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Land resource survey report of the Brigadoon development proposal

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Disclaimer

The contents of this report were based on the best available information at the time of publication. It is based in part on various assumptions and predictions. Conditions may change over time and conclusions should be interpreted in the light of the latest information available.

Preface

The Department of Agriculture's Division of Resource Management is responsible for providing comments to the Town Planning Department in relation to land rezoning and subdivision proposals in rural areas. These comments are expected to help planners evaluate the effects of particular development or subdivision proposals on the viability of any agricultural industries concerned. In addition, under its legislated soil conservation responsibilities there is a need for the Department of Agriculture to evaluate the extent of any risk of land degradation associated with development.

In line with this latter responsibility the Division of Resource Management conducts a survey and 'capability' evaluation of proposed development areas referred to it by either the Town Planning Department or local government bodies. The survey is to assist planning by defining the physical nature of the land and to emphasise areas which are capable of being developed with minimal land degradation effects and without unnecessarily high development or future management inputs.

An integral part of this evaluation is an assessment of the risk of soil erosion or land degradation associated with the proposal. By providing this risk assessment to planning authorities the objective is to guide development into areas of high capability (low risk) areas in preference to areas of lower capability (higher risk). Wherever this can be achieved the effect will be to help minimize future land degradation problems.

The following report was prepared in response to a planner's request for comment on a particular development proposal. Full details of the proposal are not provided and hence the reader is forewarned that in many respects this report is not a 'stand alone' document.

Contents

Summary

This report describes the land resources of the proposed Brigadoon development area. Occurring on the edge of the Darling Scarp, the area contains a considerable diversity of soil and landform conditions which influence the risk of future land degradation problems associated with its proposed rural residential use.

The report presents an evaluation of the land's capability to sustain rural residential development with minimal risk of land degradation. The evaluation is expressed in terms of a five class rating system from 1, areas of very high capability (very low risk), to 5, areas of very low capability (very high risk).

Areas of low to very low capability (Class 4 and 5) Map units Dl, My3, H2, H3, DS1, DS2, F5, SW1—8

These map units occupy 1325 ha or 54% of the study area. The soil and landform conditions are such that they considered to have a high degree of land degradation risk associated with their potential development. It is recommended therefore that no development be permitted within areas of the most severe risk, Class 5. Within areas of Class 4 land, rural residential development should be discouraged to obviate the need for exceptionally careful subdivision design, site preparation and high future land management inputs. These would be considered essential to minimize the risk of land degradation.

Areas of moderate capability (Class 3) Map units D2, D3, My1, Hl, H4, Fl, F4, Gf3

These map units occupy 744 ha or 30% of the area. It is considered that there is a fair degree of risk of land degradation problems associated with development on these areas unless particular care is taken during the early stages involving land clearing, construction and roading.

Areas of high capability (Class 2) Map units My2, F2, F3, Gf1, Gf2

These areas occupy 258 ha or 11 % of the land. The risk of future land degradation problems here as a result of rural residential development is considered to be slight. It is recommended therefore that the most intensive parts of the development be located where possible in these areas.

Due to its proximity to commercially valuable agricultural land within the Swan Valley, the agricultural (horticulture and viticulture) capability of a portion of the development area (stage 1) has been assessed. This assessment has been made to assist planners evaluate the suitability of the proposed rural—residential development in the light of the amount of land which would effectively be taken from potential productive agricultural uses.

The assessment shows that approximately 85 ha or 40% of the stage 1 development area has land of high capability or potential for intensive agricultural uses. It is recommended that over these areas the minimum lot size should be 16 ha in order to encourage the establishment of independently viable agricultural holdings and to reduce the risk of land price escalation usually associated with the development of smaller lots. In areas of Class 3 land it is considered that the 4—5 ha minimum lot sizes proposed by the Consultant's report are appropriate for lower productivity, part time farming. Elsewhere in the study area it is considered that there is a low capability or potential for either horticulture or viticulture.

1. Introduction

The Brigadoon development proposes the creation of some 400 rural—residential lots and an associated equestrian centre over an area of 2,450ha (6,000acres) of land within the Shire of Swan. The site is located approximately 11 km north of Midland and extends over both sides of the Swan River where it emerges onto the Coastal Plain from the Darling Plateau.

