dozer;
- one Komatsu PC400-6 excavator;
- one 30 tonne articulated dump truck. In the eastern strips, an additional truck maybe used due to the increased haulage distance to the plant;
- one water cart;
- one Caterpillar 12G grader (irregularly); and

- one service vehicle (irregularly).

Additional mobile and fixed plant will be used at the processing plant, including crushers and screens, loaders, trucks and ancillary plant. No additional or alternative equipment is proposed at the processing plant, which will continue to operate in accordance with the existing development consent.

2.4.4 On-Site Haulage and Processing

Sandstone extracted from Lots 1 and 2 will be hauled by truck across Lot 29 to the existing processing plant on Lot 196. The haulage route and plant are shown on *Figure 1.2*. The haul road across Lot 29 will be extended eastwards within Lot 1 as quarrying progresses. The haul road will have an unsealed, graded surface with a drainage channel to the lower side. The channel will contain erosion control devices as required. Water management and erosion and sediment control are described in *Sections 2.5 and 2.7*.

Hauled material will be unloaded at the plant for crushing and screening. Approximately 80 percent of extracted material will be dry processed while the remainder will be washed to remove clay fines.

The processing plant has three dump hoppers, belt feeders and conveyors, vibrating screens, crushers, scrubbers, a radial stacker and cyclones. The processing plant has a maximum capacity of 250 tonnes per hour.

Approximately 15 percent of material that is washed is fine clays and silts that are removed as tailings and pumped to a tailings storage dam. This dam is dewatered and rehabilitated when full. Existing tailings dams and voids on Lot 196 will also be used for tailings disposal for material from Lots 1 and 2.

Adjacent to the processing plant are a raw material stockpile and five product stockpiles for washed sand, mortar or brickies' sand, yellow brickies' sand and concrete sand. Approximately two weeks production is stockpiled at any one time.

2.4.5 Product Haulage

Product is currently trucked from the quarry and all sales are made from the on-site weighbridge. Once loaded, trucks leave via the access road and Crown Reserve Road to Old Northern Road. Trucks generally travel south along Old Northern Road to the Wisemans Ferry Road intersection. From this intersection, approximately 65 percent continue south along Old Northern Road towards Glenorie and Dural, 35 percent turn right into Wisemans Ferry Road and travel towards Windsor, Richmond and Penrith.

It is proposed that sand extracted from Lots 1 and 2 will supply the same markets as the current operation and the same transport routes will be used. As it is not proposed to increase production rates from the quarry, the number of truck movements will remain the same. This is currently approved at 60 laden trucks per day (120 truck movements).

2.4.6 Workforce and Hours of Operation

The current workforce numbers will remain at ten to fifteen staff, depending on sales. Truck drivers contracted or employed by others would pick up loads from the plant site.

The hours of operation on Lots 1 and 2 will be in accordance with the approved hours of operation for the existing site, being:

- 5.45 am Monday to Saturday Site - gates open to allow entry of vehicles to site;
- 6.00am – 7.00 am Monday to Saturday (not including Public Holidays) - 30 truck movements (15 loaded vehicles) may enter or leave site;
- 7.00 am – 6.00 pm Monday to Saturday (not including Public Holidays) - extraction, transportation and processing or running of machinery for maintenance purposes permitted; and
- no extraction, transportation or processing on Sundays and Public Holidays.

2.5 SURFACE WATER MANAGEMENT

2.5.1 Existing Water Management

The existing quarry's surface water management system aims for:

- discharge of stormwater from the site is clear of sediment (<50 mg/litre total suspended solids);
- a base flow through a low flow pipe is provided to the downstream creek;
- downstream ecosystems are protected;
- on site re-use of water is maximised; and
- groundwaters are not breached or contaminated.

Water management structures include diversion banks, crushed sandstone check dams, sediment basins, catch ponds, tailings ponds and storage ponds.

The acidity of a small spring that discharges into an unnamed watercourse on Lot 196 has been measured for some time and generally ranges from 4 to 4.5 units as reported in the existing quarries environmental management plan (ERM, 2000).

Surface runoff from the southern sub-catchments on Lots 1 and 2 currently discharges to an ephemeral creek that flows across the southern boundary of Lot 2. This ephemeral creek is a tributary of an unnamed creek that discharges to the Hawkesbury River 4.5 kilometres north west of the site. The other sub-catchment on Lots 1 and 2 flows into a dam on the adjacent Lot 196 Lots 1 and 2 have no current active water management apart from two dams used for stock water.

