Subdivision
of
Lot 502 Brand Highway, Dongara

GUILDELINES FOR BUILDING

Civil Technology
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South Perth WA 6151

December 2007

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1 Introduction

Lot 502 Brand Highway, Dongara ("Lot 502") is referred to by its owners as the "Old Acres Estate" and is located north-east of the town of Dongara within the Shire of Irwin (see Appendix A – Locality Plan).

On 10 March 2006, Lot 502 was approved for subdivision by the WA Planning Commission ("WAPC") reference 129561 into 143 residential lots of about 2000m2 in area each ("Approval 129561"). The plan of the proposed subdivision of Lot 502 is included herein as Appendix B.

The 143 lots will be developed for residential use according to the zoning for Lot 502 as stipulated by the Shire of Irwin's Town Planning Scheme No. 2.

2 Scope of Guidelines

These guidelines are intended to be of general use for the Shire of Irwin when approving residential use of the lots produced from the subdivision of Lot 502.

They are a guide only and should not be taken to be sufficient replace:

(a) Detailed field testing carried out by a structural engineer charged with the responsibility of certify as structurally adequate the design of any building proposed to be erected on any lot.

(b) Certification from a structural engineer the design of any building proposed to be erected on any lot.

(c) Field location of any sewer, stormwater or power connection to any lot.

3 Landform

3.1 The natural soils

The land comprising the subdivision comprised very flat (elevations ranging from 8.5m AHD to 9.5m AHD) of alluvial sand, silt and clay. The entire site comprise a fine to granular topsoil layer of varying depth 0.1m to 0.3m which is underlain by high plasticity clay soils.

A copy of a report prepared by Golder Associates and Dated February 2007 (excluding test pit results) is annexed hereto as Appendix C (the "Golder Report").

These clay soils are:

(a) of low permeability

(b) tend to promote the perching of surface water and become muddy; and,

(c) are susceptible to volume change if moisture content fluctuates

3.2 The final finished soils

In order to avoid the problems encountered with wet surface clays becoming sticky when wet and to provide the initial house pad elevation, the following subdivision works were carried out:

(a) 50mm of topsoil was stripped from the site and removed offsite; and,

(b) a 300mm layer of clean sand fill was placed and compacted over the lots.

3.3 Other relevant subdivisional works

As the understory soils of the site are of low permeability, it was considered that each new building be provided with a stormwater connection point discharging into the street front drainage system rather than attempt to drain buildings into the existing soils, which may have failed or contributed to volume change in the soils which could lead to cracking in structures.

Each lot was also provided with a reticulated sewer, water and underground power connection point.

4 Development requirements

4.1 Structural competency

Table 4 (read together with Figure 3) of the Golder Report classifies areas of the site according to AS 2870 – 1996 Residential Slabs and Footings.

In order to ensure that development on the land is carried out with minimal problems, it is recommended that the Shire require before the issue of a building license that:

- the design of all proposed buildings and retaining walls be certified by a Certified Practising Engineer who is a Corporate Member of the Institute of Engineers, Australia (“the Engineer”),

- the Engineer carry out specific soil testing of each lot in the location of the proposed building,

- the Engineer give an opinion as to the classification of the soils supporting each proposed building as against AS 2870 - 1996 Residential, Slabs and Footings

- the Engineer design sand pads and footings of a strength not less than those footings which would applicable to the land as classified according to AS 2870 - 1996.

- Liaise with the proponent builder to determine if it is desirable to reduce the structural detail required within the foundations of the proposed building by achieving an “S” Classification in areas identified in the Golder Report as an “M” classification or achieving an “M” Classification in areas identified in the Golder Report as an “H” classification. If it is desirable, ensure that the foundations have vertical clearance to the filled soil (i.e post subdivision) level:

    - in the case of an M classified site, not less than 400mm (ie 700mm above the natural ground level)

    - in the case of an H classified site, not less than 200mm (ie. 500mm above the natural ground level.

  (refer Page 7 of the Golder Report)

4.2 Drainage control

In order to ensure that development on the land is carried out with minimal risk for future problems related to building on clay soils, it is recommended that the Shire require as a condition attached to any building license issued for a lot in the Lot 502 Brand Highway subdivision where the building comprises water fixtures and a rooved or paved area that:

(a) all waste water fixtures and fittings be properly connected to the reticulated sewer system connection provided to each lot, the approximate location of which are shown on the plan annexed hereto as Appendix D, in accordance with Regulations,

(b) the rooved area/s be guttered and downpiped and the paved area/s be graded so that they drain a grated gully,

(c) that the downpipes and gullies be connected by 90mm and/or 150mm uPVC pipework to a silt trap installed by the Applicant or the Applicant's builder at the stormwater connection point provided at each lot, the approximate location of which are shown on the plan annexed hereto as Appendix E,

(d) the uPVC pipework joints be sealed with solvent cement to prevent moisture loss, and;

(e) the silt trap be constructed:

- in a manner which prevents silt entering into the Shire's street drains; and,

- in accordance with the drawing annexed hereto as Appendix F.

4.3 Site stabilization

At completion of the subdivision, the site was stabilised with a layer of course "river sand".

The lots produced from the subdivision of Lot 502 are relatively flat so stabilisation of insitu soils from the potentially erosive effect of rainfall is not considered to be a problem.

However, as the site is denuded of vegetation and is exposed to prevailing winds it is likely that wind will present problems on any disturbed areas. As a result, the Shire should place conditions on any building and development that occurs on any lot that upon completion that the site be stabilised by reinstatement of the "river sand" overlay to all disturbed areas. Stabilisation by hydro-mulching is not considered to have longevity of "river sand" and should not be favoured.

It would be expected that once buildings are occupied each occupier will over time develop some landscaping on their respective lots which will reduce the potential for wind erosion to occur over time.

5 Maintenance

Clay soils react to the presence of water by slowly absorbing it, making the soil increase in volume. This volume change can present problems with building structures particularly if there is unevenness in movement in the soils supporting the building.

There are measures that the owner of each lot may employ to avoid and mitigate the effects of volume change in the soils of their respective lot and as such should be made aware of these measures.

The subdivider of Lot 502 has provided a copy of the Commonwealth Scientific and Industrial Research Organisation ("CSIRO") document entitled "Foundation Maintenance and Footing Performance: A home Owners Guide" also produced by the CSIRO, a copy of which is annexed hereto as Appendix G.

The practice of providing the document annexed hereto as Appendix G is to be continued throughout the sales programme for the Lot 502 subdivision.

Kevin Lilly BE (Hons) CPE
Design Engineer

Ian McKellar
Project Manager

Audit - Peter Botman ACA
Financial Controller

LIST OF APPENDICIES

1. Appendix A   Locality Plan
2. Appendix B   Proposed Subdivision Plan
3. Appendix C   Golder Associates Report, February 2007
4. Appendix D   Sewer Reticulation Plan
5. Appendix E   Drainage Reticulation Plan
6. Appendix F   Silt trap detail
7. Appendix G   CSIRO: Foundation & Footing maintenance

APPENDIX A

LOCALITY PLAN

No.	DATE	BY	DESCRIPTION

AMENDMENTS

W.A.P.C. No.: 129561

DRAWN: .

APPROVED: .

DESIGNED BY:
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SCALE: A3 1 : 10000

BEN CLARKE

PROPOSED SUBDIVISION OF
LOT 502 BRAND HIGHWAY, DONGARA
OLD ACRES ESTATE
LOCALITY PLAN

FILE NAME: 576-FIG 1.DGN | DATE: 17-05-07 | DRAWING No.: 576-DNMP-APP1 | AMDT No.: .

APPENDIX B

PROPOSED SUBDIVISION PLAN

No.	DATE	BY	DESCRIPTION

AMENDMENTS

SCALE:

40m 0 40m 80m 120m

A1 PAGE - SCALE 1 : 2000
A3 PAGE - SCALE 1 : 4000

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PROPOSED SUBDIVISION OF LOT 502 BRAND HWY, DONGARA

OLD ACRES ESTATE

PROPOSED SUBDIVISION PLAN

FILE NAME: 576-FIG 3.DGN
DATE: 30-05-07
DRAWING No.: 576-DNMP-APP3
AMDT No.:

APPENDIX C

GOLDER REPORT, February 2007

(Nb. excludes test pit results)

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REPORT ON

GEOTECHNICAL INVESTIGATION PROPOSED SUBDIVISION OLD ACRES ESTATE BRAND HIGHWAY DONGARA

Submitted to:

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DISTRIBUTION:

1	Copy	-	J.W. & A. Clarke
2	Copies		Civil Technology
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Appendix D	Important Information About Your Geotechnical Engineering Report

1.0 INTRODUCTION

This report presents the results of a geotechnical investigation for a proposed residential subdivision of Old Acres Estate, Dongara. The work was performed by Golder Associates Pty Ltd at the request of Mr Jim Clarke and in accordance with our Proposal P054494-P01-Rev1 and was authorised by a signed client authorisation dated 18 August 2005.

The site is located along the Brand Highway between Waldeck Street and Moore Road, and is bordered by a railway reserve to the north, refer to Figure 1: Location Plan. The site is roughly pentagonal in shape, encompassing an area of 37.45 ha. A triangular shaped reserve, with frontage onto Brand Highway, is located approximately mid-way along the southern boundary of the site.

The present plan is to subdivide the land into 74 lots, each sized to about 4,000 m^2. The triangular reserve has been set aside for recreational use.

The site is relatively level at an elevation of about 9.0 m AHD and 85% of the land was cropped at the time of the investigation. The remaining area consists predominantly of cleared land although a farming shed and a stone block silo are present to the south-east, and a decommissioned railway line is present along the south-west edge, parallel to the Brand Highway. An overhead Western Power line runs north-south through the middle of the site.

2.0 OBJECTIVES

The objectives of the investigation were to:

- assess general subsurface soil and groundwater conditions across the site;
- classify the site in accordance with AS 2870 "Residential Slabs and Footings";
- provide site preparation procedures; and
- provide appropriate geotechnical design parameters for pavement thickness design..

3.0 FIELD PROGRAMME

The fieldwork programme was performed on 24 and 25 August 2005 and comprised:

- inspection of 76 test pits previously excavated by the client, to depths ranging from 1.4 m to 2.2 m; and
- Perth Sand Penetrometer (PSP) tests adjacent to about one third of the test pits to depths ranging from 0.6 m to 0.9 m.

Test pit numbering coincided with lot numbers, with a further two test pits, TP75 and TP76 in or adjacent to an area proposed as Public Open Space (POS). The test locations are shown on Figure 2: Site Plan. Test pit reports are presented as Appendix A along with notes on the soil classification system used to log the soils. PSP testing was carried out in accordance with AS 1289 6.3.3 and test results are presented with the test pit reports.

A geotechnical engineer from Golder Associates inspected the test pits, logged the soils encountered, recovered samples from the spoil for inspection and possible laboratory testing and carried out the penetrometer testing. Laboratory testing of selected samples has not been included at this stage.

4.0 LABORATORY TESTING

Laboratory testing was carried out at Blacktop Materials Engineering's NATA accredited laboratory. The testing comprised determination of:

- particle size distribution on six samples;
- Atterberg limits and linear shrinkage on six samples;
- dry density moisture content relationship using Modified compactive effort on four samples; and
- soaked California bearing ratio (CBR) on four samples.

The test results are summarised in Table 1, Summary of Laboratory Test Results. The individual results of the testing along with the test methods followed are presented in Appendix B, Laboratory Test Results.

Table 1: Summary of Laboratory Test Results

Test Pit	Depth (m)	USC	% Fines	Atterberg Limits (%)			LS (%)	Modified Compaction		Soaked CBR (%)
				LL	PL	PI		MDD (t/m^3)	OMC (%)	
TP34	0.5–1.5	CH	81	57	23	34	15.0	1.74	17.0	1.5
TP35	0.8–2.0	CH	82	56	23	33	15.0	-	-	-
TP43	0.2–1.9	CH	91	64	38	26	10.0	1.74	17.0	2.5
TP50	0.3–0.8	SC-SM	39	21	16	5	2.0	2.05	8.0	17.0
TP56	0.5–2.0	CI	72	45	16	29	12.5	-	-	-
TP71	0.5–1.8	CI-CH	83	50	18	32	14.0	1.86	13.5	2.5

Notes

1. LL Liquid Limit; PL Plastic Limit; PI Plasticity Index; LS Linear Shrinkage, MDD Maximum Dry Density; OMC Optimum Moisture Content
2. Soaked CBR samples compacted to 92% MDD at or just dry of OMC.

5.0 SITE CONDITIONS

5.1 Geology

The 1:250,000 scale Dongara-Hill River Sheet of the Geological Series shows the site is underlain by recent Alluvium. This material is described as alluvial sand, silt, and clay, which is consistent with the material observed on-site.

5.2 Subsurface Conditions

From the field observations and the laboratory test results, the site area can be categorised into five general areas of increasing clay content, as summarised in Table 2 and Figure 3. Some overlapping of areas occurs due to the variability of alluvial soils encountered.

Table 2: Areas of Similar Subsurface Conditions

	Description	Lots
Area 1	South-western boundary parallel to Brand Highway	70 – 74 & 76
Area 2	Predominately across southern half of the site	1 to 3, 44, 46 to 53, 56, 58 to 60, 62, TP63 & POS
Area 3	Along eastern site boundary	4-9, 45
Area 4	Central area	31 to 34, 37, 40, 54 & 61
Area 5	Northern area	10 to 30, 35, 36, 38, 39, 41 to 43, 55, 57 & 64 to 69

It should be noted that test pits TP3, TP11, TP12, TP25, TP35, TP44, TP45, TP47, and TP67 encountered occasional thin lenses of clayey gravel/clayey sand/silty clay above the underlying orange brown silty clay. These lenses comprise fine to medium, sub-angular to angular, pale grey, grey and white sands and gravel and low plasticity clays and silts. Usually dry and cemented, these lenses are medium dense to dense granular material or very stiff to hard clays.

The entire site is underlain by high plasticity and occasional medium plasticity clay soils at shallow depth covered with various thicknesses of granular soils. The areas have been grouped on the basis of the type and thickness of granular soils overlying the high plasticity soils.

5.2.1 Area 1 – South-Western Boundary

Test pits pertinent to this area are TP70 to TP74 & TP76.

The south-western edge of the site, marked Area 1 in Figure 3, is parallel to the Brand Highway where a railway line once existed. The rail line has been removed for some time and the embankments spread out and levelled. General subsurface conditions comprise:

- FILL – Silty SAND (SM), fine to medium grained, sub-angular, grey to pale grey, extending from ground surface to depths ranging from 0.3 to 0.5 m. Also contains trace gravel and ballast. Test pit TP74 encountered 0.2 m of silty sand topsoil below the fill.

- Silty SAND (SM), fine to medium grained, sub-angular to subrounded, grey to dark grey to orange brown, medium dense, dry to moist, extending to depths ranging from 0.7 to 1.5 m. This layer was not present in test pit TP70.

- Silty CLAY (CH), high plasticity, orange brown, moist, very stiff to hard, extending to the depth investigated of 2.0 m.

5.2.2 Area 2 - Southern Half of Site

Test pits pertinent to this area are TP1 to TP3, TP44, TP46 to TP53, TP56, TP58 to TP60, TP62, TP63, TP75 & TP76.

The southern proportion of the site, marked Area 2, includes a cleared area, shed and silo structures, the recreation reserve and a portion of farmed area along the south-east and south-west of the site. The general subsurface conditions comprise:

- TOPSOIL – Silty SAND (SM), fine to medium grained, sub-angular, pale grey to dark grey with some organic content including plant rootlets, dry to moist, loose, extending from the ground surface to depths ranging from 0.05 to 0.3 m.

