GEOTECHNICAL INVESTIGATION:

New Spa at **39 Seaforth Crescent, Seaforth**

1. Proposed Development

1.1 Install a spa on the downhill side of the property by excavating to a maximum depth of ~0.9m.

1.2 Details of the proposed development are shown on 3 drawings prepared by Premier Pools, Project number 701, drawings numbered 1/3 to 3/3, dated 5th March, 2022.

2. Site Description

2.1 The site was inspected on the 20th April, 2022.

2.2 This waterfront residential property is on the low side of the street and has a S aspect. It is located on the steeply graded lower reaches of a hillslope. The slope falls across the property at an average angle of ~30° to the waterfront. The slope above the property eases to moderate angles.

2.3 At the road frontage, a shared concrete driveway runs down the slope to a garage on the uphill side of the property (Photo 1). The garage is partially seated on outcropping Medium Strength Rock that is slightly undercut to ~2.0m (Photo 2). The garage extends ~1.0m over the undercut area. Given the thickness of the supporting cantilever arms with no visible defects, the undercut rock is considered to be stable. A series of stable sandstone block retaining walls reaching up to ~1.8m high terrace the slope in between the road frontage and the house (Photo 3). A ~9.0m high cut to create a level platform for the house has been taken entirely through outcropping Competent Medium Strength Sandstone (Photo 4). A portion of the cut face has been protected with sprayed concrete (Photo 5). The three-storey rendered masonry house is supported on masonry walls and concrete piers (Photo 6). The masonry walls show no significant signs of movement and the concrete piers stand vertical. A partially suspended pool extends off the downhill side of the house (Photo 7). No significant movement has occurred in the concrete shell of the pool as indicated by the water level against the pool tiles. A series of low sandstone block retaining walls terrace the steep slope that extends to the lower common boundary (Photo 8). A ~1.5m high sandstone block retaining wall supports a fill for a moderately sloping lawn area (Photo 9). The wall is covered in vegetation but from what could be seen, appears to be in good condition. It is supported directly off outcropping Competent Medium Strength Sandstone. Sandstone bedrock outcrops and steps down the property to the waterfront (Photos 10 & 11).

3. Geology

The Sydney 1:100 000 Geological sheet indicates the site is underlain by Hawkesbury Sandstone. It is described as a medium to coarse grained quartz sandstone with very minor shale and laminite lenses.

4. Subsurface Investigation

Ten Dynamic Cone Penetrometer (DCP) tests were put down to determine the relative density of the overlying soil and the depth to bedrock. The locations of the tests are shown on the site plan attached. It should be noted that a level of caution should be applied when interpreting DCP test results. The test will not pass through hard buried objects so in some instances it can be difficult to determine whether refusal has occurred on an obstruction in the profile or on the natural rock surface. This is not expected to be an issue for the testing on this site. However, excavation and foundation budgets should always allow for the possibility that the interpreted ground conditions in this report vary from those encountered during excavations. See the appended "Important information about your report" for a more comprehensive explanation. The results are as follows:

DCP TEST RESULTS – Dynamic Cone Penetrometer					
Equipment: 9kg hammer, 510mm drop, conical tip.				Standard: AS1289.6.3.2 - 1997	
Depth(m) Blows/0.3m	**DCP 1** (~RL2.3)	**DCP 2** (~RL5.4)	**DCP 3** (~RL6.5)	**DCP 4** (~RL8.7)	**DCP 5** (~RL10.5)
0.0 to 0.3	Exposed at the surface	2	Exposed at the surface	Exposed at the surface	3
0.3 to 0.6		2			#
0.6 to 0.9		5			
0.9 to 1.2		7			
		#			
		Refusal on Rock @ 0.8m			Refusal on Rock @ 0.3m