2.5.2 Proposed Surface Water Management

i. Outline

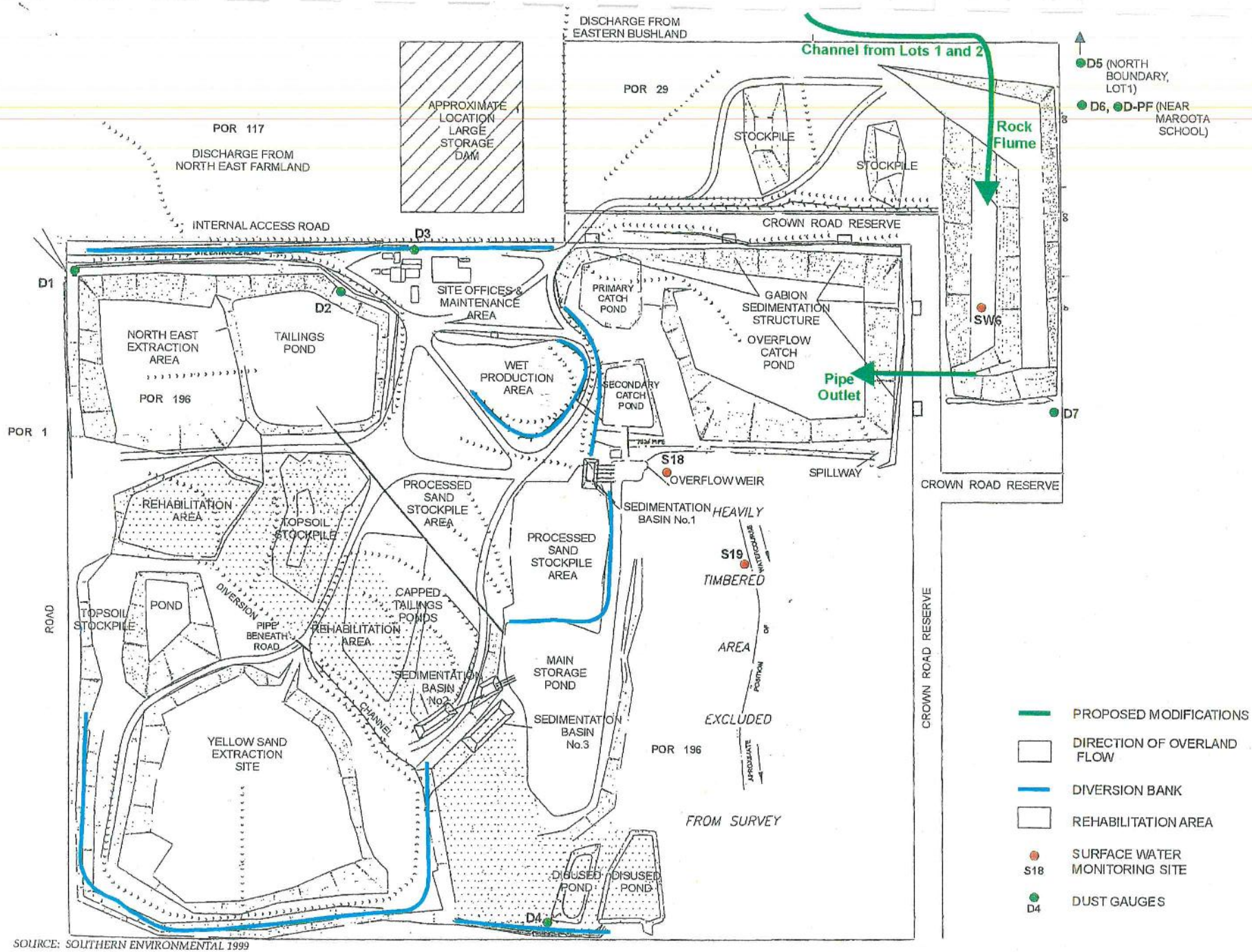
It is proposed to direct surface water runoff from the extraction areas on Lots 1 and 2 to the existing pond on Lot 29. Surplus water will discharge to a creekline via a weir on Lot 196 (refer *Figure 2.4*). The proposed water system for two representative stages of quarrying is provided as follows.

ii. Stage 2 of Quarrying

Water management at stage 2 of quarrying is shown on *Figure 2.2*. A backpush bank into the buffer area around the threatened plant and community will divert clean water from uphill of the stage 2 area.

Lot 29 (which by then will have been extracted to about 15 metres below ground level) will drain west into the Lot 196 water management system. The large void on Lot 29 currently has a volume of about 65,000 cubic metres, but extraction on this lot will reduce this to approximately 2,500 cubic metres. Dirty water from the stage 2 quarry area will be directed through a constructed channel along the quarry floor into the Lot 29 void. Small silt traps as shown on *Figure 2.2* will be excavated into the floor along the channel.

Table 2.2 details calculations and design specifications for Stage 2 water management works.



SOURCE: SOUTHERN ENVIRONMENTAL 1999

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ERM

Figure 2.4 EXISTING DEVELOPMENT WATER MANAGEMENT SYSTEM & MONITORING LOCATIONS

Table 2.2 STAGE 2 WATER MANAGEMENT DESIGN

	Units	Lot 29 less void	Stage 2 quarry	Clean catch above stage 2
Catchment Area	sq.m	28,500	36,750	22,750
Time of Concentration, tc	min	11.8	13.0	10.8
Average Coefficient of Runoff		0.80	0.80	0.30
Rainfall Intensity ARI 20 tc	mm/hr	121.00	120.00	124.00
Peak Discharge Flow rate, Q	c.m/sec	0.77	0.98	0.24
WATERWAY				
Friction Factor	Choice		4	
1. Long Grass, 2. Short Grass, 3. Concrete, 4 Rocks, 5. Corrugated, 6 Earth	Material n		Rocks 0.04	
Bed Slope	mV/mH		0.0270	
Design Velocity	m/sec		2	
Average Batter Grade	mH/ mV		2	
Base Width	m		3.0	
Depth	m		0.22	
Wetted Perimeter	m		3.98	
Flow Cross Sectional Area	sq.m		0.76	
Actual Velocity	m/sec		1.36	
Flow Comparison			105%	
Velocity Comparison			68%	
TRIANGULAR CHANNEL				
Left side slope	m H:V			37
Right side slope	m H:V			2.5
Manning's n	factor			.045
Channel slope	m/m			.1
Depth	m			.11
Discharge	c.m/sec			.24