- Silty SAND (SM), fine to coarse grained, sub-angular, pale brown to dark brown, grey to dark grey, dry to moist, loose to medium dense, extending to depths ranging from 0.45 to 1.4 m (thickness ranges from 0.4 m to 1.2 m). This soil was present to the depth investigated of 1.5 m in test pit TP76.

- Silty CLAY (CH), medium to high plasticity, brown to orange brown, moist, very stiff to hard, extending to the depth investigated of 2.1 m. This zone occurs at depths ranging from 0.4 m to 1.4 m.

5.2.3 Area 3 - Eastern Boundary

Test pits pertinent to this area are TP4 to TP9 & TP45.

Area 3 includes lots located along the eastern boundary of the site and one lot on the eastern boundary of the recreation reserve. The soil profile contains sands that are more clayey than the southern half of the site. General subsurface conditions comprise:

- TOPSOIL – Silty SAND (SM), fine to medium grained, sub-angular, dark grey with some organic content including plant rootlets, dry to moist, loose, extending to depth ranging from 0.2 to 0.3 m.

- Clayey SAND (SC), ranges from fine to medium to medium to coarse grained, sub-angular, pale brown to brown, dry, medium dense, extending to depths ranging from 0.4 to 0.95 m. (0.3 m to 0.95 m thick). This layer was present as a clayey gravel in test pit TP45.

- Silty CLAY (CH), medium to high plasticity, brown to orange brown, dry to moist, very stiff to hard, fissures observed in test pits TP6 and TP9, extending to the depth investigated of 2.0 m.

5.2.4 Area 4 - Central Area

Test pits pertinent to this area are TP31 to TP34, TP37, TP40, TP54 & TP61.

Area 4 includes lots located north of the reserve and generally to the west of the overhead power line. General subsurface conditions comprise:

- TOPSOIL – Silty SAND (SM), to Silty CLAY (CH), fine to medium grained, sub-angular, dark brown to dark grey with some organic content including plant rootlets, moist to dry and predominately loose, clay is high plasticity, moist to dry, and ranges from firm to very stiff, extending from the ground surface to depths ranging from 0.15 to 0.25 m.

- Sandy CLAY (CH), high plasticity, orange brown to dark grey, fine to coarse sub rounded to rounded SAND, dry and fissured, very stiff to hard, extending to depths ranging from 0.6 to 1.5 m (range in thickness 0.6 m to 1.4 m)

- Silty CLAY (CH), high plasticity, orange brown, moist, very stiff to hard, extending to the depth investigated of 2.1 m.

5.2.5 Area 5 – Northern Area

Test pits pertinent to this area are TP10 to TP30, TP35, TP36, TP38, TP39, TP41 to TP43, TP55, TP57 & TP64 to TP69.

This includes lots located predominantly in the northern half of the site. General subsurface conditions comprise:

- TOPSOIL –Silty CLAY (CI – CH), medium to high plasticity, brown trace organic content, extending from the surface to depths ranging from 0.15 to 0.5 m. Silty sand was present to a depth of 0.5 m immediately below the topsoil in test pits TP29, 55 and 57.

- Silty CLAY (CH), high plasticity, brown grey to orange brown, dry for the first 1.2 to 1.5 m than moist, very stiff to hard.

5.3 Groundwater

Groundwater was not encountered within the depths investigated, up to 2.2 m.

6.0 DISCUSSION

6.1 Site Classification

Site classifications in accordance with Australian Standard AS 2870 (1996) are provided on the basis of the expected characteristic surface movement. The definitions of the various site classes and the surface movements to which they relate (taken from Table 2.1 and Table 2.3 of the code) are summarised in Table 3, Definitions of Site Classifications for reference.

The site classification applicable to the development site is particularly governed by the properties of the clayey soils and the thickness of the inert granular material (*in situ* sand and placed sand fill) overlying the clayey soil.

Table 3: Definition of Site Classifications

Class	Foundation Type	Characteristic Surface Movement y_s (mm)
A	Most sand or rock sites with little or no ground movement from moisture changes.	negligible
S	Slightly reactive clay sites with only slight ground movement from moisture changes.	0 to 20
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes.	20 to 40
H	Highly reactive clay sites, which can experience extreme ground movement from moisture change.	40 to 70
E	Extremely reactive clay sites, which can experience extreme ground movement from moisture change.	> 70
A to P	Filled sites.	-
P	Sites which include soft soils, such as soft clay or silt, loose sands, landslip, mine subsidence, collapsing soils, soils subject to erosion, reactive sites subject to abnormal moisture conditions or sites which can not be classified otherwise.	-

The underlying silty clay soil is considered to have a high potential for volume change with changes in moisture content. Ground movements are dependent upon several factors including:

- Thickness of granular soil overlying soil prone to seasonal movement (clayey soil).
- Plasticity of the fines (particles <0.075 mm) within the clay soil.
- Proportion of fines within clayey soil.
- Degree of cementing within the clayey soil.
- Thickness of soil prone to movement.
- Climate and drainage characteristics of the site.
- Type and proximity of surrounding vegetation.

Site classifications have been assessed in accordance with AS 2870-1996 "Residential Slabs and Footings" based on the laboratory test results and visual-tactile identification of the soils. The results of the assessment are presented in Table 4, Site Classification.

Table 4: Site Classification

Area	Description	Classification as per AS 2870
1	South-western boundary parallel to Brand highway	M
2	Predominately across southern half of the site	S
3	Along eastern site boundary	M
4	Central area	H
5	Northern area	H

The site classifications can be changed dependent on the thickness of granular material present over the site. This thickness of granular material can consist of *in situ* and/or imported granular fill.

In order to achieve a 'Class 'S' site classification on those areas designated as 'M', a minimum of 0.7 m thickness of granular material (including *in situ* granular materials) is required to be present below the underside of footings and slabs. This equates to a thickness of 1.0 m of granular material over the ground surface assuming that footings are founded at 0.3 m depth.

In order to achieve a Class 'M' site classification on those areas designated as 'H', a minimum of 0.5 m thickness of granular material (including *in situ* granular materials) is required to be present below the underside of footings and slabs. This equates to a thickness of 0.8 m of granular material over the ground surface assuming that footings are founded at 0.3 m depth.

6.2 Site Preparation

The following site preparation procedure is recommended to achieve a class "M" site classification:

- Remove the topsoil (up to about 0.3 m) from the area of construction;
- Grade the exposed surface to provide drainage and prevent ponding of water on the surface;
- Proof compact the exposed surface. Should soft zones be identified during proof compaction, over excavation of these zones will be required; and
- Place approved granular backfill in maximum loose layers of 0.3 m and compact to a density level commensurate with a blow count of at least 8 blows per 300 mm penetration using a PSP in accordance with Australian Standard AS 1289 6.3.3

The *in situ* density of the sand exposed at foundation level should be checked for a depth of at least 0.9 m below underside of footings or ground slabs; or until the top of the clay is reached, whichever is lesser. If difficulty arises in achieving the specified PSP blow counts, *in situ* density testing should be performed to confirm the correlation between blow count and density at the specific location to ensure that a density index of at least 70% is being achieved in accordance with AS 1289 5.6.1

Care should be taken to ensure that water is not allowed to pond on the clayey soil beneath the fill, as a primary design objective is to maintain the equilibrium moisture condition in the clay after construction. A surface drain should be constructed to channel water around the site. The granular pad should not be used to receive stormwater flows. Other details on drainage when building on clay foundations is provided in Appendix C, "A Guide to Homeowners on Foundation Maintenance and Footing Performance" (CSIRO).

Where possible, large trees should be retained to maintain equilibrium moisture conditions. Reference is made in Appendix C to new plantings and their locations in relation to buildings.

6.3 Road Pavements

6.3.6 Subgrade Preparation

The subgrade is likely to consist of high plasticity clay in a very stiff to hard condition when in a moist to dry condition. Weak areas are not expected to be present at subgrade level, however it is good practice to proof compact at subgrade level. This process will indicate and locate whether and where any weak areas are present.

The proof compaction process should be carried out using suitable compaction equipment to achieve a minimum dry density ratio of 95% using Modified compactive effort in accordance with AS 1289.5.2.1. Prior to compaction the moisture content of the subgrade should be adjusted to a moisture content within the range of 2% dry to optimum moisture content.

6.3.7 Design CBR

Provided the subgrade is prepared in accordance with Section 6.3.1 a design CBR of 5% can be used for pavement thickness design.

6.3.8 Drainage

The earthworks should be constructed such that water does not pond against the pavement. As the *in situ* Clays are likely to have a relatively low permeability in relation to the pavement materials, the subgrade should be graded so that water does not pond under the pavement.

7.0 IMPORTANT INFORMATION

Your attention is drawn to the document - "Important Information About Your Geotechnical Engineering Report", which is included in Appendix D of this report. This document has been prepared by the ASFE *(Professional Firms Practicing in the Geosciences)*, of which Golder Associates is a member. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the groundworks for this project. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

GOLDER ASSOCIATES PTY LTD

Fred Davenport
Senior Geotechnical Engineer

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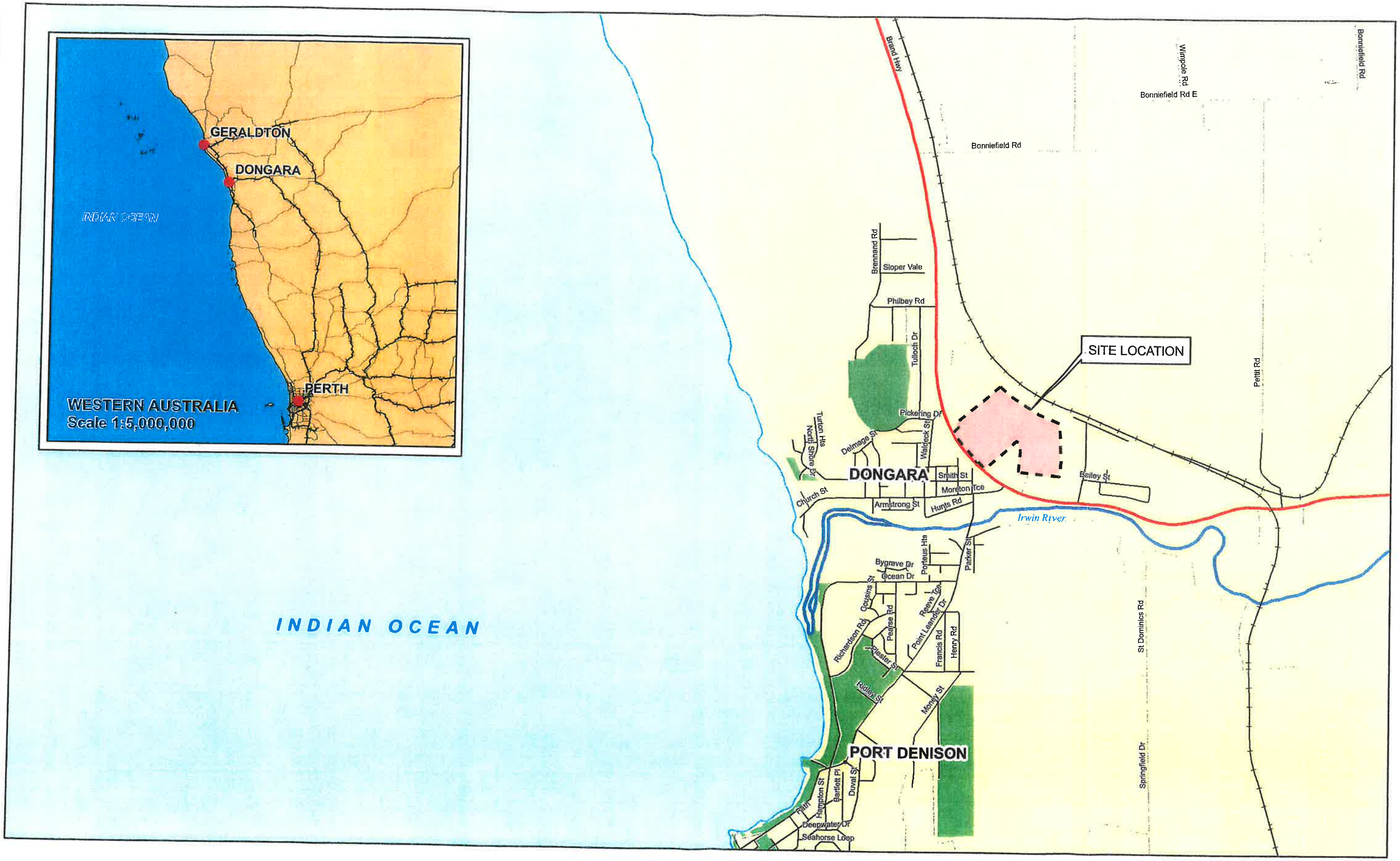

NOTES :
1. Base map copyright Mapinfo Australia Pty Ltd.
2. Datum GDA94, Projection MGA94, Zone 50
3. Aerial photography DLI March 2002
4. Cadastral data DLI Aug 2004

N

0 375 750 1,500 2,250 3,000
metres

Golder Associates

CLIENT: B.J. Clarke & Co Real Estate		PROJECT: Old Acres Estate, Dongara	
DRAWN: JRP	DATE: Feb. 07	TITLE: LOCATION PLAN	
CHECKED: [signature]	DATE: Feb '07		
SCALE: 1:30,000	A3	PROJECT No: 05642356-R01	FIGURE No: 1

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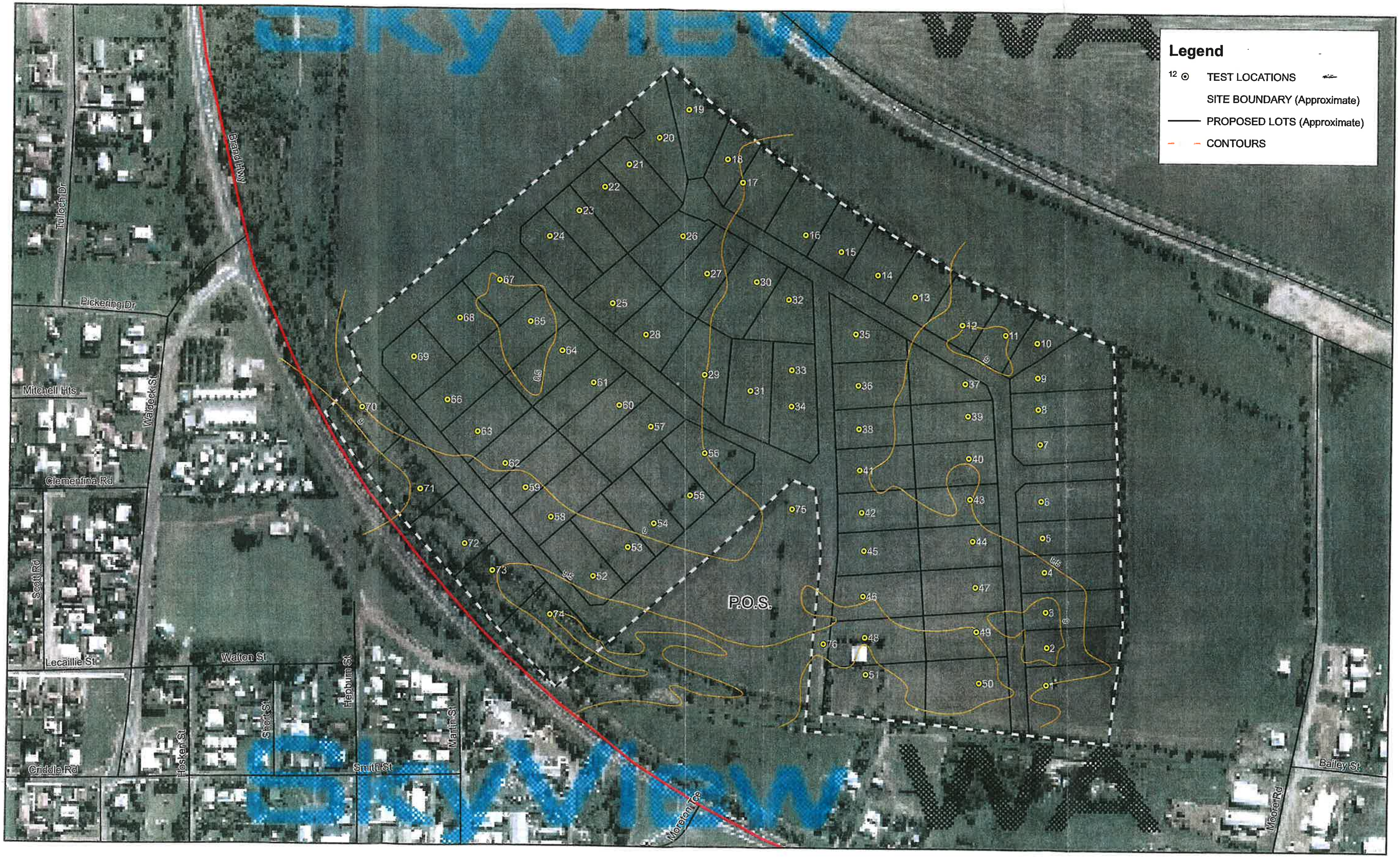