A planning consultant firm, T.S. Martin and Associates, was engaged by the developer, Bond Corporation, to produce a report detailing the nature of the development proposal and its relationship to the land resources of the area. When commenting on environmental effects the consultant's report, although detailed in many respects, relied heavily on landform and soils information previously presented by the Department of Conservation and Environment in the System 6 (Darling System) report of 1980. The mapping, originally at 1:250,000 scale, needed to be enlarged to a scale of 1:10,000 to enable a direct comparison with the development plan. Such an enlargement was considered by the Department of Agriculture's Division of Resource Management to provide a rather inadequate base for any specific evaluation of the development proposal.

The response to the Town Planning Department's request for comment on the proposal was therefore to re—map the area at a more appropriate scale to provide additional basic soils/land form information. This was then used to evaluate the possible physical limitations to the development.

2. Field survey

Twenty eight map units were identified by stereoscopic air photo examination of the area. These represent sub units of the broader landform/soils groupings employed in the System 6 mapping. During subsequent field survey some thirty two sites were inspected in the field to obtain detailed soil and landform data for these map units.

Table 1 provides a brief description of each map unit and indicates limitations considered likely to affect the development. This table should be used as an expanded legend to the soils and landform maps included with this report.

3. Land evaluation - land capability assessment

The method of evaluating the development proposal has been to consider the nature of the land in each map unit and to rate the number and severity of physical factors which are perceived as being likely to lead to land use problems. For each map unit a rating

from 1 (land with few if any, physical limitations) to 5 (land with many severe physical limitations) has been derived to express the capability of that land to support residential development with minimal land degradation effect.

The five class capability rating system basically presents a 'hazard of erosion' assessment, but also includes the ability of the soil to accept on—site effluent disposal, and suitability for general construction activities. Definitions of the capability classes shown for each unit in Table 1 are given in Table 2.

In addition to rural residential capability, the ability or potential of lands in the lowland (stage 1) area for future viticultural or horticultural use has also been assessed (Table 3) in terms of the five class system from 1, very high potential, to 5, very low potential.

4. Limitations to Development

There are seven major factors which relate to the physical nature of the land and which are likely to impose varying levels of limitations or constraints to the development proposal. These are:

i) erosion hazard
ii) suitability of land for agricultural purposes (lowland areas only)
iii) suitability of soils for on—site effluent disposal
iv) adequacy of water supplies
v) flood risk
vi) fire hazard
vii) current landscape recreation and aesthetic amenity value

From these, some specific comments are made in this report about the first four. Brief comments about flood risk, as indicated from historical soil and landform evidence, are made in Table 1, however it is recommended that further information on this factor be sought from the relevant management authority.

No specific comments are made in this report about fire hazard or aesthetic landscape value as these obviously fall beyond the area of Department of Agriculture responsibility. It is hoped however that due to the obvious relevance of detailed land resource information to an evaluation of these factors that comments made by the relevant Government bodies are related to the Department of Agriculture's mapping input during the Town Planning Board's evaluation phase.

Table 1.

Darling Plateau

Map Unit	Description (refers to Map1)	Limitations to development	Capability rating (refer to map1a)
Dwellingup Lateritic Uplands			
D1	Gently undulating crests and upper surfaces of plateau, with shallow gravelly yellow or red sands and open forest vegetation. Slopes up to 8%. Lateritic stone and massive rock outcrops are common.	Very shallow gravelly soils and considerable rock outcrop affecting construction and effluent disposal.	4
D2	Generally flat upland areas which have been cleared. Dense Dryandra shrubland regrowth is common. Slopes generally less than 5%. Shallow gravelly yellow earths and gravelly red sands occur with common laterite stones and pavement areas.	Shallow gravelly soils and considerable rock outcrop affecting construction and effluent disposal.	3
D3	Gentle upper slopes on plateau with gradients up to 10%. Similar to Dl but with less gravel and rock outcrop. Shallow to moderately deep gravelly yellow earths.	Shallow gravelly soils and considerable rock outcrop affecting construction and effluent disposal.	3
Murray - Incised Upland Valleys On Granite Parent Material			
My1	Moderate to steep valley side— slopes (10—20%) with moderately deep yellow earths and yellow duplex soils with few, if any, gravels. Patchy rock outcrop and open woodland vegetation.	Slopes and somewhat dispersive subsoils provide a moderate erosion hazard .	3
My2	Gentle to moderate valley side—slopes (8—15%) with similar, possibly deeper soils to My1. Similar rock outcrop and vegetation to My1.	Minor hazard of erosion on steeper areas due to subsoil dispersability.	2
My3	Drainage channels and narrow alluvial terraces at base of valleys. Rock outcrop common. Variable slopes.	High local flood risk and erosion hazard due to position. Unacceptable for effluent disposal.	5