Table 2.2 STAGE 2 WATER MANAGEMENT DESIGN

	Units	Lot 29 less void	Stage 2 quarry	Clean catch above stage 2
CATCHMENT YIELD .25 1ARI tc				
Catchment Area	sq.m	28,500	36,750	
Time of Concentration, tc	min	11.8	13.0	
Average Coefficient of Runoff		0.80	0.80	
Rainfall Intensity .25 1ARI TC	mm/hr	13.00	12.00	
Peak Discharge Flow rate, Q	c.m/sec	0.08	0.10	
Catchment Yield	c.m	87	115	
TYPE C BASIN SURFACE AREA				
q	m3/sec	0.08	0.10	
settling velocity (Dept Housing table 6.2)	m/sec	0.00029	0.00029	
surface area	sq.m	284.14	338.20	
20 ARI tc				
Catchment Area	sq.m	28,500	36,750	
Time of Concentration, tc	min	11.8	13.0	
Average Coefficient of Runoff		0.80	0.80	
Rainfall Intensity 20 ARI tc	mm/hr	122.00	118.00	
Peak Discharge Flow rate, Q	c.m/sec	0.77	0.96	
Catchment Yield	c.m	821	1128	

The last column in *Table 2.2* details the catchment characteristics and backpush bank design for the clean catchment above the stage 2 quarry.

Table 2.2 also details characteristics and predicted water yields from the void and the stage 2 quarry floor. The design storm was chosen in accordance with the Department of Housing's Managing Urban Stormwater handbook (Section 6.3.3). This handbook recommends a type C sediment basin should be designed for coarse soils, such as exist at the quarry. These basins require calculation of the following:

- surface area based on a 0.25 ARI time of concentration storm with an assumed particle size of 0.02 millimetres;
- settling zone depth of 0.6 metres minimum;

- length to width ratio of 3:1 or more; and
- sediment storage zone volume the same as settling zone depth.

While the EIS requirements letter from the EPA suggested a 90 percentile five day event as the design storm, the Department of Housing's Managing Urban Stormwater handbook, page 6.19 suggests this is more appropriate to fine soils that take longer to settle. Particle size analysis of crushed sandstone from Lot 196 recorded only 12 percent finer than 0.02 millimetres (Southern Environmental, 1999). While there is no doubt that the Hawkesbury sandstone topsoils are highly erodible once disturbed, the same cannot be said of the friable sandstone below. This material is far less erodible, and in most cases is solid rock. A coarse type C basin is more appropriate.

To calculate the required basin, the following method was used in accordance with the Department of Housing's Managing Urban Stormwater handbook:

Surface area = design discharge/particle settling velocity

Where design discharge is calculated for a 0.25 ARI time of concentration storm (see *Table 2.2*). Peak discharge was calculated in accordance with Australian Rainfall and Runoff (Pilgrim, 1987) although runoff coefficients were estimated by the method described by Turner and reproduced in the Soil Conservation Service Design Manual for Soil Conservation Works (Aveyard, 1990) to consider land management and surface cover. Time of concentration was determined for each section of channel by $Tc = 0.76\ A^{0.38}$ as described in Pilgrim (1987).

Where settling velocity equals 0.00029 metres per second as per Table 6.2 of Department of Housing's Managing Urban Stormwater handbook.

The resulting required surface area is approximately 220 square metres. Therefore a basin to settle water from the stage 2 quarry floor would have a surface area of 220 square metres, a settling and sediment storage zone of 1.2 metres depth and a length to width ratio of three to one.

The remnant of the void on Lot 29 will have capacity of approximately 2,500 cubic metres, a surface area of 1500 square metres and a length to depth ratio of four to one when extraction on Lot 29 is complete. The void will therefore have excess capacity for settling and will be able to retain a single ARI 20 time of concentration storm yield from both the stage 2 quarry floor and the void itself (1100 plus 800 cubic metres respectively from *Table 2.2*). Additional capacity will be provided in the small silt traps to be excavated along the constructed drainage channel.

Overflows from the Lot 29 void will occur in prolonged wet weather when water usage is low and repeated flows from the quarry fill the void. Overflows will be piped from the

pond into the overflow dam. The pipe will be buried under the Crown Road separating the Lot 29 pond from the overflow dam as shown on Figure 2.4. The operation of the overflow dam is detailed in Appendix 5 of the Rehabilitation and Revegetation Strategy, Department of Land and Water Conservation, 2000). The overflow dam overflows into the current discharge point.

Table 2.2 details the constructed channel that will convey dirty water through the working quarry into the void. The channel will be three metres wide and has been designed with a bare channel grade. The channel will be slightly below quarry floor level, which will be graded to drain into the channel.

iii. Stage 5 of Quarrying

Stage 5 has been used to represent later quarrying. The overall management will remain the same as for stage 2, however, the clean water diversion is more complicated and the total flow volumes are higher, owing to the larger quarry floor. Separate diversion of clean water from rehabilitated sections of the quarry (for example strips 1 and 2) was considered, but while it is possible to divert this water direct through Lot 29 and off site, this would require floor regrading that would consequently require additional rehabilitation. The preferred option is to continue passing all water through the main quarry floor channel into the Lot 29 void.