NOTES :
1. Base map copyright Mapinfo Australia Pty Ltd.
2. Datum GDA94, Projection MGA94, Zone 50
3. Aerial photography DLI March 2002
4. Cadastral data DLI Aug 2004

N

0 50 100 200 300 400
metres

Golder Associates

CLIENT	B.J. Clarke & Co Real Estate
DRAWN	JRP
DATE	Feb. 07
CHECKED	FAD
DATE	Feb/07
SCALE	1:4,000
	A3
PROJECT	Old Acres Estate, Dongara
TITLE	SITE PLAN
PROJECT No	05642356-R01
FIGURE No	2

File Location: J:\Jobs405\ENVIRON\05643346 PTA PSI Geraldton\GIS\Projects\05643364-R01-Fig02.mxd

APPENDIX D

SEWER RETICULATION PLAN

LEGEND

- PROPOSED GRAVITY SEWER WITH ACCESS CHAMBER/MAINTENANCE SHAFT
- FUTURE GRAVITY SEWER WITH ACCESS CHAMBER/MAINTENANCE SHAFT
- EXISTING SEWER
- PROPOSED STORMWATER DRAINAGE AND ACCESS POINT
- EXISTING STORMWATER DRAINAGE
- EXISTING OPTIC FIBRE
- PROPERTY CONNECTIONS
- INDICATES DN150 PROPERTY CONNECTION
- INDICATES SLOPE JUNCTION FOR FUTURE HOUSE CONNECTIONS
- RETICULATION AREA BOUNDARY
- PIPE DETAILS: DIAMETER (mm), GRADIENT, INVERT LEVEL, LENGTH
- PIPE DETAILS: UPSTREAM INVERT LEVEL, DIAMETER / GRADIENT, DISTANCE, DOWNSTREAM INVERT LEVEL
- ACCESS CHAMBER DETAILS: INDICATES TRAFFICABLE COVER, ACCESS CHAMBER NUMBER, ACCESS CHAMBER TYPE AS PER WATER CORPORATION CLASSIFICATION, INDICATES DROP, DEPTH FROM TOP OF COVER TO INVERT LEVEL
- SEWER INVERT LEVEL, DRAINAGE INVERT LEVEL — CLEARANCE
- MINIMUM FINISHED SURFACE LEVEL REQUIRED TO SERVICE LOT (FOR WATER CORPORATION INFORMATION ONLY. CONTRACTOR TO COMPLY WITH FINISHED LEVELS SHOWN ON EARTHWORKS PLAN.)
- EXISTING CONTOUR LINE
- DESIGN CONTOUR LINE

NOTES

1. BASE INFORMATION:
   A. GROUND WATER LEVEL IS APPROXIMATELY R.L. 4.00.
   B. CONTOUR INTERVAL IS 0.5m.
   C. LEVELS ARE TO A.H.D..
   D. EXISTING CONTOURS DERIVED FROM SPOT HEIGHTS.
   E. AREA DESIGNATED DRY UNLESS OTHERWISE NOTED.
2. REFERENCE DRAWINGS:
   SEWERS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CURRENT WATER CORPORATION STANDARD DRAWINGS.
3. SEWER ALIGNMENT:
   SEWERS SHALL BE LOCATED AS FOLLOWS UNLESS SHOWN OTHERWISE:
   A. ON A 3.0m ALIGNMENT IN ROAD RESERVES.
   B. 1.0m OFFSET FROM THE CENTRELINE OF R.O.W.S
   C. ON A 1.5m ALIGNMENT INSIDE LOTS.
4. PUBLIC UTILITIES:
   ALL SERVICES TO BE LOCATED PRIOR TO ANY MECHANICAL EXCAVATION WITHIN EXISTING ROAD RESERVE. SERVICE INFORMATION SHOWN ON THE DRAWING IS INDICATIVE ONLY AND MAY NOT BE COMPLETE.
5. PIPE MATERIAL:
   DN100 TO DN375 PIPES AND FITTINGS SHALL BE UNPLASTICISED POLYVINYL CHLORIDE TO AS/NZ 1260.
   DN100 PIPES SHALL BE CLASS SN4
   DN150 TO DN375 PIPES SHALL BE CLASS SN8 (LESS THAN 7.0m COVER).
   DN100 TO DN375 MOULDED FITTINGS SHALL BE CLASS SN6 (LESS THAN 7.0m COVER).
   UNMOULDED FITTINGS TO BE CLASS SN8 PIPE AND FIBREGLASS WRAPPED (LESS THAN 7.0m COVER).
   PIPE JOINT WORK SHALL BE IN ACCORDANCE WITH AS2032-PART3.
   DN100 TO DN300 PIPEWORK SHALL BE SOLVENT CEMENT JOINTED.
   DN 375 PIPEWORK SHALL BE RUBBER RING JOINTED.
6. JUNCTIONS AND PROPERTY CONNECTIONS:
   A. JUNCTIONS TO BE A MINIMUM 2.0m APART, EXCEPT ON THE END OF AN I.O. OR I.S. WHERE THEY SHALL BE POSITIONED AS SHOWN ON THE STANDARD DRAWINGS.
   B. ALL PROPERTY CONNECTIONS SHALL DN100 (UNLESS SHOWN OTHERWISE) AND BROUGHT UPTO WITHIN 1.0m OF THE DESIGN SURFACE AND BROUGHT 0.5m INSIDE LOT BOUNDARY.
7. ACCESS CHAMBERS/MAINTENANCE SHAFTS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE RELEVANT CURRENT WATER CORPORATION STANDARD DRAWINGS.
8. EXISTING SEWER INFORMATION TO BE OBTAINED FROM WATER CORPORATION LAND DEVELOPMENT BRANCH.
9. THE CONTRACTOR, AT THEIR EXPENSE, SHALL CARRY OUT CONNECTION WORKS TO THE EXISTING SEWERAGE SYSTEM UNDER THE SUPERVISION OF THE WATER CORPORATION. THE CONTRACTOR SHALL ISSUE THE WATER CORPORATION A PURCHASE WORK ORDER NUMBER FOR SUPERVISION WORKS AT COST AND OBTAIN A 'CLEARANCE TO WORK' AT LEAST 10 DAYS PRIOR TO THE PROPOSED CONNECTION DATE.
10. ALL EXCAVATION BY OPEN CUT METHODS UNLESS SHOWN OTHERWISE.
11. PROPERTY CONNECTIONS TO BE EXTENDED TO CLEAR HOUSE CONNECTION PITS.

This plan is accepted as complying with overall Sewerage planning. Compliance with Water Corporation Sewerage manuals remains the responsibility of the Consulting Engineer.

________________ for Manager L.D. Branch ________________ Date

IU81-203-1A

FILE No. GNI 2005 00731 V01

RETICULATION AREA DONAGRA D8

POINT	EASTING	NORTHING	POINT	EASTING	NORTHING
.	.	.	.	.	.

AMENDMENTS

No.	DATE	BY	DESCRIPTION
11	06-06-07	ZMW	EXTEND I.S. TO LOT 230 TO SUIT POWER SITE.
10	10-05-07	ZMW	EXTEND SEWER LINE TO RELOCATE TANKERING POINT.
9	1-02-07	PMS	AMEND SEWER LINE BETWEEN A/C 0506 & PUMP STATION SITE.
8	19-01-07	PMS	AMEND TO SUIT WATER CORPORATION COMMENTS.
7	14-12-06	PMS	DELETE DROP ON M/S 'D' & AMEND LEVELS TO SUIT.
6	24-11-06	NM	AMEND TO SUIT DESIGN CHANGES ALONG TYFORD ROAD.
5	15-11-06	PMS	AMEND TO SUIT CURRENT PRECAL.
4	26-09-06	PMS	AMEND LOCATION OF PUMP STATION SITE.

SCALE: 10m 0 10m 20m 30m
A1 PAGE - SCALE 1:500
A3 PAGE - SCALE 1:1000

DRAWN: P. SUMMERS
CHECKED: .
APPROVED: BSc BE (Hons) CPEng MIE (Aust)

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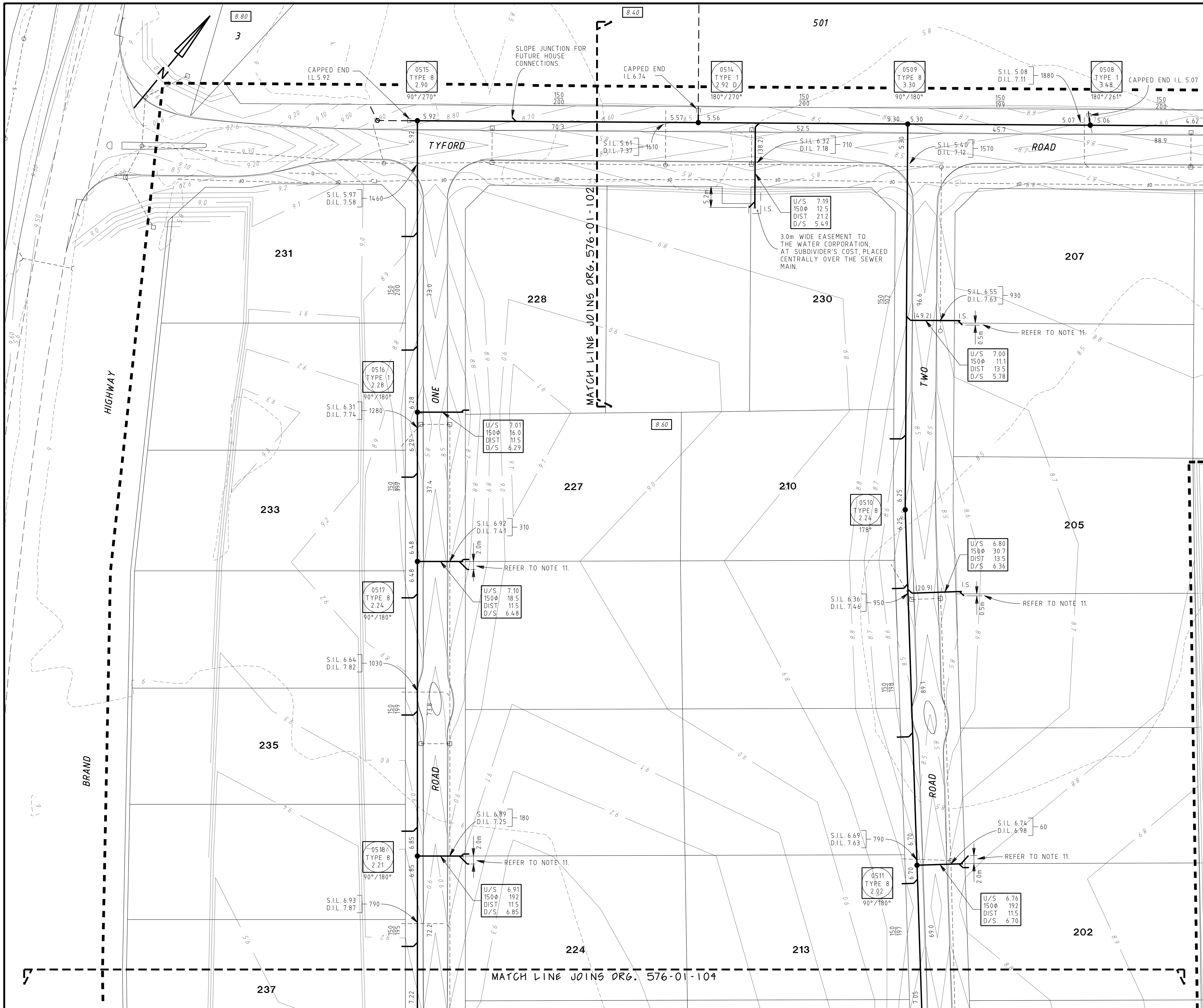
W.A.P.C. No.: 129561

BEN CLARKE

PROPOSED SUBDIVISION OF
LOT 502 BRAND HIGHWAY, DONGARA
OLD ACRES ESTATE - STAGE 1
SEWER RETICULATION PLAN - SHEET 1 OF 3

FILE NAME	DATE	DRAWING No.	AMDT No.
576-01-102.DGN	27-05-06	576-01-102	11



NOTES

1. BASE INFORMATION:
   A. GROUND WATER LEVEL IS APPROXIMATELY R.L. 4.00.
   B. CONTOUR INTERVAL IS 0.5m.
   C. LEVELS ARE TO A.H.D..
   D. EXISTING CONTOURS DERIVED FROM SPOT HEIGHTS.
   E. AREA DESIGNATED DRY UNLESS OTHERWISE NOTED.
2. REFERENCE DRAWINGS:
   SEWERS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CURRENT WATER CORPORATION STANDARD DRAWINGS.
3. SEWER ALIGNMENT:
   SEWERS SHALL BE LOCATED AS FOLLOWS UNLESS SHOWN OTHERWISE:
   A. ON A 3.0m ALIGNMENT IN ROAD RESERVES.
   B. 1.0m OFFSET FROM THE CENTRELINE OF R.O.W.S
   C. ON A 1.5m ALIGNMENT INSIDE LOTS.
4. PUBLIC UTILITIES:
   ALL SERVICES TO BE LOCATED PRIOR TO ANY MECHANICAL EXCAVATION WITHIN EXISTING ROAD RESERVE. SERVICE INFORMATION SHOWN ON THE DRAWING IS INDICATIVE ONLY AND MAY NOT BE COMPLETE.
5. PIPE MATERIAL:
   DN100 TO DN375 PIPES AND FITTINGS SHALL BE UNPLASTICISED POLYVINYL CHLORIDE TO AS/NZ 1260.
   DN100 PIPES SHALL BE CLASS SN4
   DN150 TO DN375 PIPES SHALL BE CLASS SN8 (LESS THAN 7.0m COVER).
   DN100 TO DN375 MOULDED FITTINGS SHALL BE CLASS SN6 (LESS THAN 7.0m COVER).
   UNMOULDED FITTINGS TO BE CLASS SN8 PIPE AND FIBREGLASS WRAPPED (LESS THAN 7.0m COVER).
   PIPE JOINT WORK SHALL BE IN ACCORDANCE WITH AS2032-PART3.
   DN100 TO DN300 PIPEWORK SHALL BE SOLVENT CEMENT JOINTED.
   DN 375 PIPEWORK SHALL BE RUBBER RING JOINTED.
6. JUNCTIONS AND PROPERTY CONNECTIONS:
   A. JUNCTIONS TO BE A MINIMUM 2.0m APART, EXCEPT ON THE END OF AN I.O. OR I.S. WHERE THEY SHALL BE POSITIONED AS SHOWN ON THE STANDARD DRAWINGS.
   B. ALL PROPERTY CONNECTIONS SHALL DN100 (UNLESS SHOWN OTHERWISE) AND BROUGHT UPTO WITHIN 1.0m OF THE DESIGN SURFACE AND BROUGHT 0.5m INSIDE LOT BOUNDARY.
7. ACCESS CHAMBERS/MAINTENANCE SHAFTS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE RELEVANT CURRENT WATER CORPORATION STANDARD DRAWINGS.
8. EXISTING SEWER INFORMATION TO BE OBTAINED FROM WATER CORPORATION LAND DEVELOPMENT BRANCH.
9. THE CONTRACTOR, AT THEIR EXPENSE, SHALL CARRY OUT CONNECTION WORKS TO THE EXISTING SEWERAGE SYSTEM UNDER THE SUPERVISION OF THE WATER CORPORATION. THE CONTRACTOR SHALL ISSUE THE WATER CORPORATION A PURCHASE WORK ORDER NUMBER FOR SUPERVISION WORKS AT COST AND OBTAIN A 'CLEARANCE TO WORK' AT LEAST 10 DAYS PRIOR TO THE PROPOSED CONNECTION DATE.
10. ALL EXCAVATION BY OPEN CUT METHODS UNLESS SHOWN OTHERWISE.
11. PROPERTY CONNECTIONS TO BE EXTENDED TO CLEAR HOUSE CONNECTION PITS.