Darling Plateau

Map Unit	Description (refers to Map1)	Limitations to development	Capability rating (refer to map1a)
Helena Major, Very Deeply Incised Valleys Of The Swan River And Its Major Tributaries. Occurs Within Granite And Mixed Granitic, Migmatite And Basic Rocks.			
H1	Relatively narrow, undulating crests with shallow yellow brown earths and common massive rock outcrop. Slopes generally less than 8%.	Shallow soils and rock outcrop will affect construction and effluent disposal in some areas.	3
H2	Moderately steep slopes (15—25%) usually adjacent to crests or plateau surface. Shallow to moderately deep yellow or red earths with occasional rock outcrop.	Slopes and areas of rock will affect construction and effluent disposal. Moderate hazard of erosion. Some access difficulties.	4
H3	Steep to very steep valley slopes with considerable massive rock outcrops and very shallow soils. Gradients 25 to greater than 35%. Contains many narrow drainage pathways.	Severe hazard of erosion, exceptional construction and access difficulties.	5
H4	Lower coluvial footslopes at base of valley. Similar to H2 but with lesser slopes (5—15%).	Moderate erosion hazard in steeper areas due to position in path of runoff from adjacent slopes. Minor flood risk in lower areas. Access difficult.	3
Darling Scarp - Steep Scarp Face Separating Coastal Plain From Darling Plateau. Similar Parent Materials As Helena.			
DS1	Steep slopes of the scarp face with shallow red and yellow earths with much rock outcrop. Gradients generally between 20 and 35%.	Severe hazard of erosion due to slope and exposure. Severe access, construction and effluent disposal problems due to slope, soil depth and rock outcrop.	5
DS2	Moderately steep slopes of the scarp face, gradients generally m between 10 and 20%. Dominantly red earths and red duplex soils with some gravels and common rock outcrop.	Moderate erosion hazard due to slope and subsoil dispersability. Some construction and access difficulties in steeper, rocky areas.	4

Swan Coastal Plain

Map Unit	Description (refers to Map1)	Limitations to development	Capability rating (refer to map1a)
Forrestfield - Lateritised Foothills Of The Darling Scarf, Of Colluvial Origin.			
F1	Gentle to moderately sloping foothills with moderately deep to deep, well drained gravelly red earths and some duplex brown soils. These areas have relatively minor surface stone and are eroded in places due to heavy stocking by sheep. Gradients up to 10%.	Moderate erosion hazard due to considerable overgrazing in the past and consequent lack of vegetative cover.	3
F2	Gently undulating to flat colluvial footslopes with deep, moderately well drained gravelly red sands and yellow earths with varying amounts of subsoil gravel. Small amounts of surface gravel are present and gradients are up to 3%.	Minor hazard of erosion due to overgrazing in the past.	2
F3	Gently undulating to flat colluvial footslopes with deep well drained red earths without gravels. Gradients usually less than 1.5%.	Very minor erosion hazard due to loose sandy surface if left unvegetated for long periods.	2
F4	Gentle to moderate slopes separating the lower alluvial flats from the plain and colluvial footslopes. Gradients usually between 5 and 12%. Soils are deep, somewhat poorly to moderately well drained, grey or yellow brown earths which may contain gravels.	Minor erosion hazard in some steeper areas. Effluent disposal problems may occur in limited areas due to slow infiltration.	3
F5	Drainage channels and valley complexes through the foot—hills. These have varying slopes and are commonly stony. The soils are usually shallow gravelly yellow or red earths.	High local flood and erosion hazard due to position in catchment areas. Unacceptable for effluent disposal.	5
Guildford Flat Plain Formed From Fluviatile Deposits Of Pleistocene Age.			
Gf1	Slightly undulating to flat plain with moderately deep sands overlying clayey soil at depth (yellow duplex soils). These are moderately well drained and free of gravel. Gradients usually less than 2%.	Minor hazard of wind erosion of the sandy surfaces if vegetative cover removed. External drainage is limited due to lack of slope.	2
Gf2	Flat plain with deep moderately well drained yellow earths with relatively minor ferruqinous subsoil gravels, Gradients less than 1%.	Minor site drainage problems due to lack of slope. Effluent disposal may be limited in minor areas by slow permeability.	2
Gf3	Sandhill remnant of aeolian origin with deep somewhat excessively well drained yellow sands. Slopes range from up to 5% on top, to 23% in limited areas at margins.	Moderate wind erosion hazard due to loose sandy surface, particularly on short steep margins.	3