Table 2.3 details catchment characteristics and design specifications for Stage 5 works.

Table 2.3 STAGE 5 WATER MANAGEMENT DESIGN

	Units	Lot 29 Void	school catchment	stage 5 quarry
Catchment Area	sq.m	16,500	53,000	110,750
Time of Concentration, tc	min	9.6	14.9	19.8
Average Coefficient of Runoff		1.00	0.30	0.80
Rainfall Intensity ARI 20 tc	mm/hr	125.00	115.00	90.00
Peak Discharge Flow rate, Q	c.m/sec	0.57	0.51	2.22

Table 2.3 STAGE 5 WATER MANAGEMENT DESIGN

WATERWAY				
Friction Factor	Choice			4
1. Long Grass, 2. Short Grass,	Material			Rocks
3. Concrete, 4 Rocks,	n			.04
5 Corrugated, 6 Earth				
Bed Slope	mV/mH			0.0244
Design Velocity	m/sec			2
Average Batter Grade	mH/ mV			2
Base Width	m			3.0
Depth	m			0.36
Wetted Perimeter	m			4.61
Flow Cross Sectional Area	sq.m			1.34
Actual Velocity	m/sec			1.71
Flow Comparison				103%
Velocity Comparison				86%
CATCHMENT YIELD .25 1ARI tc				
Catchment Area	sq.m	16,500	53,000	110,750
Time of Concentration, tc	min	9.6	14.9	19.8
Average Coefficient of Runoff		1.00	0.30	0.80
Rainfall Intensity .25 1ARI TC	mm/hr	13.75	11.85	9.95
Peak Discharge Flow rate, Q	c.m/sec	0.06	0.05	0.25
Catchment Yield	c.m	54	70	436
TYPE C BASIN SURFACE AREA				
Q	m3/sec	0.06	0.05	0.25
settling velocity (Dept Housing table 6.2)	m/sec	0.00029	0.00029	0.00029
surface area	m2	217.49	180.62	845.09
20ARI tc				
Catchment Area	sq.m	16,500	53,000	110,750
Time of Concentration, tc	min	9.6	14.9	19.8
Average Coefficient of Runoff		1.00	0.30	0.80
Rainfall Intensity 20 ARI tc	mm/hr	125.00	107.00	90.00
Peak Discharge Flow rate, Q	c.m/sec	0.57	0.47	2.22
Catchment Yield	c.m	495	636	3943

Construction of the noise bund along the edge of the Maroota School buffer will separate approximately five hectares of clean water catchment. It is not desirable to have this water enter the pit, so an existing small dam within the buffer area will be used to hold the yield

from two ARI 20 time of concentration storms. This 1,200 cubic metre dam will have a secondary earthen spillway that would discharge back into the quarry void, although most flows will be drained through a small diameter pipe. This pipe will be installed to drain the entire dam over several days to maintain storage capacity for the next design storm. The outlet pipe will discharge into the existing drainage depression in the centre of Lot 2 (see *Figure 2.3)*. Catch banks will direct water from the northeast corner of Lot 1 and the southeast corner of Lot 2 into the dam.

By stage 5, the quarry floor will have expanded to about 11 hectares. The same three metre wide channel used for stage 2 will be adequate to take flow rates from an ARI 20 time of concentration storm from stage 5 (see *Table 2.3)*. By stage 5, three silt traps will have been excavated along the length of the channel to provide additional settling capacity. *Table 2.3* shows that the larger floor area of the stage 5 quarry requires additional settling area (850 square metres), although the Lot 29 void will still be adequate.

iv. Final Landform Surface Water Management

The proposed final landform is shown on *Figure 2.5* and it aims to mimic existing flow patterns where possible. The previous quarry floor will grade gradually southwest, following a level two metres above standing water level. The quarry face against the school buffer zone will be battered to three in one (vertical to horizontal) to join the quarry floor, as will the northern boundary and the threatened species and community area. While the quarry face against the school buffer zone will be pushed down from the buffer zone. The other faces will be backfilled with reject. The rehabilitation plan is detailed in *Section 2.8*.

After quarrying is complete, the school buffer zone catchment will continue to drain into the 1,200 cubic metres dam with pipe outlet. Once the quarry face is battered to the required angle, a rock flume will be built to accept water from the dam's secondary earthen spillway. This flume will discharge onto the quarry floor and into the main excavated channel. Minor flows from the small diameter pipe will continue to discharge into the unquarried drainage depression on Lot 2.

The undisturbed threatened species and community buffer area will continue to drain predominately south, although the backfilled batters against the buffer areas will drain onto the quarry floor.

The quarry floor will continue to drain via the constructed channel into the Lot 29 void with overflows passing along the spillway channel along the western boundary of Lot 29 and through Lot 196. Once revegetation of the batters and quarry floor is complete, desilting of the small silt traps in the constructed channel will cease and the traps are expected to revegetate with semi-aquatic and emergent plants.