NOTE: OPTIC FIBRE LOCATED IN THIS AREA. OPTIC FIBRE SHOWN ON THIS PLAN IS INDICATIVE ONLY, CONTRACTOR TO LOCATE PRIOR TO ANY MECHANICAL EXCAVATION.

LEGEND

- PROPOSED GRAVITY SEWER WITH ACCESS CHAMBER/MAINTENANCE SHAFT
- FUTURE GRAVITY SEWER WITH ACCESS CHAMBER/MAINTENANCE SHAFT
- EXISTING SEWER
- PROPOSED STORMWATER DRAINAGE AND ACCESS POINT
- EXISTING STORMWATER DRAINAGE
- EXISTING OPTIC FIBRE
- PROPERTY CONNECTIONS — φ150 INDICATES DN150 PROPERTY CONNECTION
- INDICATES SLOPE JUNCTION FOR FUTURE HOUSE CONNECTIONS
- RETICULATION AREA BOUNDARY
- PIPE DETAILS: 150 — DIAMETER (mm); 200 — GRADIENT; 16.35 — INVERT LEVEL; 65.4 — LENGTH
- PIPE DETAILS: U/S 16.85 — UPSTREAM INVERT LEVEL; 150φ 185 — DIAMETER / GRADIENT; DIST 55.5 — DISTANCE; D/S 16.55 — DOWNSTREAM INVERT LEVEL
- ACCESS CHAMBER DETAILS: INDICATES TRAFFICABLE COVER; AA6868 — ACCESS CHAMBER NUMBER; TYPE 1 — ACCESS CHAMBER TYPE AS PER WATER CORPORATION CLASSIFICATION; D — INDICATES DROP; 3.5 — DEPTH FROM TOP OF COVER TO INVERT LEVEL
- S.I.L. 16.55 / D.I.L. 17.25 — 500: SEWER INVERT LEVEL / DRAINAGE INVERT LEVEL — CLEARANCE
- 19.10: MINIMUM FINISHED SURFACE LEVEL REQUIRED TO SERVICE LOT (FOR WATER CORPORATION INFORMATION ONLY. CONTRACTOR TO COMPLY WITH FINISHED LEVELS SHOWN ON EARTHWORKS PLAN.)
- 20.0 EXISTING CONTOUR LINE
- 20.0 DESIGN CONTOUR LINE

This plan is accepted as complying with overall Sewerage planning. Compliance with Water Corporation Sewerage manuals remains the responsibility of the Consulting Engineer.

________ for Manager L.D. Branch ________ Date

IU81-203-2A

FILE No. GNI 2005 00731 V01

RETICULATION AREA DONGARA D8

POINT	EASTING	NORTHING	POINT	EASTING	NORTHING
.	.	.	.	.	.

No.	DATE	BY	DESCRIPTION
8	06-06-07	ZMW	EXTEND I.S. TO LOT 230 TO SUIT POWER SITE.
7	7-03-07	PMS	AMEND TO SHOW EARTHWORKS CHANGES.
6	19-01-07	PMS	AMEND TO SUIT WATER CORPORATION COMMENTS.
5	14-12-06	PMS	DELETE DROP ON M/S 'D' & AMEND LEVELS TO SUIT.
4	24-11-06	NM	AMEND TO SUIT DESIGN CHANGES ALONG TYFORD ROAD.
3	14-11-06	PMS	AMEND TO SUIT CURRENT PRECAL.
2	8-08-06	PMS	AMEND TO INCLUDE LOTS 199-207 IN STAGE 1 WORKS.
1	30-06-06	PMS	AMEND TO SHOW DRAINAGE & SIL/DIL'S.

AMENDMENTS

SCALE: 10m 0 10m 20m 30m
A1 PAGE - SCALE 1:500
A3 PAGE - SCALE 1:1000

DRAWN: P. SUMMERS

CHECKED: .

APPROVED: [signature] BSc BE (Hons) CPEng MIE (Aust)

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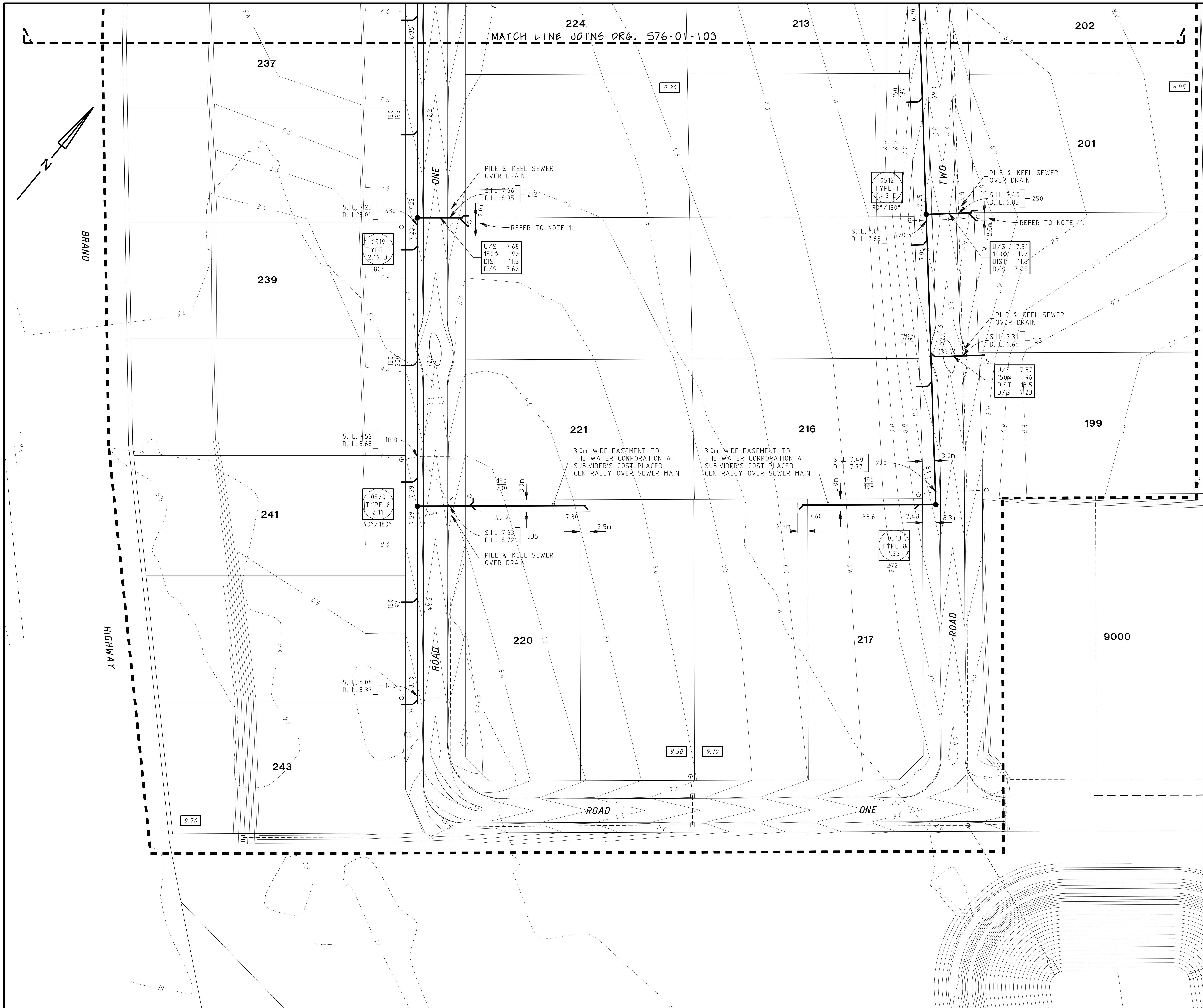
BEN CLARKE

PROPOSED SUBDIVISION OF
LOT 502 BRAND HIGHWAY, DONGARA
OLD ACRES ESTATE - STAGE 1
SEWER RETICULATION PLAN - SHEET 2 OF 3

FILE NAME:	DATE:	DRAWING No.:	AMDT No.:
576-01-103.DGN	27-05-06	576-01-103	8



NOTES

1. BASE INFORMATION:
   A. GROUND WATER LEVEL IS APPROXIMATELY R.L. 4.00.
   B. CONTOUR INTERVAL IS 0.5m.
   C. LEVELS ARE TO A.H.D..
   D. EXISTING CONTOURS DERIVED FROM SPOT HEIGHTS.
   E. AREA DESIGNATED DRY UNLESS OTHERWISE NOTED.
2. REFERENCE DRAWINGS:
   SEWERS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CURRENT WATER CORPORATION STANDARD DRAWINGS.
3. SEWER ALIGNMENT:
   SEWERS SHALL BE LOCATED AS FOLLOWS UNLESS SHOWN OTHERWISE:
   A. ON A 3.0m ALIGNMENT IN ROAD RESERVES.
   B. 1.0m OFFSET FROM THE CENTRELINE OF R.O.W.S
   C. ON A 1.5m ALIGNMENT INSIDE LOTS.
4. PUBLIC UTILITIES:
   ALL SERVICES TO BE LOCATED PRIOR TO ANY MECHANICAL EXCAVATION WITHIN EXISTING ROAD RESERVE. SERVICE INFORMATION SHOWN ON THE DRAWING IS INDICATIVE ONLY AND MAY NOT BE COMPLETE.
5. PIPE MATERIAL:
   DN100 TO DN375 PIPES AND FITTINGS SHALL BE UNPLASTICISED POLYVINYL CHLORIDE TO AS/NZ 1260.
   DN100 PIPES SHALL BE CLASS SN4
   DN150 TO DN375 PIPES SHALL BE CLASS SN8 (LESS THAN 7.0m COVER).
   DN100 TO DN375 MOULDED FITTINGS SHALL BE CLASS SN6 (LESS THAN 7.0m COVER).
   UNMOULDED FITTINGS TO BE CLASS SN8 PIPE AND FIBREGLASS WRAPPED (LESS THAN 7.0m COVER).
   PIPE JOINT WORK SHALL BE IN ACCORDANCE WITH AS2032-PART3.
   DN100 TO DN300 PIPEWORK SHALL BE SOLVENT CEMENT JOINTED.
   DN 375 PIPEWORK SHALL BE RUBBER RING JOINTED.
6. JUNCTIONS AND PROPERTY CONNECTIONS:
   A. JUNCTIONS TO BE A MINIMUM 2.0m APART, EXCEPT ON THE END OF AN I.O. OR I.S. WHERE THEY SHALL BE POSITIONED AS SHOWN ON THE STANDARD DRAWINGS.
   B. ALL PROPERTY CONNECTIONS SHALL DN100 (UNLESS SHOWN OTHERWISE) AND BROUGHT UPTO WITHIN 1.0m OF THE DESIGN SURFACE AND BROUGHT 0.5m INSIDE LOT BOUNDARY.
7. ACCESS CHAMBERS/MAINTENANCE SHAFTS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE RELEVANT CURRENT WATER CORPORATION STANDARD DRAWINGS.
8. EXISTING SEWER INFORMATION TO BE OBTAINED FROM WATER CORPORATION LAND DEVELOPMENT BRANCH.
9. THE CONTRACTOR, AT THEIR EXPENSE, SHALL CARRY OUT CONNECTION WORKS TO THE EXISTING SEWERAGE SYSTEM UNDER THE SUPERVISION OF THE WATER CORPORATION. THE CONTRACTOR SHALL ISSUE THE WATER CORPORATION A PURCHASE WORK ORDER NUMBER FOR SUPERVISION WORKS AT COST AND OBTAIN A 'CLEARANCE TO WORK' AT LEAST 10 DAYS PRIOR TO THE PROPOSED CONNECTION DATE.
10. ALL EXCAVATION BY OPEN CUT METHODS UNLESS SHOWN OTHERWISE.
11. PROPERTY CONNECTIONS TO BE EXTENDED TO CLEAR HOUSE CONNECTION PITS.

LEGEND

- PROPOSED GRAVITY SEWER WITH ACCESS CHAMBER/MAINTENANCE SHAFT
- FUTURE GRAVITY SEWER WITH ACCESS CHAMBER/MAINTENANCE SHAFT
- EXISTING SEWER
- PROPOSED STORMWATER DRAINAGE AND ACCESS POINT
- EXISTING STORMWATER DRAINAGE
- PROPERTY CONNECTIONS (Φ150) INDICATES DN150 PROPERTY CONNECTION
- RETICULATION AREA BOUNDARY
- PIPE DETAILS: 150 DIAMETER (mm); 200 GRADIENT; 16.35 INVERT LEVEL; 65.4 LENGTH
- PIPE DETAILS: U/S 16.85 UPSTREAM INVERT LEVEL; 150Φ 185 DIAMETER / GRADIENT; DIST 55.5 DISTANCE; D/S 16.55 DOWNSTREAM INVERT LEVEL
- ACCESS CHAMBER DETAILS: AA6868 INDICATES TRAFFICABLE COVER; ACCESS CHAMBER NUMBER; TYPE 1 ACCESS CHAMBER TYPE AS PER WATER CORPORATION CLASSIFICATION; INDICATES DROP; 3.5 D DEPTH FROM TOP OF COVER TO INVERT LEVEL
- S.I.L. 16.55 SEWER INVERT LEVEL; D.I.L. 17.25 DRAINAGE INVERT LEVEL; 500 CLEARANCE
- 19.10 MINIMUM FINISHED SURFACE LEVEL REQUIRED TO SERVICE LOT (FOR WATER CORPORATION INFORMATION ONLY. CONTRACTOR TO COMPLY WITH FINISHED LEVELS SHOWN ON EARTHWORKS PLAN.)
- 20.0 EXISTING CONTOUR LINE
- 20.0 DESIGN CONTOUR LINE

This plan is accepted as complying with overall Sewerage planning. Compliance with Water Corporation Sewerage manuals remains the responsibility of the Consulting Engineer.

______________ for Manager L.D. Branch ______________ Date

IU81-203-3A

FILE No. GNI 2005 00731 V01

RETICULATION AREA DONGARA D8

POINT	EASTING	NORTHING	POINT	EASTING	NORTHING

AMENDMENTS

No.	DATE	BY	DESCRIPTION
5	7-03-07	PMS	AMEND TO SHOW EARTHWORKS CHANGES.
4	19-01-07	PMS	AMEND TO SUIT WATER CORPORATION COMMENTS.
3	14-11-06	PMS	AMEND TO SUIT CURRENT PRECAL.
2	8-08-06	PMS	AMEND TO INCLUDE LOTS 199-207 IN STAGE 1 WORKS.
1	3-07-06	PMS	AMEND TO SHOW DRAINAGE & SIL/DIL'S.