Map Unit	Description (refers to Map1)	Limitations to development	Capability rating (refer to map1a)
Swan Flat Alluvial Terraces Formed From Recent Deposits.			
SW1	Highest level river terrace with deep, well drained red earthy sands. Slopes are usually less than 2%.	Some possibility of flooding in exceptionally wet seasons due to position on Recent alluvial material. Minor erosion hazard to sandy surface if left devoid of vegetation cover.	4
SW2	Middle level river terrace with deep, uniform loamy soils which externally are somewhat poorly drained but internally are quite well drained. Slopes are usually less than 1%.	High flood hazard due to position.	5
SW3	Middle level river terrace with up to 30 cm of surface sand overlying similar deep soils to SW2. Slopes are also similar.	High flood hazard due to position.	5
SW4	Backplain area of middle level terrace. Soils are deep, somewhat poorly drained uniform clays. These have heavy clay loam surfaces which are sometimes cracked. External drainage is poor due to slope gradients less than 1%.	High flood hazard due to position. Some construction difficulties likely with cracking clay subsoils. Unacceptable for effluent disposal due to slow permeability.	5
SW5	Swamp area, inundated for considerable period of the year. Deep, very poorly drained mottled clays are likely to occur.	High flood hazard due to 5 considerable period of the problems due to inundation. Unacceptable for effluent disposal.	
SW6	Minor short steep slopes between higher and lower terraces. Deep sandy soils similar to SW1.	High flood hazard due to position. Limited capability due to narrow extent.	5
SW7	Lowest level terraces adjacent to river, with deep mixed alluvial soils.	Very high flood hazard due to position.	5
SW8	Low—lying incised drainage areas within the alluvial plain. These link up with unit F5 and contain variable, somewhat poorly drained alluvial soils.	High local flood risk and erosion hazard due to position in catchment areas and on the Recent alluvial plain.	5

Table 2. Land capability classes.

Land class	Degree of limitation	General description
1	None to very slight,	Areas with a high capability for the proposed activity or use. The limitations of long term instability, engineering difficulties or erosion hazard do not occur or they are very slight. Standard designs and installation techniques, normal site preparation and/or management should be satisfactory to minimise the impact on the environment.
2	Slight	Areas capable of the proposed activity or use. Slight limitations are present in the form of engineering difficulties and/or erosion hazard. Careful planning and/or the use of standard specifications for site preparations, construction and follow—up management should minimise developmental impact on the land.
3	Moderate	Areas with fair capability for the proposed activity or use. Moderate engineering and/or high erosion hazard exist during construction. Specialised designs and techniques are required to minimise developmental impact on the environment.
4	High	Areas with poor capability for the proposed activity or use. There are considerable engineering difficulties during development and/or a high erosion hazard exists during and after construction. Extensively modified design and installation techniques, exceptionally careful site preparation and/or management are necessary to minimise the impact on the environment.
5	Severe	Areas with very poor capability for the proposed activity or use. Limitations, either long term instability hazards, erosion or engineering difficulties cannot be easily overcome with current technology. Severe deterioration of the environment will probably occur if the activity or use is attempted in these areas.

(i) Erosion Hazard

The development proposal occurs over a wide variety of land types as indicated by the 28 map units delineated on the landform and soils map included with this report.

On all land there is a degree of erosion hazard associated with vegetation clearing and land disturbance which accompanies subdivision or 'urbanization' of a rural area. The magnitude of the erosion hazard is determined by a variety of factors including slope, soil texture, structure and depth, amount of surface gravels and rock outcrop, and position with respect to drainage pathways.