2.6 SOIL MANAGEMENT

Topsoil will be stripped immediately prior to extraction and used in rehabilitation. In most cases the topsoil will be stripped and spread immediately over areas to be rehabilitated. In the event that a rehabilitation area is not ready for topsoil spreading, the topsoil will be stockpiled temporarily (less than 12 months) away from drainage lines. Silt fences around the base of the stockpiles will prevent soil loss off-site. The stockpiles will be no more than three metres high to preserve aerobic soil microbes and organic material.

In most cases, topsoil will be stripped and used directly for rehabilitation of a previously quarried area.

2.7 EROSION AND SEDIMENT CONTROL

Given the soils on site are highly erodible under concentrated flows, erosion and sediment controls have been proposed to control drainage on the site and minimise the area of soil exposed to surface water flows. Controls will include the following:

- maintain buffers/boundary setbacks and install silt fences where appropriate to prevent sediment transport and impact on adjoining land;
- minimise the area of disturbance by only clearing areas immediately prior to extraction within each stage or precinct and progressive rehabilitation of completed precincts (refer to rehabilitation strategy for soil stabilisation techniques);
- divert upslope drainage away from disturbed areas;
- diversion of dirty runoff to sediment basins; and
- regular inspection and maintenance of sediment controls.

The environmental management plan to be implemented for the works will detail these controls in more detail, including types, locations, inspections and monitoring.

2.8 REHABILITATION AND FINAL LAND USE

2.8.1 Rehabilitation Plan

Figure 2.5 show the conceptual final landform for the proposed quarry. The objectives of the rehabilitation plan are to:

- form a final landform similar to the surrounding landscape;
- ensure rehabilitation works are implemented progressively;
- enhance the scenic and environmental quality of the site;
- maintain existing flow paths wherever possible and reinstate the ephemeral watercourse through Lot 2;
- protect and enhance habitat for threatened species and communities; and
- continue agricultural land uses on Lots 1 and 2.

As the extractable resource approximately follows existing topography, the quarry floor would be similar in form to the current landform, but approximately three to twenty metres lower. Those parts of Lots 1 and 2 that are low lying and closer to the watertable and consequently not available for quarrying will remain at their current levels.

Buffers required to reduce noise around the school and protect threatened vegetation provide a useful role in rehabilitation in that they retain mature stands of vegetation on site. Disturbance to these buffers would be kept to a minimum and modified only to reduce differences in slope towards extracted areas. The buffer protecting the Shale-Sandstone Transition Forest and *Tetratheca glandulosa* will be higher than the extracted area. Development between this buffer and the final landform has attempted to integrate this area with the extraction area by backfilling to reduce batter grades and rehabilitation with similar species.

No buffer is provided along the southern boundary of Lot 2 as it adjoins the adjacent quarry.

The western edge of the quarry will blend into the floor of the quarried area on Lot 29. The quarry floor on the northern and eastern edges of Lots 1 and 2 will be backfilled and battered respectively up to the top of the existing landform to an average grade of 3:1 (horizontal to vertical). An estimated 145,000 cubic metres of backfill is required to form the batters around the threatened species exclusion zone and the northern boundary; all this material will be sourced from overburden stripped off site. An additional 150,000 cubic metres will be required to rehabilitate the eastern batters and as estimates show there will be insufficient overburden available, this batter will be cut from the east to 3:1 after quarrying is complete.

After quarrying is complete, it is proposed to reinstate the ephemeral watercourse through Lot 2 as shown in *Figure 2.5*. As these works would be carried out about 15 years from now, details have not been designed. A conceptual plan will be formulated in consultation with DLWC as part of the environmental management plan, and as quarrying approaches its

final extent, full specifications will be designed, using latest methodology proven at that time. An outline of sections of this rebuilt channel follows:

- the small existing dam will be retained to capture and release storm flows, although the pipe outlet will be shortened to discharge immediately downstream of the dam;
- flows from the dam and the rest of the catchment will be directed into a rock flume built on the quarry highwall;
- the flume will discharge into a stilling basin and then along a relatively flat grassed channel along the old quarry floor; and
- the floor channel will accept additional flows from the rehabilitated quarry and discharge into the undisturbed section of the watercourse and then through the southern boundary.

2.8.2 Rehabilitation Process

Extraction and rehabilitation would be undertaken in strips that progressively follow quarrying eastwards. Each strip would be cleared, extracted and then rehabilitated. Cleared vegetation and topsoil from one strip would be transferred directly for use in rehabilitation of another strip. This process requires a staged approach where a number of strips would be either cleared, extracted or rehabilitated concurrently. An example of this process follows, where strip 3 is being cleared prior to extraction, strip 2 is in the final stages of extraction and, strip 1 is being rehabilitated:

- fell large trees in strip 3 and temporarily stockpile on strip 1;
- clear remaining vegetation and topsoil on strip 3 with a dozer and stockpile on strip 3. Stockpiles would be small, less than three metres high and would not be left for more than three months to minimises decomposition of seeds, sticks and leaves;
- strip overburden from strip 3 and truck to backfill the vertical cuts on strip 1;
- truck topsoil stockpiled on strip 3 and spread over strip 1;
- cover topsoiled areas of strip 1 with large trees felled from strip 3 that had been temporarily stockpiled on strip 1.
- plant and maintain tubestock on strip 1. Weed and replace dead plants as necessary.