SCALE: 10m 0 10m 20m 30m
A1 PAGE - SCALE 1:500
A3 PAGE - SCALE 1:1000

DRAWN: P. SUMMERS
CHECKED:
APPROVED: BSc BE (Hons) CPEng M (Aust)

DESIGNED BY: CIVIL TECHNOLOGY CONSULTING CIVIL AND STRUCTURAL ENGINEERS
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W.A.P.C. No.: 129561

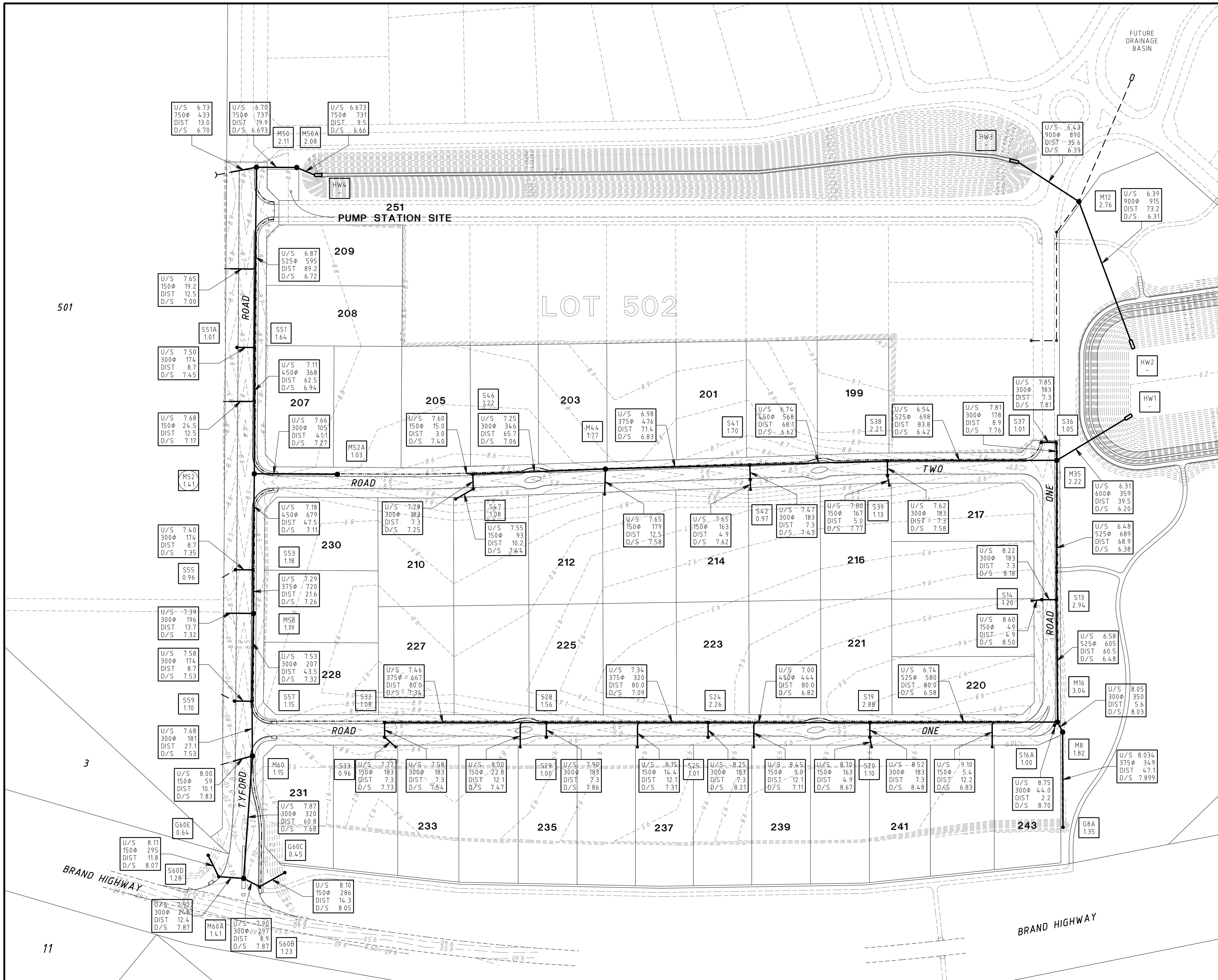
BEN CLARKE

PROPOSED SUBDIVISION OF
LOT 502 BRAND HIGHWAY, DONGARA
OLD ACRES ESTATE - STAGE 1
SEWER RETICULATION PLAN - SHEET 3 OF 3

FILE NAME: 576-01-104.DGN | DATE: 27-05-06 | DRAWING No.: 576-01-104 | AMDT No.: 5

APPENDIX E

DRAINAGE RETICULATION PLAN



LEGEND

PROPOSED DRAINAGE AND ACCESS POINT

PROPOSED DRAINAGE AND CATCHMENT POINT (SIDE ENTRY PIT/GULLY PIT)

PROPOSED DN100 VINIDEX 'DRAINCOIL' OR IPLEX 'AGRIDRAIN'.

FUTURE DRAINAGE

PROPOSED FOOTPATHS AND PRAM RAMPS

FUTURE FOOTPATHS AND PRAM RAMPS

DESIGN CONTOUR LEVELS

PIPE DETAILS:
- DIAMETER (mm)
- SUBSOIL TYPE (AS INDICATED)
  - SS - SUBSOIL
  - OJ - OPEN JOINT
- GRADIENT
- INVERT LEVEL
- LENGTH

225-OJ/235 16.35 65.4

PIPE DETAILS:
- UPSTREAM INVERT LEVEL
- DIAMETER / GRADIENT
- DISTANCE
- DOWNSTREAM INVERT LEVEL

U/S 16.85
150φ 185
DIST 55.5
D/S 16.55

ACCESS/CATCHMENT POINT DETAILS:
- INDICATES TRAFFICABLE COVER
- ACCESS POINT NUMBER
  - M - MANHOLE
  - S - SIDE ENTRY PIT
  - G - GULLY PIT
  - HC - HOUSE CONNECTION PIT
- DEPTH FROM TOP OF COVER TO INVERT LEVEL

M1 3.5

No.	DATE	BY	DESCRIPTION

AMENDMENTS

W.A.P.C. No.: 129561

DRAWN: N.MOLYNEUX

APPROVED: .

DESIGNED BY:

CIVIL TECHNOLOGY
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SCALE: A3 1 : 2000

BEN CLARKE

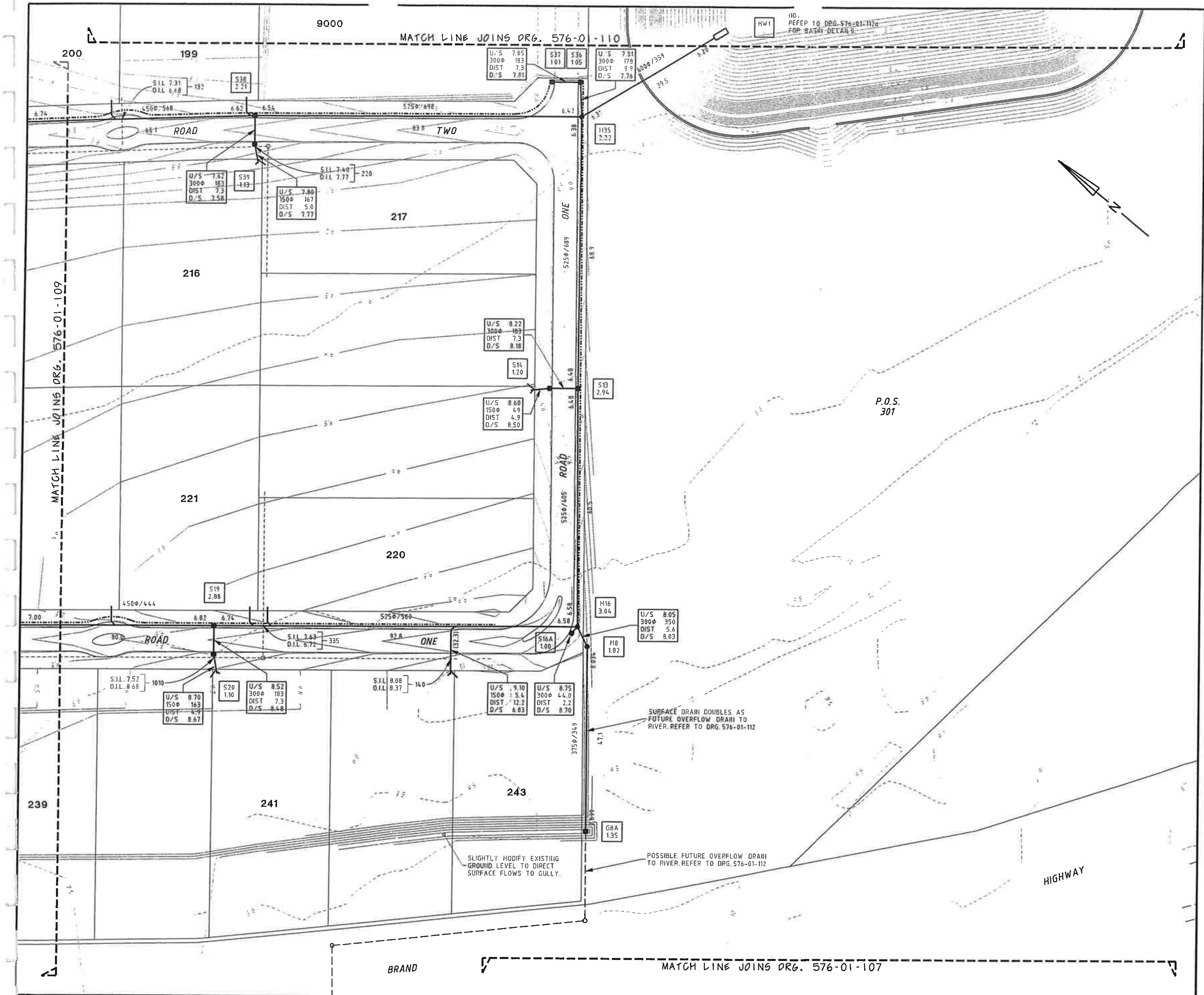
PROPOSED SUBDIVISION OF LOT 502 BRAND HIGHWAY, DONGARA OLD ACRES ESTATE STAGE 1 DRAINAGE PLAN

FILE NAME: 576-FIG 4.DGN

DATE: 18-05-07

DRAWING No.: 576-DNMP-APP8

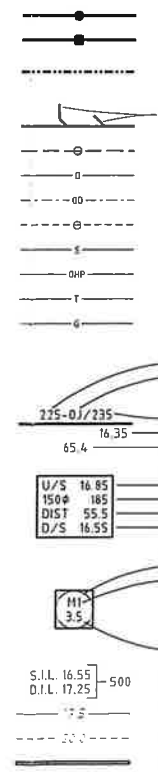
AMDT No.: .



NOTES

1. BASE INFORMATION
   A DESIGN CONTOUR INTERVAL IS 0.1m
   B LEVELS ARE TO A.H.D.
2. REFERENCE DRAWINGS
   REFER TO DRAWING 576-01-102 TO 576-01-104 FOR PROPOSED SEWER INFORMATION
   REFER TO DRAWING 576-01-113 TO 576-01-115 FOR DRAINAGE STANDARD DETAILS
   ALL WORKS TO CONFORM WITH THE SHIRE OF IRWIN STANDARD SPECIFICATIONS AND DRAWINGS.
3. DRAINAGE ALIGNMENT
   DRAINAGE POSITIONS TO BE DETERMINED FROM COORDINATES PROVIDED OR AS PER ALIGNMENTS SHOWN
4. PUBLIC UTILITIES:
   ALL SERVICES TO BE LOCATED PRIOR TO ANY MECHANICAL EXCAVATION WITHIN EXISTING ROAD RESERVE
   SERVICE INFORMATION SHOWN ON THE DRAWING IS INDICATIVE ONLY AND MAY NOT BE COMPLETE.
5. MATERIALS:
   A. SOLID PIPES
   - DRAINAGE PIPES (AND MOULDED FITTINGS) 150 DIA AND LOWER SHALL BE CLASS SN4 UPVC, SOLVENT CEMENT JOINT.
   - DRAINAGE PIPES 225 DIA AND GREATER SHALL BE CLASS 2 R.C.P. RUBBER RING JOINT.
   B. SUBSOIL PIPES (AS INDICATED, EXCEPT UNDER ROAD PAVEMENT)
   - SUBSOIL DRAINAGE PIPES 150 DIA SHALL BE SLOTTED CLASS SN4 UPVC, SOLVENT CEMENT JOINT.
   - SUBSOIL DRAINAGE PIPES 225 DIA TO 525 DIA SHALL BE CLASS 2 R.C.P. OPEN JOINT.
   - SUBSOIL DRAINAGE PIPES 600 DIA AND GREATER SHALL BE CLASS 2 R.C.P. RUBBER RING JOINT WITH A SLOTTED 150 DIA CLASS SN4 UPVC PIPE LAID PARALLEL TO THE MAIN PIPE (REFER TO DETAILS).
   C. MANHOLE LINERS TO BE:
   - 1200 DIA WHERE ANY PIPE INTO THE MANHOLE IS GREATER THAN 525 DIA.
   - 1050 DIA WHERE ANY PIPE INTO THE MANHOLE IS GREATER THAN 375 DIA.
   - 940 DIA UNLESS OTHERWISE NOTED.
   D. ALL MANHOLES TO HAVE STEP IRONS WHERE DEPTH EXCEEDS 1.2m.
6. DEPTH SHOWN ON MANHOLE NOTATION IS TO INVERT LEVEL OF DOWNSTREAM PIPE, NOT TO BASE OF PIT.
7. ALL EXCAVATION BY OPEN CUT METHODS UNLESS SHOWN OTHERWISE

LEGEND



PROPOSED DRAINAGE AND ACCESS POINT
PROPOSED DRAINAGE AND CATCHMENT POINT (SIDE ENTRY PIT/GULLY PIT)
PROPOSED DN100 VINIDEX 'DRAINCOIL' OR IPLEX 'AGRIDRAIN'. REFER TO DRG. 576-01-113 FOR DETAIL.
INDICATES 100φ 45° JUNCTION
FUTURE DRAINAGE AND ACCESS POINT
EXISTING DRAINAGE
EXISTING OPEN DRAIN
PROPOSED SEWER AND ACCESS POINT
EXISTING SEWER
EXISTING OVERHEAD POWER
EXISTING TELSTRA
EXISTING GAS

PIPE DETAILS:
- DIAMETER (mm)
- SUBSOIL TYPE (AS INDICATED)
  - SS - SUBSOIL
  - OJ - OPEN JOINT
- GRADIENT
- INVERT LEVEL
- LENGTH

PIPE DETAILS:
- UPSTREAM INVERT LEVEL
- DIAMETER / GRADIENT
- DISTANCE
- DOWNSTREAM INVERT LEVEL

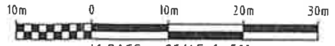
ACCESS/CATCHMENT POINT DETAILS:
- INDICATES TRAFFICABLE COVER
- ACCESS POINT NUMBER
  - M - MANHOLE
  - S - SIDE ENTRY PIT
  - G - GULLY PIT
  - H - HOUSE CONNECTION PIT
- DEPTH FROM TOP OF COVER TO INVERT LEVEL