During the Brigadoon survey these factors were considered for each map unit or 'land type' in order to derive a rating (from very good, class 1, to very poor, class 5) which expresses the capability of land in each map unit to sustain residential development with minimal risk of land degradation or erosion. Hence, land with a high rating, class 1 or 2, is considered to have a minimal risk of soil erosion when developed for residential purposes, however when land of class 5 is similarly developed the risk of erosion or land degradation is considered very high.

The Soil Conservation Service Branch of the Department of Agriculture is concerned that development on land of low to very low capability (class 4 and 5) does not occur due to the likelihood of resultant soil erosion and land degradation problems. It considers that where possible development should be guided into those areas of higher capability and hence lower associated soil erosion hazard (i.e. areas of classes 1—3).

The consultant's report recognizes that the topography of the country is such that subdivision into small lots must be confined to limited areas of the uplands, the foothills, and the coastal plain. Although the proposal largely achieves this goal there are some areas where it is felt the subdivision design needs to be modified. Of major concern is the occurrence of a number of proposed residential lots within drainage pathways (map units My3, F5, SW8) where the erosion hazard is considered high. Likewise the occurrence of some residential lots on excessively steep (H3, DS1) land is considered undesirable.

The development plan could be modified in a number of ways to lessen the impact of the proposal in terms of potential soil erosion. Referring to the land capability map included with this report, the following guidelines apply:

1. No development should be permitted within areas of very low capability (class 5).

2. Residential development within areas of class 4 should be discouraged. If relocation is not possible, lot sizes should be increased to include at least some land of higher capability (class 2 or 3). Within these expanded lots, building envelopes should be delineated on the 'more capable' areas and clearing controls (subject to fire control considerations) should be specified over the remainder of the lot.

3. Wherever possible the most intensive development should be guided into those areas of higher capability and hence areas with fewer associated limitations or hazards, i.e. into class 1 or 2 and failing that, class 3.

(ii) Effluent Disposal

As all 400 residential lots within the proposed development will be required to dispose of household sewage effluent on—site, the ability of the soils present to absorb and break down the amount of waste applied is a major planning consideration.

The Department of Agriculture, having conducted a soils/landform study over the area, is in a position to comment with some authority on the nature of the soils and their properties which influence their ability to absorb septic effluent. It does however recognise the authority of the Department of Health in these matters and has therefore provided that Department with some results of the resource survey prior to completion of this report in order to assist that Department's evaluation of the development proposal.

The attached table 1, which provides a brief description of the nature of the land and the inherent physical limitations, also includes comments on potential effluent disposal problems where appropriate. In general there are three areas of concern:

1. On the upland areas which have considerable rock outcrop (map units Dl, D2 and D3) is there adequate loose lateritic material present to allow leach drains to function effectively?

2. If so, what happens to the effluent when it reaches the underlying granite? How pervious is it? Will it move laterally towards the sideslopes of the Swan River Valley?

3. Are the heavier (finer textured) subsoils in some lowland areas (map units Gf1, Gf2) sufficiently permeable to absorb effluent at and acceptable rate and what should the trench lengths be?

With the limited time available for this preliminary evaluation of the development proposal, it is simply not possible to provide clear cut answers to these questions from the land resource survey alone. However it is hoped that the survey has more clearly delineated those areas (i.e. map units Dl, Gf1, Gf2) where additional soil hydraulic conductivity tests may be required to supplement the currently largely subjective assessment made here by considering soil depth, texture and rock outcrop as reflected in the capability rating and description of limiting factors in Table 1.

(iii) Agricultural Suitability (Refer maps 2 and 2a)

Stage one of the proposed development occurs adjacent to farming land within the Swan Valley which is currently being used for viticultural purposes. The land resource survey conducted over this area has shown that the site contains areas of potentially high class horticultural and viticultural soils. The accompanying agricultural capability map delineates these areas by ranking all map units from good, (high potential for

horticulture or viticulture) to very poor, (very low potential - unsuitable for either horticulture or viticulture).