It should be noted that this is a summary of the rehabilitation process and that a comprehensive Rehabilitation Strategy would be prepared as part of the Environmental

Management Plan. Other components of the Rehabilitation Strategy would minimise clearing or extraction to not more than two strip areas at any one time and include an ongoing weed control program.

2.8.3 Rehabilitation Species and Technique

Rehabilitation techniques will be similar to:

- those described in the Rehabilitation and Revegetation Strategy prepared by Soil Service, Department of Land and Water Conservation (DLWC, 2000); and
- those being undertaken for Lot 196.

Rehabilitation of Lot 196 involves a combination of brush matting, sowing and transplanting. Seeds of species dependent on fire for germination would be heat-treated before planting. Instead of manual brush matting as used on Lot 196, the mixture of topsoil, leaf litter and brush stripped by dozer is expected to supply the main seed source.

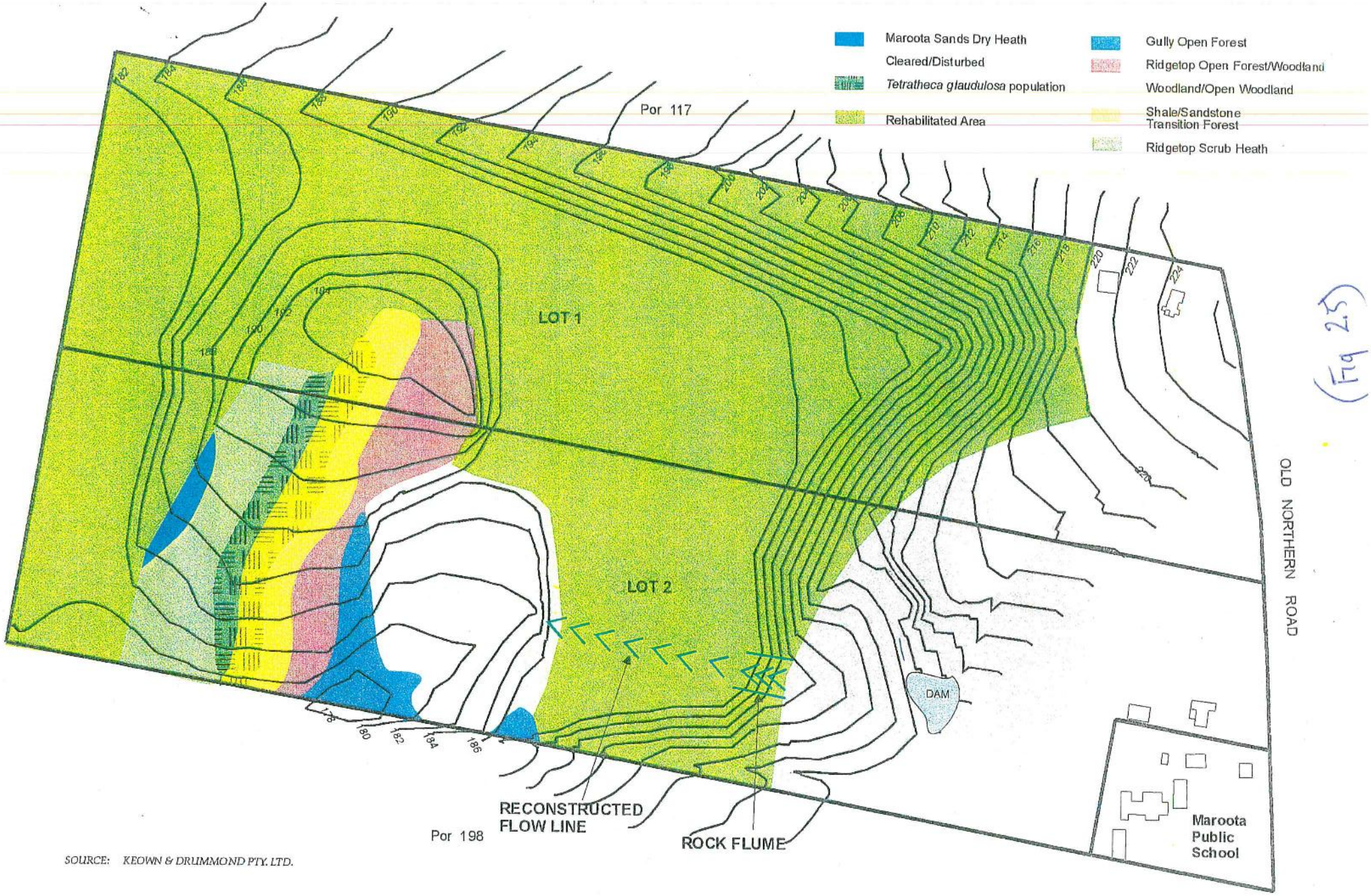
Broad vegetation groups (genus level) to be used in rehabilitation of Lots 1 and 2, and their associated rehabilitation techniques, have been detailed in *Table 2.4*. It should be noted that this is not a comprehensive list and that more than one rehabilitation technique may be applied to one species to optimise germination. Species for each vegetation group would be selected from those currently occurring on Lots 1 and 2.