SEWER INVERT LEVEL / DRAINAGE INVERT LEVEL – CLEARANCE
DESIGN CONTOUR LINE
EXISTING CONTOUR LINE
PROPOSED RETAINING WALL

No	DATE	BY	DESCRIPTION
6	4-04-07	PNS	ADD SUBSOIL DRAINAGE & 100φ 45° JUNCTIONS AND DELETE HOUSE CONNECTION PITS.
5	7-03-07	PNS	AMEND TO SHOW NEW MANHOLE 'M8', GULLY 'G8A' & SEP 'S16A'.
4	18-01-07	PNS	AMEND TO SHOW CURRENT DRAINAGE LAYOUT.
3	20-12-06	PNS	DELETE OUTFALL DRAIN SHOWN IN LOT 242.
2	7-11-06	PNS	AMEND TO SHOW CURRENT DRAINAGE LAYOUT.
1	8-08-06	PNS	AMEND TO INCLUDE LOTS 199-207 IN STAGE 1 WORKS

AMENDMENTS

SCALE:



A1 PAGE - SCALE 1 : 500
A3 PAGE - SCALE 1 : 1000

DRAWN: P. SUMMERS

CHECKED:

APPROVED: BSc BE (Hons) CPEng MIE (Aust)

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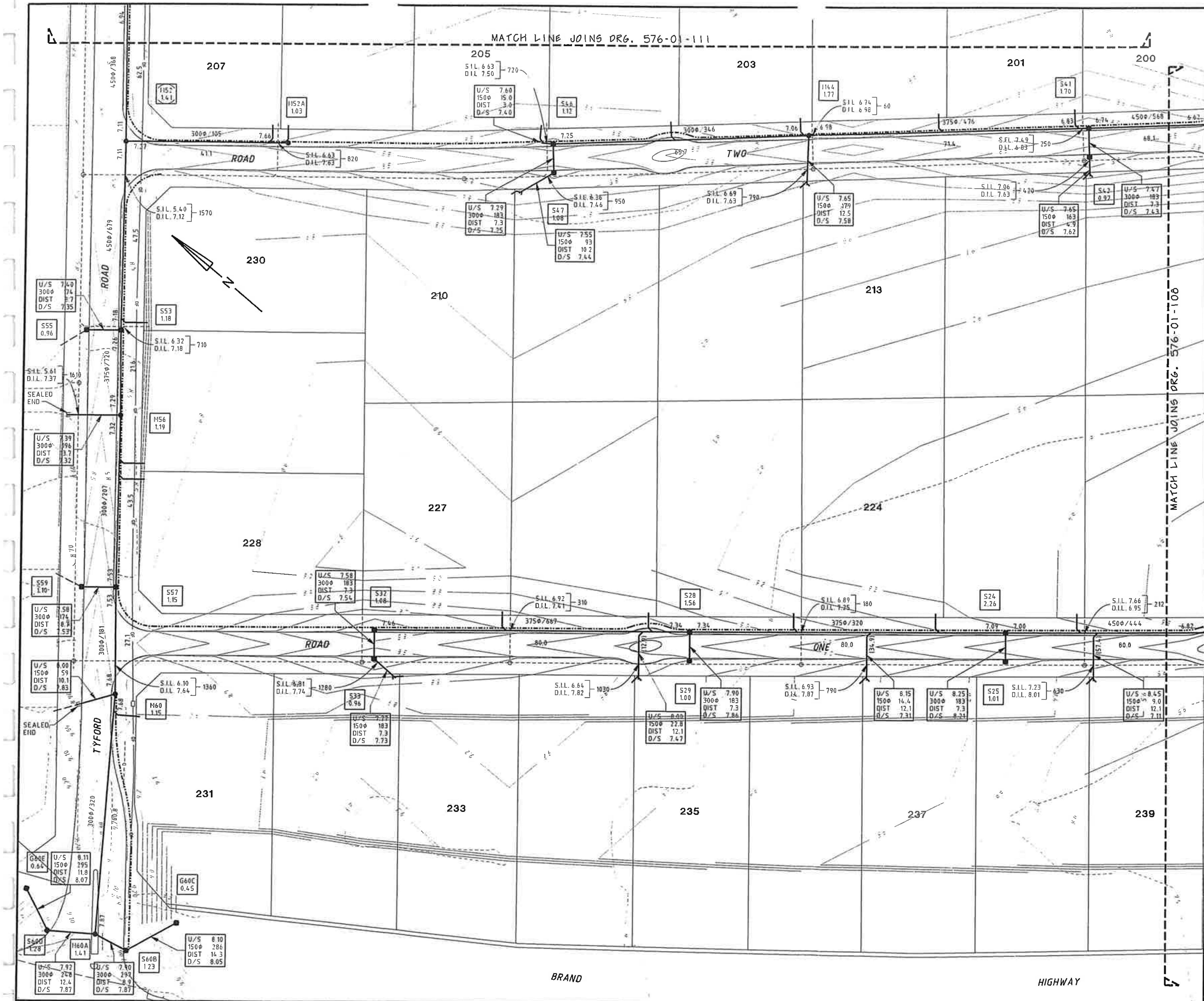
W.A.P.C. No: 129561

BEN CLARKE

PROPOSED SUBDIVISION OF LOT 502 BRAND HIGHWAY, DONGARA OLD ACRES ESTATE - STAGE 1

DRAINAGE RETICULATION PLAN - SHEET 3 OF 6

FILE NAME: 576-01-108.DGN
DATE: 29-06-06
DRAWING No: 576-01-108
AMDT No: 6



NOTES

1. BASE INFORMATION
   A. DESIGN CONTOUR INTERVAL IS 0.1m.
   B. LEVELS ARE TO A.H.D.
2. REFERENCE DRAWINGS:
   REFER TO DRAWING 576-01-102 TO 576-01-104 FOR PROPOSED SEWER INFORMATION.
   REFER TO DRAWING 576-01-113 TO 576-01-115 FOR DRAINAGE STANDARD DETAILS.
   ALL WORKS TO CONFORM WITH THE SHIRE OF IRWIN STANDARD SPECIFICATIONS AND DRAWINGS.
3. DRAINAGE ALIGNMENT:
   DRAINAGE POSITIONS TO BE DETERMINED FROM COORDINATES PROVIDED OR AS PER ALIGNMENTS SHOWN.
4. PUBLIC UTILITIES:
   ALL SERVICES TO BE LOCATED PRIOR TO ANY MECHANICAL EXCAVATION WITHIN EXISTING ROAD RESERVE. SERVICE INFORMATION SHOWN ON THE DRAWING IS INDICATIVE ONLY AND MAY NOT BE COMPLETE.
5. MATERIALS.
   A. SOLID PIPES
   DRAINAGE PIPES (AND MOULDED FITTINGS) 150 DIA AND LOWER SHALL BE CLASS SN4 UPVC, SOLVENT CEMENT JOINT.
   - DRAINAGE PIPES 225 DIA AND GREATER SHALL BE CLASS 2 R.C.P. RUBBER RING JOINT.
   B. SUBSOIL PIPES (AS INDICATED, EXCEPT UNDER ROAD PAVEMENT)
   - SUBSOIL DRAINAGE PIPES 150 DIA SHALL BE SLOTTED CLASS SN4 UPVC, SOLVENT CEMENT JOINT.
   - SUBSOIL DRAINAGE PIPES 225 DIA TO 525 DIA SHALL BE CLASS 2 R.C.P. OPEN JOINT.
   - SUBSOIL DRAINAGE PIPES 600 DIA AND GREATER SHALL BE CLASS 2 R.C.P. RUBBER RING JOINT WITH A SLOTTED 150 DIA CLASS SN4 UPVC PIPE LAID PARALLEL TO THE MAIN PIPE (REFER TO DETAILS).
   C. MANHOLE LINERS TO BE:
   - 1200 DIA WHERE ANY PIPE INTO THE MANHOLE IS GREATER THAN 525 DIA.
   - 1050 DIA WHERE ANY PIPE INTO THE MANHOLE IS GREATER THAN 375 DIA.
   - 940 DIA UNLESS OTHERWISE NOTED.
   D. ALL MANHOLES TO HAVE STEP IRONS WHERE DEPTH EXCEEDS 1.2m.
6. DEPTH SHOWN ON MANHOLE NOTATION IS TO INVERT LEVEL OF DOWNSTREAM PIPE, NOT TO BASE OF PIT.
7. ALL EXCAVATION BY OPEN CUT METHODS UNLESS SHOWN OTHERWISE.

LEGEND

- PROPOSED DRAINAGE AND ACCESS POINT
- PROPOSED DRAINAGE AND CATCHMENT POINT (SIDE ENTRY PIT/GULLY PIT)
- PROPOSED DN100 VINIDEX 'DRAINCOIL' OR IPLEX 'AGRIDRAIN'. REFER TO DRG. 576-01-113 FOR DETAIL.
- INDICATES 100Φ 45° JUNCTION
- FUTURE DRAINAGE AND ACCESS POINT
- EXISTING DRAINAGE
- EXISTING OPEN DRAIN
- PROPOSED SEWER AND ACCESS POINT
- EXISTING SEWER
- EXISTING OVERHEAD POWER
- EXISTING TELSTRA
- EXISTING GAS
- EXISTING OPTIC FIBRE

PIPE DETAILS:
225-OJ/235 — DIAMETER (mm); SUBSOIL TYPE (AS INDICATED) SS - SUBSOIL, OJ - OPEN JOINT; GRADIENT
16.35 — INVERT LEVEL
65.4 — LENGTH

PIPE DETAILS:
U/S 16.85 — UPSTREAM INVERT LEVEL
150Φ 185 — DIAMETER / GRADIENT
DIST 55.5 — DISTANCE
D/S 16.55 — DOWNSTREAM INVERT LEVEL

ACCESS/CATCHMENT POINT DETAILS:
M1 3.5 — INDICATES TRAFFICABLE COVER; ACCESS POINT NUMBER: M - MANHOLE, S - SIDE ENTRY PIT, G - GULLY PIT, H - HOUSE CONNECTION PIT; DEPTH FROM TOP OF COVER TO INVERT LEVEL

S.I.L. 16.55 / D.I.L. 17.25 — 500 — SEWER INVERT LEVEL / DRAINAGE INVERT LEVEL — CLEARANCE

- DESIGN CONTOUR LINE
- EXISTING CONTOUR LINE
- PROPOSED RETAINING WALL

NOTE: OPTIC FIBRE LOCATED IN THIS AREA. OPTIC FIBRE SHOWN ON THIS PLAN IS INDICATIVE ONLY, CONTRACTOR TO LOCATE PRIOR TO ANY MECHANICAL EXCAVATION.

No	DATE	BY	DESCRIPTION
4	4-04-07	PHS	ADD SUBSOIL DRAINAGE & 100Φ 45° JUNCTIONS AND DELETE HOUSE CONNECTION PITS.
3	7-03-07	PHS	AMEND TO SHOW ADDITIONAL DRAINAGE AT BRAND HWY/TYFORD ROAD INTERSECTION.
2	14-11-06	PHS	AMEND TO SUIT CURRENT PRECAL.
1	8-08-06	PHS	AMEND TO INCLUDE LOTS 199-207 IN STAGE 1 WORKS.

AMENDMENTS

SCALE: 10m 0 10m 20m 30m
A1 PAGE - SCALE 1:500
A3 PAGE - SCALE 1:1000

DRAWN: P. SUMMERS
CHECKED:
APPROVED: BSc BE (Hons) CPEng MIE (Aust)

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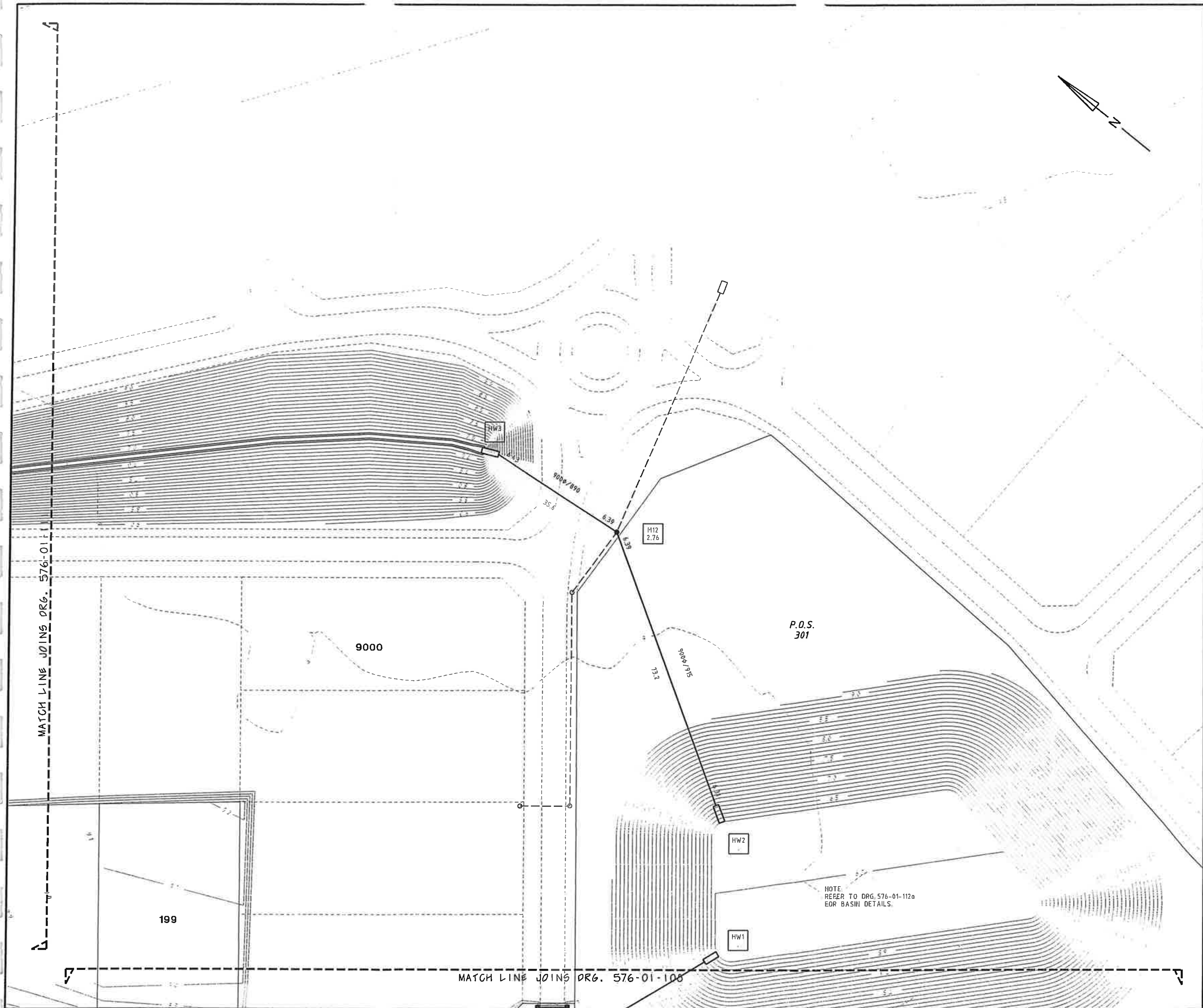
WAPC No: 129561

BEN CLARKE

PROPOSED SUBDIVISION OF
LOT 502 BRAND HIGHWAY, DONGARA
OLD ACRES ESTATE - STAGE 1
DRAINAGE RETICULATION PLAN - SHEET 4 OF 6