Table 3. Agricultural Assessment

Map Unit	Soil Type (CSIRO)	Relevant Features (refer Map2)	Viticultural or Horticultural Potential	Capability rating (ref. Map2a)
DS2	-	Moderately steep slopes with common rock outcrop. Soils not easily worked and are erosion prone.	Poor	4
F1	Oakover gravelly sandy loam	Soils have good drainage status but topography and surface stone may be limiting in steeper areas.	Fair	3
F2	Oakover gravelly sandy loam and unnamed type G	As for F1 but with no topographic limitation.	Fair	3
F3	Range sand	Good drainage status and is cultivated with ease.	Good	2
F4	Unnamed type W	Some hazard of erosion on steeper Fair areas. Reasonable waterholding characteristics.	Fair	3
F5	Type W and valley complex	Drainage pathway. High erosion hazard area.	Very poor	5
Gf1	Herne sand	Many vines grown on this soil type. Soils are easily cultivated and in general present no problems of drainage. Are not highly fertile yet they are not exceptionally low.	Good	2
Gf2	Cruse sand and Herne sand	As for Gf1	Good	2
Gf3	Karrakatta sand and minor Houghton sand	Easily worked but low to very low waterholding capacity and are prone to wind erosion.	Poor	4
SW1	Houghton sand	Soils are easily worked and there are no drainage problems.	Good	2
SW2	Pyrton loam	Soils are quite fertile and although externally poorly drained, they have good internal drainage. There is some danger of flooding in winter.	Fair	3
SW3	Pyrton sand	Similar to SW2 but with alluvial sand veneer over loam.	Fair	3
SW4	Pyrton clay loam	Similar to SW2 but with finer, heavier soil textures and poorer internal drainage.	Fair	3
SW5	Permanent swamp	Very poorly drained; largely useless for agriculture.	Very Poor	5
SW6	Houghton sand	Erosion hazard due to short steep slopes, otherwise as for SW1.	Fair	3
SW7	River wash, alluvial	Soils similar to Pyrton series but higher hazard of flooding.	Fair	3
SW8	Valley complex and minor swamp areas.	Very poorly drained drainage pathways. High erosion hazard areas.	Very Poor	5

In assessing the horticultural or viticultural capability of each map unit a number of physical attributes of the soils and landforms have been considered. These include soil depth, texture, structure and subsequently drainage status, in addition to stone and rock content, landform slope and position. These attributes determine in part, the erosion hazard, water holding capacity, ease of root penetration, ease of cultivation and susceptibility to waterlogging or droughtiness, all of which influence the potential of the land for agricultural uses.

It is recognised that a major constraint to future horticultural or viticultural development in this area is likely to be the quantity, and quality of available groundwater. At present the Department of Agriculture has insufficient data on this aspect to make an authoritative statement on the effect of this potential limitation. It is recommended therefore that the relevant water management authority be approached to provide further details which will help planning decisions.

The assessment of areas of high potential for horticulture or viticulture has been made therefore on the assumption that water quantity or quality will not be a limiting factor. Given this, the areas of high capability, or potential, are those containing soils of the Houghton, Herne and Cruse series (map units SW1, Gf 1, Gf 2 and F3, see Table 3). The Department of Agriculture at present considers that such land should be retained for potential productive full time agricultural users and in order to allow this the minimum recommended lot size over these map units should be 16 ha. In areas of lower capability, but still with fair potential, it is considered that the 4 to 5 ha minimum lot sizes proposed by the consultant are appropriate to part—time relatively non—productive farming.

In other lowland areas of lower capability (class 4 and 5) and over the remainder of the development site, the Department recognises the low potential for either horticulture or viticulture. However, it is concerned over any development in these areas due to the risk of land degradation. Table 3 overleaf shows the evaluation of each of the map units in the lowland area (stage 1) in terms of the potential of the land for horticultural or viticultural use.

(iv) Water Supplies

A portion of the proposed development (stage 1) occurs within the Swan Valley Underground Water Control area and therefore the location of any bores is subject to Public Works Department approval. The Swan Valley is a gazetted irrigation area and the amount of water it is proposed to extract from underground sources represents an estimated 15% of the available supply.

The Department of Agriculture estimates that 400 rural residential lots will require 548 to 658Kl of water per day to cope with average household and garden use. A supply of this magnitude will require the development of a major water supply system and dams of sufficient size would require Public Works Department approval in design and during construction. If it was proposed to supplement the supply with individual property dams,

it must be recognised that due to soil and topographic conditions, suitable dams sites are not readily available in granite country.

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