Table 2.4 REHABILITATION TECHNIQUES AND VEGETATION GROUPS

Rehabilitation Technique.	**Broad Vegetation Group (genus)**
Brush matting	*Allocasuarina, Banksia*, Hakea, Leptospermum*, Acacia** and *Eucalypt.*
Topsoil	*Grevillea, Pultenaea, Hibbertia, Bossiaea* and other native grasses and herbs
Transplanting	*Lomandra, Dillwynia, Pultanaea*
Broad Sowing	*Acacia*, Iosopogon, Banksia *, Hakea** and native grasses
Tubestock	*Persoonia, Eucalypt* and other small shrubs that do not germinate from topsoil.

* may require heat treatment

The rehabilitation program would also involve use of cleared logs and felled trees for ground fauna habitat and soil stabilisation.



(Fig 2.5)

SOURCE: KEOWN & DRUMMOND PTY. LTD.

ERM

Figure 2.5 FINAL LANDFORM PLAN

Chapter 5

ENVIRONMENTAL MANAGEMENT

5.1 SUMMARY OF MITIGATION MEASURES

This chapter provides a summary of mitigation measures, as required by the Department of Urban Affairs and Planning Director-General requirements. The following information on mitigation measures has been drawn from the various sections of this EIS.

Mitigation measures have been implemented for each stage of development, categorised here as pre-extraction, extraction and rehabilitation.

5.1.1 Pre-Extraction

Prior to any works commencing on Lots 1 and 2, the following mitigation measures will be implemented.

i. Environmental Monitoring System

The current environmental monitoring system will be reviewed to ensure that any additional sites or parameters required to monitor extraction within Lots 1 and 2 are included, in accordance with the consent conditions. This could include installation of any additional dust gauges or samplers required by the EPA, acoustic checks on equipment (for example, to measure sound power levels to validate predictions), and any flora and fauna monitoring required prior to extraction. Groundwater wells installed in early 1998 have been regularly monitored to gather background information on the groundwater depth. No additional monitoring systems or groundwater wells are proposed for Lots 1 and 2, however, existing gauges, wells and other systems will be checked to ensure they are operational.

ii. Water Management and Erosion/Sedimentation Control

Prior to extraction, the initial water management controls will be constructed for stage 1 works. These include construction of the clean water diversion drain around strip 1, and implementation of temporary sediment controls in drainage lines to catch any sediment laden runoff from clearing works.

Groundwater wells will be checked to ensure they are functional and their location reviewed in terms of the latest extraction plan, to check whether they require relocation prior to extraction.

iii. Community Notification and Complaints Management

The local community will be notified of the commencement of works within Lots 1 and 2 and a reminder of the current complaints procedure will be provided.

iv. Flora and Fauna

The buffer area surrounding the *Tetratheca glandulosa* community and the transitional forest will be surveyed and permanently staked to identify the boundaries. Permanent staking around the ecological area will ensure vehicles do not encroach on the buffer area. The 250 metre buffer boundary from the Maroota Public School will also be fenced to ensure extraction does not encroach into this buffer.

The 20 metre buffer north of the *Tetratheca glandulosa* and Shale-Sandstone Transition Forest buffer will be revegetated as described in the rehabilitation plan described in *Chapter* 2.

v. Noise Bunding

A three metre high noise bund is proposed along the northern boundary of Lot 1. It is proposed to build this bund progressively with each extraction stage. However the bund for the full length of strip 1 will be constructed prior to extraction of this strip. The bund will be built from overburden from strip 1. Temporary erosion control will be used during construction. The northern side of this bund will be seeded with pasture species to improve its appearance from the north.

A five metre high bund on the eastern buffer boundary will be built in the same manner as the northern bund, with the eastern face shaped and seeded. Trees and shrubs will be planted between this bund and Old Northern Road to reduce its visibility from the road.

vi. Tree Screening

The 30 metre buffer from Old Northern Road will be planted with trees and shrubs from the rehabilitation list to assist in screening views to the quarry from this direction. This planting will occur on commencement of strip 1 extraction, to

provide maximum growing time for the screen so that it is effective when extraction is occurring closer to the road.

vii. Staff Training

Staff will receive training on particular environmental protection requirements for Lots 1 and 2, including instructions on the buffer areas, bunding, screening and any noise restrictions.

viii. Traffic

No additional traffic controls are required as all traffic will enter and leave the site via the existing Crown Road from Lot 196 to Old Northern Road.

5.1.2 *Extraction*

During extraction on Lots 1 and 2, the following mitigation measures will be implemented. Extraction includes topsoil and overburden stripping, extraction of resource, trucking to the plant and back-filling for rehabilitation.

i. Water Management and Erosion/Sediment Control

Water management and erosion/sediment controls will be implemented as described in *Chapter* 2. These include clean water diversion drains around the eastern side of the extraction strips. A drainage channel will be formed in the extracted floor of the quarry, which will be directed to a void on Lot 29. Silt traps will be excavated into this channel at intervals.

A detailed water management strategy will be developed for each strip prior to its extraction, locating all required water management and erosion/sediment controls.

Regular surveys of extraction depth, combined with monthly groundwater level monitoring will ensure extraction does not occur within two metres of the wet weather high groundwater level.