FILE NAME	DATE	DRAWING No	AMDT No
576-01-109.DGN	29-06-06	576-01-109	4



NOTES

1. BASE INFORMATION
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   B. LEVELS ARE TO A.H.D.
2. REFERENCE DRAWINGS:
   REFER TO DRAWING 576-01-102 TO 576-01-104 FOR PROPOSED SEWER INFORMATION.
   REFER TO DRAWING 576-01-113 TO 576-01-115 FOR DRAINAGE STANDARD DETAILS.
   ALL WORKS TO CONFORM WITH THE SHIRE OF IRWIN STANDARD SPECIFICATIONS AND DRAWINGS.
3. DRAINAGE ALIGNMENT.
   DRAINAGE POSITIONS TO BE DETERMINED FROM COORDINATES PROVIDED OR AS PER ALIGNMENTS SHOWN.
4. PUBLIC UTILITIES:
   ALL SERVICES TO BE LOCATED PRIOR TO ANY MECHANICAL EXCAVATION WITHIN EXISTING ROAD RESERVE. SERVICE INFORMATION SHOWN ON THE DRAWING IS INDICATIVE ONLY AND MAY NOT BE COMPLETE.
5. MATERIALS.
   A. SOLID PIPES
   - DRAINAGE PIPES (AND MOULDED FITTINGS) 150 DIA AND LOWER SHALL BE CLASS SN4 UPVC, SOLVENT CEMENT JOINT.
   - DRAINAGE PIPES 225 DIA AND GREATER SHALL BE CLASS 2 R.C.P. RUBBER RING JOINT.
   B. SUBSOIL PIPES (AS INDICATED, EXCEPT UNDER ROAD PAVEMENT)
   - SUBSOIL DRAINAGE PIPES 150 DIA SHALL BE SLOTTED CLASS SN4 UPVC, SOLVENT CEMENT JOINT.
   - SUBSOIL DRAINAGE PIPES 225 DIA TO 525 DIA SHALL BE CLASS 2 R.C.P. OPEN JOINT.
   - SUBSOIL DRAINAGE PIPES 600 DIA AND GREATER SHALL BE CLASS 2 R.C.P. RUBBER RING JOINT WITH A SLOTTED 150 DIA CLASS SN4 UPVC PIPE LAID PARALLEL TO THE MAIN PIPE (REFER TO DETAILS).
   C. MANHOLE LINERS TO BE:
   - 1200 DIA WHERE ANY PIPE INTO THE MANHOLE IS GREATER THAN 525 DIA.
   - 1050 DIA WHERE ANY PIPE INTO THE MANHOLE IS GREATER THAN 375 DIA.
   - 940 DIA UNLESS OTHERWISE NOTED.
   D. ALL MANHOLES TO HAVE STEP IRONS WHERE DEPTH EXCEEDS 1.2m.
6. DEPTH SHOWN ON MANHOLE NOTATION IS TO INVERT LEVEL OF DOWNSTREAM PIPE, NOT TO BASE OF PIT.
7. ALL EXCAVATION BY OPEN CUT METHODS UNLESS SHOWN OTHERWISE

LEGEND

PROPOSED DRAINAGE AND ACCESS POINT
PROPOSED DRAINAGE AND CATCHMENT POINT (SIDE ENTRY PIT/GULLY PIT)
FUTURE DRAINAGE AND ACCESS POINT
EXISTING DRAINAGE
EXISTING OPEN DRAIN
PROPOSED SEWER AND ACCESS POINT
EXISTING SEWER
EXISTING OVERHEAD POWER
EXISTING TELSTRA
EXISTING GAS

PIPE DETAILS:
225-OJ/235 — DIAMETER (mm); SUBSOIL TYPE (AS INDICATED): SS - SUBSOIL, OJ - OPEN JOINT; GRADIENT
16.35 — INVERT LEVEL
65.4 — LENGTH

PIPE DETAILS:
U/S 16.85 — UPSTREAM INVERT LEVEL
150Φ 185 — DIAMETER / GRADIENT
DIST 55.5 — DISTANCE
D/S 16.55 — DOWNSTREAM INVERT LEVEL

ACCESS/CATCHMENT POINT DETAILS:
M1 3.5
- INDICATES TRAFFICABLE COVER
- ACCESS POINT NUMBER
  M - MANHOLE
  S - SIDE ENTRY PIT
  G - GULLY PIT
  H - HOUSE CONNECTION PIT
- DEPTH FROM TOP OF COVER TO INVERT LEVEL

S.I.L. 16.55 / D.I.L. 17.25 — 500: SEWER INVERT LEVEL / DRAINAGE INVERT LEVEL — CLEARANCE
DESIGN CONTOUR LINE
EXISTING CONTOUR LINE
PROPOSED RETAINING WALL

No.	DATE	BY	DESCRIPTION
2	18-01-07	PHS	AMEND TO SHOW CURRENT DRAINAGE LAYOUT.
1	8-08-06	PHS	AMEND TO INCLUDE LOTS 199-207 IN STAGE 1 WORKS.

AMENDMENTS

SCALE:
10m 0 10m 20m 30m
A1 PAGE - SCALE 1:500
A3 PAGE - SCALE 1:1000

DRAWN: P. SUMMERS
CHECKED:
APPROVED:

DESIGNED BY:
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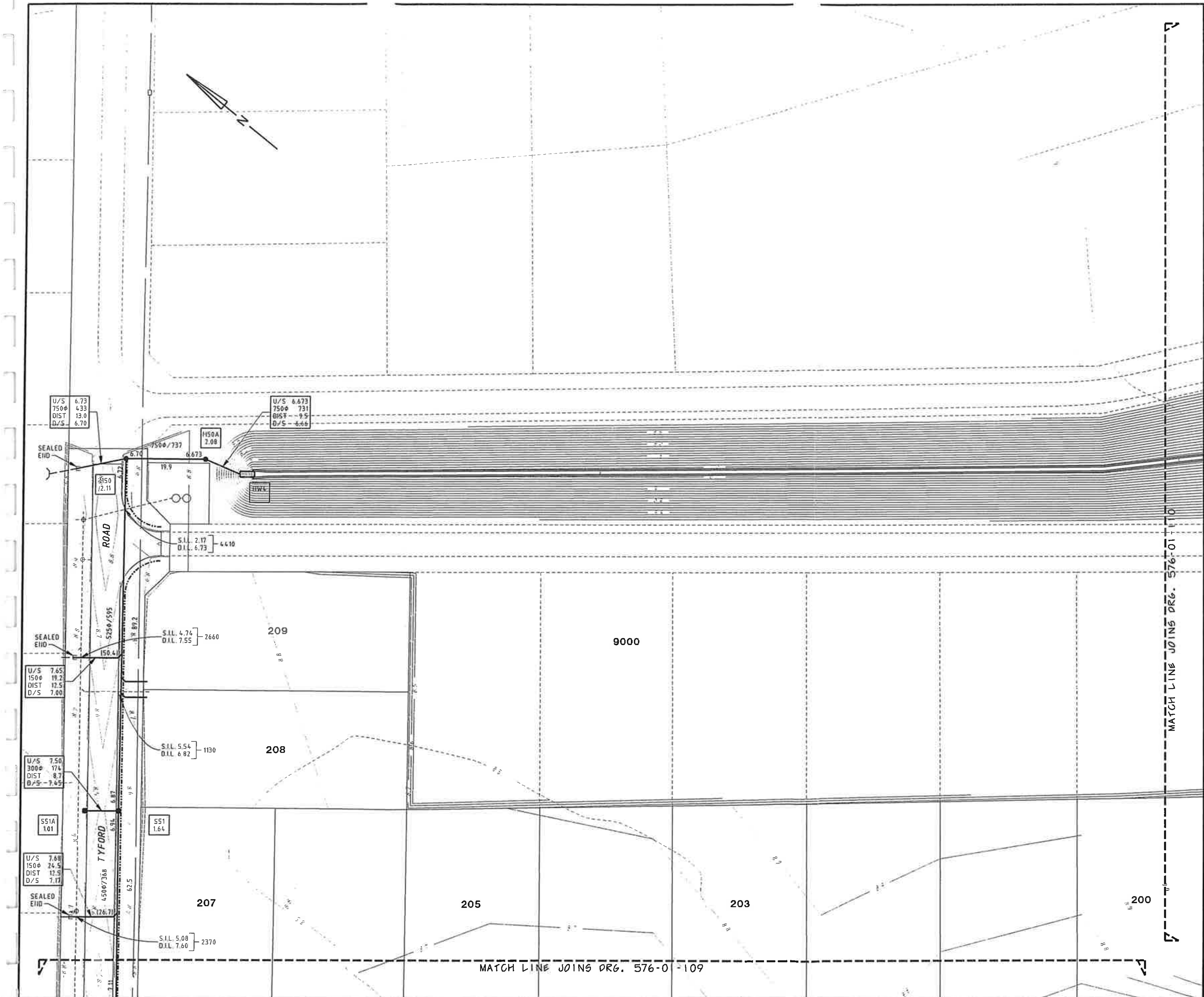
W.A.P.C. No: 129561

BEN CLARKE

PROPOSED SUBDIVISION OF
LOT 502 BRAND HIGHWAY, DONGARA
OLD ACRES ESTATE - STAGE 1
DRAINAGE RETICULATION PLAN - SHEET 5 OF 6

FILE NAME	DATE	DRAWING No:	AMDT No
576-01-110.DGN	29-06-06	576-01-110	2



NOTES

1. BASE INFORMATION
   A. DESIGN CONTOUR INTERVAL IS 0.1m
   B. LEVELS ARE TO A.H.D.
2. REFERENCE DRAWINGS:
   REFER TO DRAWING 576-01-102 TO 576-01-104 FOR PROPOSED SEWER INFORMATION
   REFER TO DRAWING 576-01-113 TO 576-01-115 FOR DRAINAGE STANDARD DETAILS.
   ALL WORKS TO CONFORM WITH THE SHIRE OF IRWIN STANDARD SPECIFICATIONS AND DRAWINGS
3. DRAINAGE ALIGNMENT:
   DRAINAGE POSITIONS TO BE DETERMINED FROM COORDINATES PROVIDED OR AS PER ALIGNMENTS SHOWN
4. PUBLIC UTILITIES:
   ALL SERVICES TO BE LOCATED PRIOR TO ANY MECHANICAL EXCAVATION WITHIN EXISTING ROAD RESERVE
   SERVICE INFORMATION SHOWN ON THE DRAWING IS INDICATIVE ONLY AND MAY NOT BE COMPLETE
5. MATERIALS:
   A. SOLID PIPES
   - DRAINAGE PIPES (AND MOULDED FITTINGS) 150 DIA AND LOWER SHALL BE CLASS SN4 UPVC, SOLVENT CEMENT JOINT.
   - DRAINAGE PIPES 225 DIA AND GREATER SHALL BE CLASS 2 R.C.P. RUBBER RING JOINT.
   B. SUBSOIL PIPES (AS INDICATED, EXCEPT UNDER ROAD PAVEMENT)
   - SUBSOIL DRAINAGE PIPES 150 DIA SHALL BE SLOTTED CLASS SN4 UPVC, SOLVENT CEMENT JOINT
   - SUBSOIL DRAINAGE PIPES 225 DIA TO 525 DIA SHALL BE CLASS 2 R.C.P. OPEN JOINT.
   - SUBSOIL DRAINAGE PIPES 600 DIA AND GREATER SHALL BE CLASS 2 R.C.P. RUBBER RING JOINT WITH A SLOTTED 150 DIA CLASS SN4 UPVC PIPE LAID PARALLEL TO THE MAIN PIPE (REFER TO DETAILS).
   C. MANHOLE LINERS TO BE:
   - 1200 DIA WHERE ANY PIPE INTO THE MANHOLE IS GREATER THAN 525 DIA.
   - 1050 DIA WHERE ANY PIPE INTO THE MANHOLE IS GREATER THAN 375 DIA.
   - 940 DIA UNLESS OTHERWISE NOTED.
   D. ALL MANHOLES TO HAVE STEP IRONS WHERE DEPTH EXCEEDS 1.2m.
6. DEPTH SHOWN ON MANHOLE NOTATION IS TO INVERT LEVEL OF DOWNSTREAM PIPE, NOT TO BASE OF PIT
7. ALL EXCAVATION BY OPEN CUT METHODS UNLESS SHOWN OTHERWISE

LEGEND

- PROPOSED DRAINAGE AND ACCESS POINT
- PROPOSED DRAINAGE AND CATCHMENT POINT (SIDE ENTRY PIT/GULLY PIT)
- PROPOSED DN100 VINIDEX 'DRAINCOIL' OR IPLEX 'AGRIDRAIN'. REFER TO DRG. 576-01-113 FOR DETAIL.
- INDICATES 100ϕ 45° JUNCTION
- FUTURE DRAINAGE AND ACCESS POINT
- EXISTING DRAINAGE
- EXISTING OPEN DRAIN
- PROPOSED SEWER AND ACCESS POINT
- EXISTING SEWER
- EXISTING OVERHEAD POWER
- EXISTING TELSTRA
- EXISTING GAS
- EXISTING OPTIC FIBRE

PIPE DETAILS: (example 225-OJ/235, 16.35, 65.4)
- DIAMETER (mm)
- SUBSOIL TYPE (AS INDICATED)
  - SS - SUBSOIL
  - OJ - OPEN JOINT
- GRADIENT
- INVERT LEVEL
- LENGTH

PIPE DETAILS: (example U/S 16.85, 150ϕ 185, DIST 55.5, D/S 16.55)
- UPSTREAM INVERT LEVEL
- DIAMETER / GRADIENT
- DISTANCE
- DOWNSTREAM INVERT LEVEL

ACCESS/CATCHMENT POINT DETAILS: (example M1, 3.5)
- INDICATES TRAFFICABLE COVER
- ACCESS POINT NUMBER
  - M - MANHOLE
  - S - SIDE ENTRY PIT
  - G - GULLY PIT
  - H - HOUSE CONNECTION PIT
- DEPTH FROM TOP OF COVER TO INVERT LEVEL

S.I.L. 16.55 / D.I.L. 17.25 — 500
- SEWER INVERT LEVEL
- DRAINAGE INVERT LEVEL
- CLEARANCE

- DESIGN CONTOUR LINE
- EXISTING CONTOUR LINE
- PROPOSED RETAINING WALL

NOTE: OPTIC FIBRE LOCATED IN THIS AREA. OPTIC FIBRE SHOWN ON THIS PLAN IS INDICATIVE ONLY, CONTRACTOR TO LOCATE PRIOR TO ANY MECHANICAL EXCAVATION.

No.	DATE	BY	DESCRIPTION
4	4-04-07	PHS	ADD SUBSOIL DRAINAGE & 100ϕ 45° JUNCTIONS AND DELETE HOUSE CONNECTION PITS.
3	1-02-07	PHS	AMEND TO ADDITIONAL DRAINAGE IN TYFORD ROAD.
2	15-11-06	PHS	AMEND TO SHOW OPTIC FIBRE.
1	8-08-06	PHS	AMEND TO INCLUDE LOTS 199-207 IN STAGE 1 WORKS.

AMENDMENTS

SCALE: 10m 0 10m 20m 30m
A1 PAGE - SCALE 1:500
A3 PAGE - SCALE 1:1000

DRAWN: P. SUMMERS
CHECKED:
APPROVED: [signature] BSc BE (Hons) CPEng MIE (Aust)

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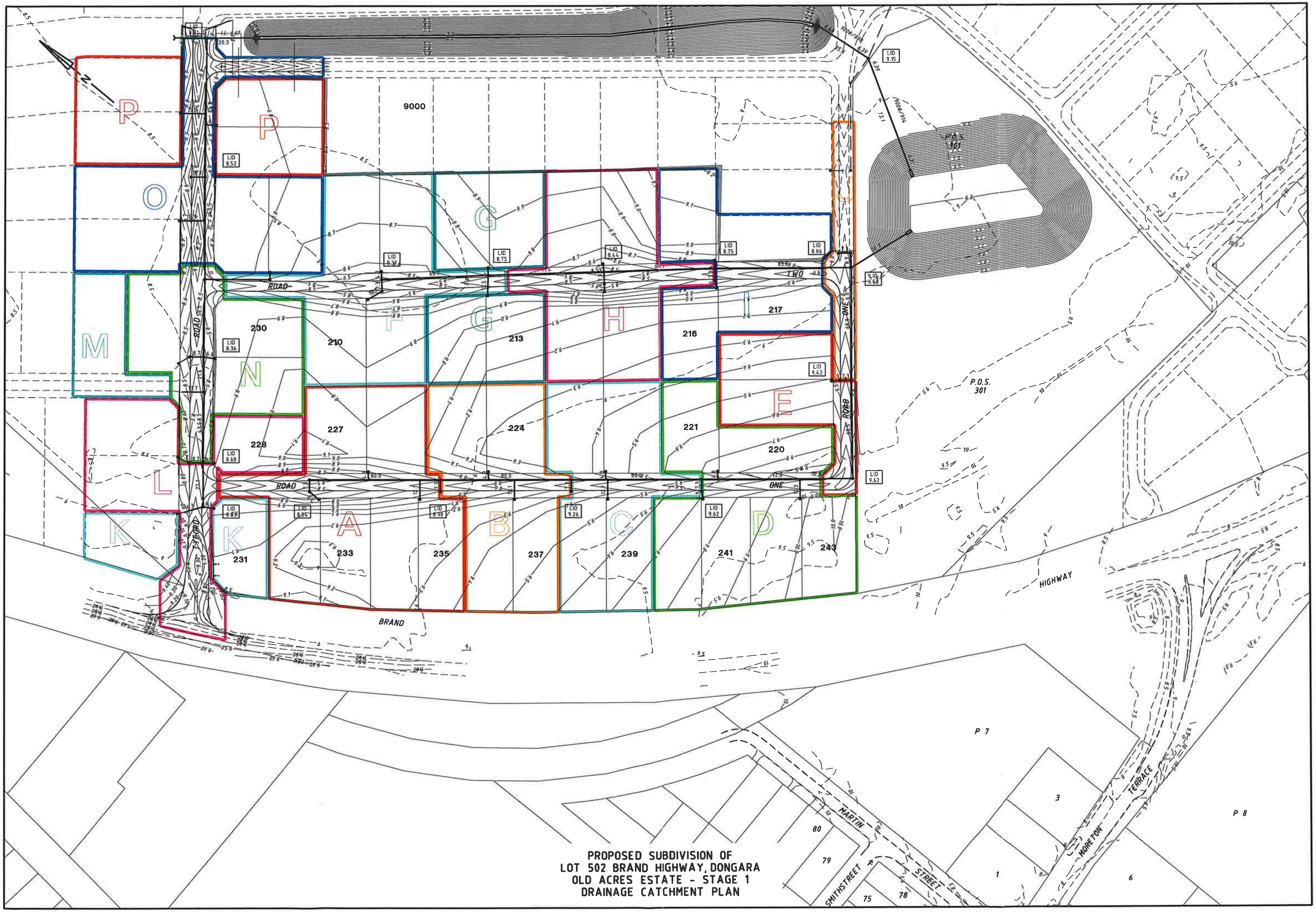
BEN CLARKE

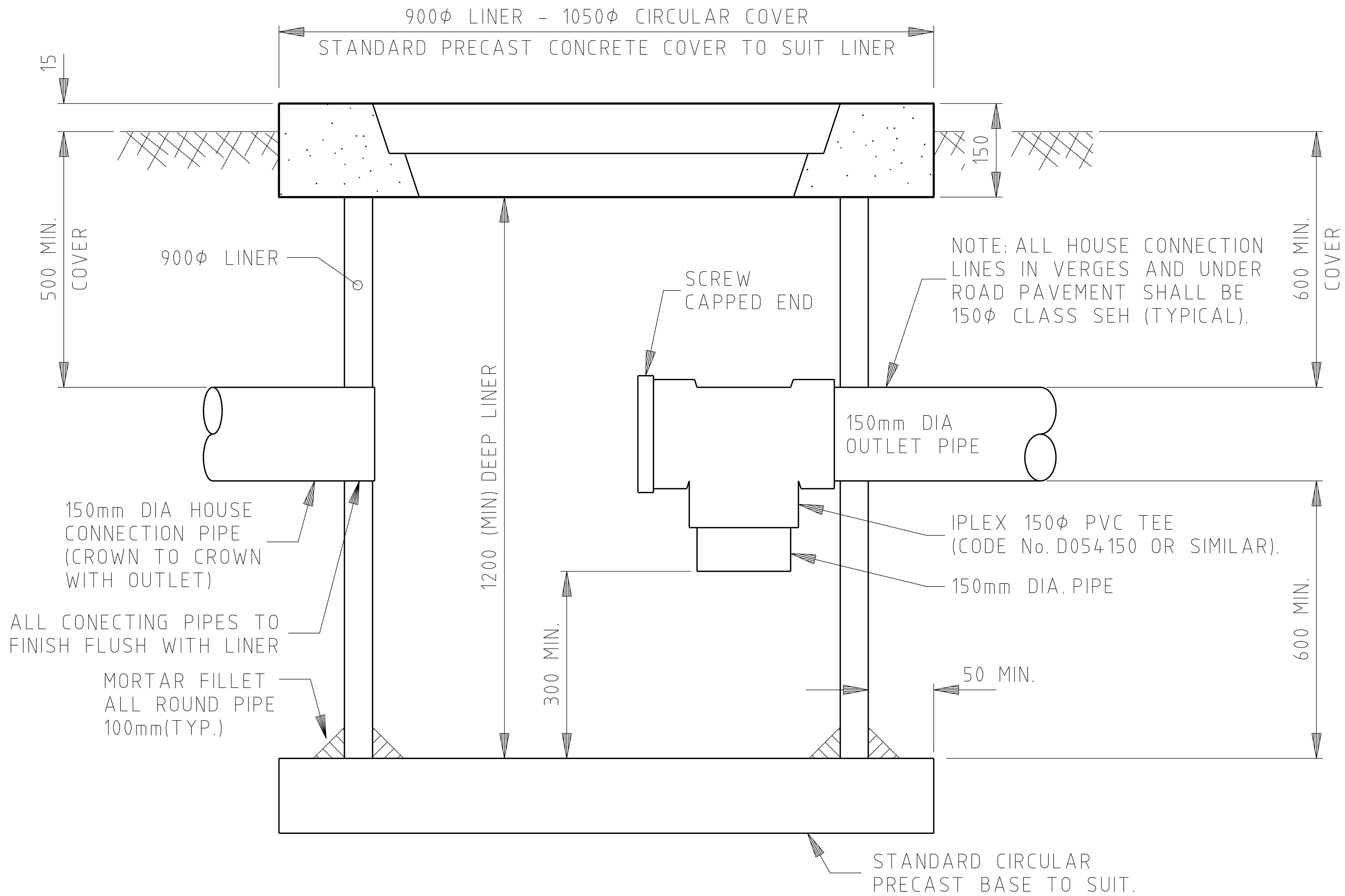
PROPOSED SUBDIVISION OF
LOT 502 BRAND HIGHWAY, DONGARA
OLD ACRES ESTATE - STAGE 1
DRAINAGE RETICULATION PLAN - SHEET 6 OF 6

FILE NAME: 576-01-111.DGN | DATE: 29-06-06 | DRAWING No.: 576-01-111 | AMDT No.: 4


PROPOSED SUBDIVISION OF
LOT 502 BRAND HIGHWAY, DONGARA
OLD ACRES ESTATE - STAGE 1
DRAINAGE CATCHMENT PLAN
9000
P.O.S. 301
ROAD ONE
ROAD TWO
BRAND HIGHWAY
MARTIN STREET
SMITH STREET
MORETON TERRACE
P 7
P 8

APPENDIX F

SILT TRAP DETAIL



TYPICAL HOUSE CONNECTION PIT DETAIL

SCALE 1 : 10

APPENDIX G

CSIRO: HOMEOWNERS GUIDE TO FOOTING AND FOUNDATION MAINTENANCE

Foundation Maintenance and Footing Performance: A Homeowner's Guide

CSIRO

BTF 18 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Tree root growth

Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation

Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

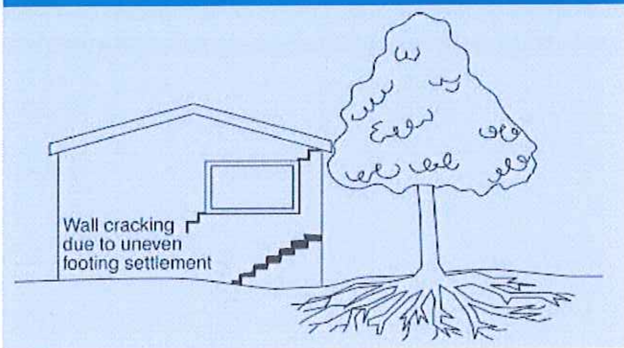
Seasonal swelling/shrinkage in clay

Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

Trees can cause shrinkage and damage



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots

In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself

Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures

Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.
Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

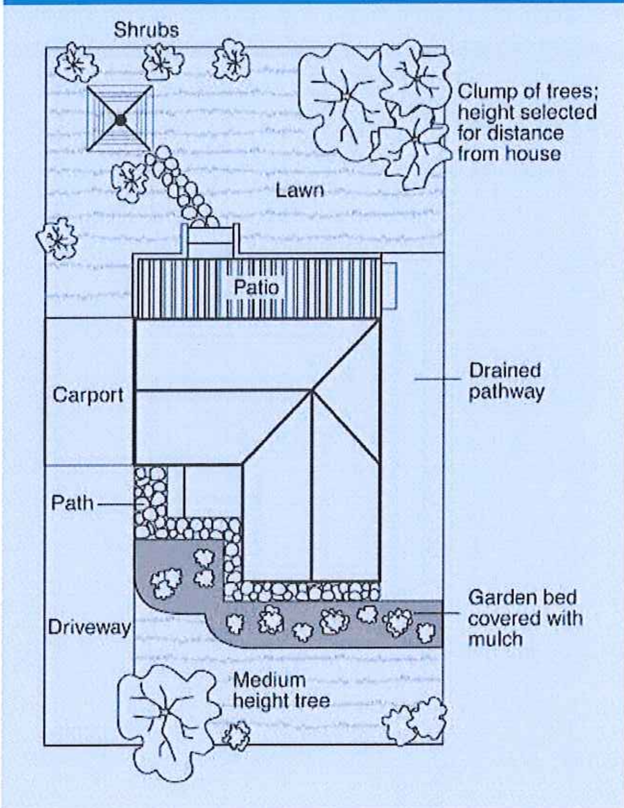
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4

Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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LEGEND

- LCP2 — LOT CONNECTION PIT NUMBER
- CONSTRUCTED DRAINAGE PIPE
- LOT CONNECTION PIT
- U/S 7.37 / 300 / 94 / 7.5m / D/S 7.29 — UPSTREAM INVERT LEVEL, PIPE DIAM / GRADE, PIPE LENGTH, DOWNSTREAM INVERT LEVEL
- M52 — EXISTING DRAINAGE STRUCTURE NUMBER
- EXISTING DRAINAGE PIPE
- EXISTING DRAINAGE STRUCTURE
- U/S 7.37 / 300 / 94 / 7.5m / D/S 7.29 — EXISTING DRAINAGE DETAILS

AS-CONSTRUCTED SURVEY NOTES:

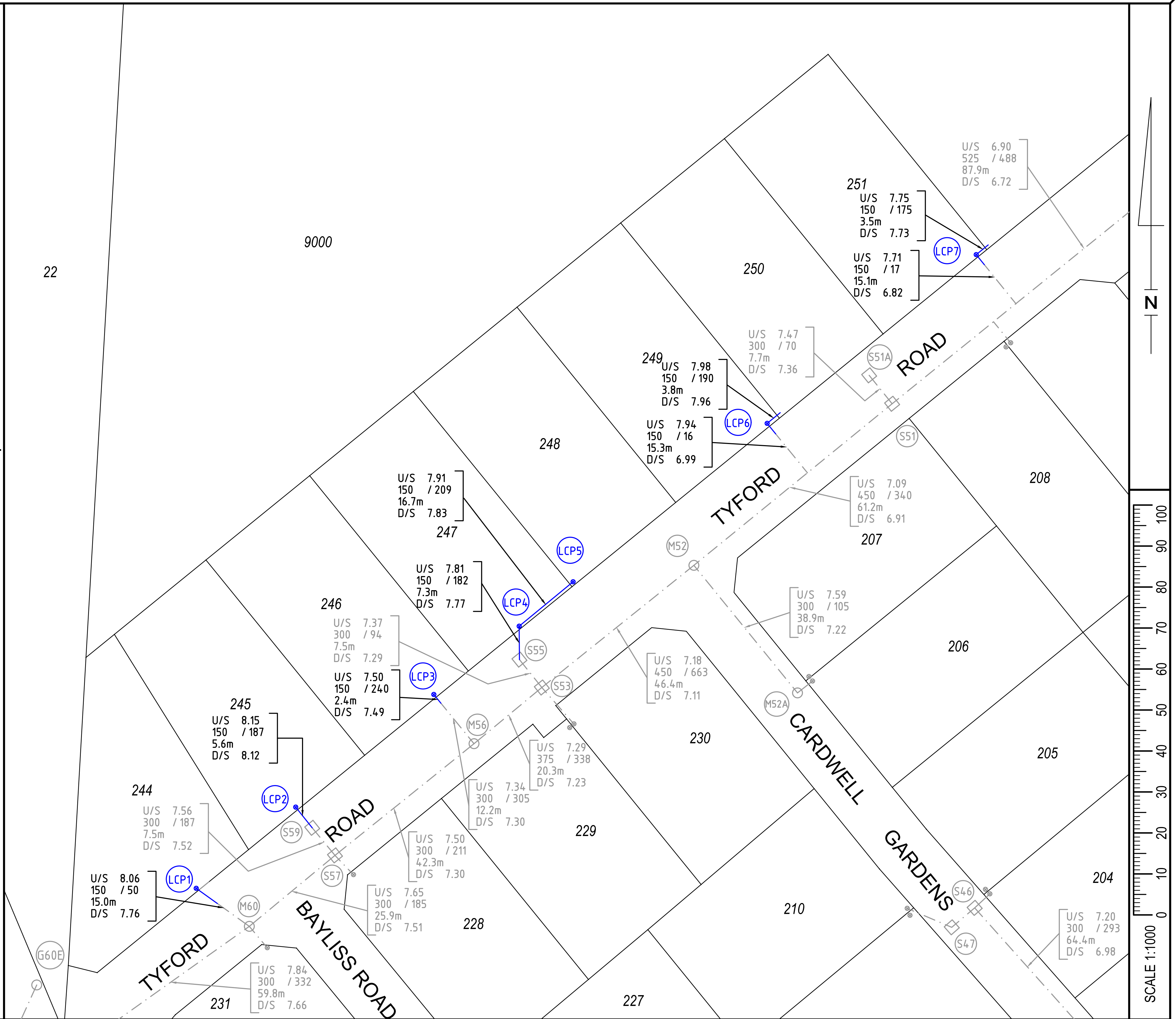
1. ALL DISTANCES ARE IN METRES. ALL PIPE DIAMETERS ARE IN MILLIMETRES.
2. HEIGHTS ARE BASED ON AHD.
3. FOR DESIGN DRAWING SEE PORTER DRAWING 22-2-14/400 REV A

LOCAL AUTHORITY: SHIRE OF IRWIN
LOCALITY: DONGARA

W.A.P.C. REF No.: 155097
CONTRACTOR: MIDCOAST CIVIL

LICENSED SURVEYOR__________________DATE_____________
QUANTUM SURVEYS

CONSULTING ENGINEER__________________DATE_____________
PORTER CONSULTING ENGINEERS



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