The majority of groundwater monitoring wells are within buffer areas. One well is within the active extraction area of strip 6 and one is close to the western boundary of the Shale-Sandstone Transition Forest buffer. These wells will be removed as extraction occurs within these strips.

ii. Noise Mitigation

The selected extraction method requires the excavator to dig into the sandstone as quickly as possible so that it can work on a bench below natural ground surface. The face then reduces noise from further extraction works. The amount of time the excavator works at natural ground level will therefore be minimised.

Other noise mitigation measures include:

- construction of a three metre high stabilised bund to the east and north of each strip prior to its extraction;
- annual monitoring of noise levels to check compliance with predicted levels and that works are below required levels; and
- monitoring of truck movements in accordance with the consent for the existing development.

iii. Air Quality

Air quality mitigation measures include:

- the use of a water truck on all active extraction areas and the haul road to suppress dust;
- ongoing air quality monitoring; and
- minimising the active extraction area through progressive clearing and rehabilitation in the strips before and after the active extraction area.

iv. Flora and Fauna

Mitigation measures include:

- the buffer areas to be excluded from extraction will be located and the boundaries staked prior to extraction commencing;
- rehabilitation of the grass area in the northern section of the *Tetratheca glandulosa*/Transition Forest buffer;
- felled trees, logs and rocks will be removed from the strip being cleared and either stockpiled or immediately used in rehabilitation of previous strips, where they will be laid on the surface to provide habitat opportunities;

- species native to the local area will be used in rehabilitation to encourage long term use of the site by native fauna; and
- training of staff in threatened flora and fauna identification and reporting procedures.

v. Archaeology

No archaeological items were located on Lots 1 and 2, however, if any are identified work in the vicinity of the item will stop until National Parks and Wildlife Service or the NSW Heritage Office are notified and advice sought.

vi. Traffic

No additional traffic controls are required as all traffic will enter and leave the site via the existing Crown Road from Lot 196 to Old Northern Road.

vii. Waste Management

All general office/amenity waste is handled on the existing site. Overburden from Lots 1 and 2 will be used in rehabilitation works in nearby strips and buffers. Tailings from material sourced from Lots 1 and 2 will be disposed in the existing voids on the existing development.

viii. Hazard

All fuels and oils will be stored on Lot 196 within the approved bunded storage areas. No refuelling of equipment will be undertaken on Lots 1 and 2. Fire extinguishers will be carried by all machinery used in Lots 1 and 2. In the event of fire, the water cart is able to access Lots 1 and 2 to assist with fire fighting.

5.1.3 *Rehabilitation*

Rehabilitation works include backfilling, topsoil spreading, seeding and planting and maintenance, such as weed control and watering until establishment. Mitigation measures to be implemented during the progressive rehabilitation stages include:

- retention of erosion and sediment controls until rehabilitation works complete, with specific controls put in place where required for rehabilitation works;

- completion of an annual survey of rehabilitation to assess floristic structure and diversity, robustness and fauna species diversity;
- continued use of the water cart to water areas where earthmoving is occuring as part of rehabilitation works (eg: backfilling);
- maintenance of rehabilitation areas until sufficiently established, including watering, weed control and feral animal protection; and
- noise and air monitoring to continue during rehabilitation works involving earthworks.

5.2 ENVIRONMENTAL MANAGEMENT PLAN FRAMEWORK

5.2.1 *Introduction*

An environmental management strategy has been prepared for the existing development on Lots 29 and 196 (ERM, 2000) and it is intended to extend this strategy to incorporate environmental management requirements for the proposed development area.

5.2.2 *Environmental Objectives*

The existing environmental management strategy has the following objectives:

- to satisfy Baulkham Hills Shire Council and other relevant authorities of the environmental management and performance of the operation and compliance with the conditions of consent;
- to provide a system to manage the site environment to minimise potential environmental impacts;
- to ensure all site users are aware of environmental protection measures and their own environmental responsibilities;
- to monitor site actions and environmental performance to determine compliance with required actions; and
- to provide a system to quickly identify and correct environmental degradation or non-compliance with consent requirements.

The environmental objectives for the proposed development are generally the same as those stated above, however, as State Significant Development, the proposed development works will also need to satisfy the requirements of the Director - General of Urban Affairs and Planning.

5.2.3 *Environmental Procedures*

Environmental procedures have been developed for the existing development. These procedures each provide:

- reference information for the operator, including relevant consent conditions and EIS reference sections;
- objectives;
- actions, or procedures, to be completed;
- monitoring requirements;
- reporting requirements;
- persons responsible for carrying out the required actions; and
- any plans, tables or schedules that illustrate or locate required actions.

Environmental procedures for the existing development have been developed for:

- Induction and Training;
- Incident Management;
- Complaints Management;
- Environmental Review and Reporting;
- Roads and Traffic Management;
- Hours of Operation;
- Permissible Extraction Program;
- Buffer Zones and Protection of Adjoining Lands;
- Water Management;

- Erosion and Sediment Control;
- Heritage Management;
- Noise and Vibration Management;
- Air Quality Management;
- Flora and Fauna Management;
- Rehabilitation and Revegetation;
- Community Relations; and
- Waste Management.

The strategy will be revised to incorporate additional environmental management requirements for the proposed development area and will include the mitigation measures provide in *Section 5.1* as well as any additional requirements provided by the consent conditions.