DCP TEST RESULTS – Dynamic Cone Penetrometer					
Equipment: 9kg hammer, 510mm drop, conical tip.				Standard: AS1289.6.3.2 - 1997	
Depth(m) Blows/0.3m	**DCP 6** (~RL14.1)	**DCP 7** (~RL14.6)	**DCP 8** (~RL19.1)	**DCP 9** (~RL28.2)	**DCP 10** (~RL30.2)
0.0 to 0.3	2	Exposed at the surface	Exposed at the surface	11	Exposed at the surface
0.3 to 0.6	5			18	
0.6 to 0.9	3			23	
0.9 to 1.2	#			#	
	Refusal on Rock @ 0.7m			Refusal on Rock @ 0.9m	

#refusal/end of test. F=DCP fell after being struck showing little resistance through all or part of the interval.

DCP Notes:

DCP1 – Rock exposed at surface.

DCP2 – Refusal on rock @ 0.8m, DCP bouncing off rock surface, white impact dust on dry tip.

DCP3 – Rock exposed at surface.

DCP4 – Rock exposed at surface.

DCP5 – Refusal on rock @ 0.3m, DCP bouncing off rock surface, white impact dust on dry tip.

DCP6 – Refusal on rock @ 0.7m, DCP bouncing off rock surface, orange impact dust on dry tip.
DCP7 – Rock exposed at surface.
DCP8 – Rock exposed at surface.
DCP9 – Refusal on rock @ 0.9m, DCP bouncing off rock surface, brown sand on dry tip.
DCP10 – Rock exposed at surface.

5. Geological Observations/Interpretation

The surface features of the block are controlled by the outcropping and underlying sandstone bedrock that steps down the property forming sub-horizontal benches between the steps. Where the grade is steeper, the steps are larger and the benches narrower. Where the slope eases, the opposite is true. Where the rock is not exposed, it is overlain by shallow soils over sandy clays that fill the bench step formation. In the test locations, where the rock is not exposed, it was encountered at depths of between ~0.3 to ~0.9m below the current surface, being slightly deeper due to the stepped nature of the underlying bedrock. The outcropping sandstone on the property is estimated to be Medium Strength or better and similar strength rock is expected to underlie the entire site as all the DCP tests bounced at refusal. See Type Section attached for a diagrammatical representation of the expected ground materials.

6. Groundwater

Seepage was observed moving over the exposed sandstone cut face during the inspection. This is considered to be normal ground water seepage that is expected to move over the buried surface of the rock and through the cracks. Due to the slope and elevation of the block, the water table is expected to be many metres below the base of the proposed excavation.

7. Surface Water

No evidence of significant surface flows were observed on the property during the inspection. Normal sheet wash from the slope above will be intercepted by the street drainage system for Seaforth Crescent above.

Should the owners be aware or, if at a later time, become aware that overland flows enter the property during prolonged heavy rainfall, our office is to be contacted so appropriate drainage can be designed and installed. It is a condition of the risk assessment in **Section 8** that this be done.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed beside the property. The steeply graded slope that falls across the property and continues above is a potential hazard (**Hazard One**). The large sandstone cut face that steps ~9.0m down the slope is a potential hazard (**Hazard Two**). The vibrations from the proposed excavation are a potential hazard (**Hazard Three**). The proposed excavation is a potential hazard until retaining structures are in place (**Hazard Four**).

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two
TYPE	The steep slope that falls across the property and continues above failing and impacting on the proposed works.	The existing sandstone cut face that steps ~9.0m down the slope failing and impacting on the proposed works (Photo 4).
LIKELIHOOD	'Unlikely' (10^{-4})	'Unlikely' (10^{-4})
CONSEQUENCES TO PROPERTY	'Medium' (15%)	'Medium' (25%)
RISK TO PROPERTY	'Low' (2×10^{-5})	'Low' (2×10^{-5})
RISK TO LIFE	9.1×10^{-7}/annum	2.9×10^{-7}/annum
COMMENTS	This level of risk is 'ACCEPTABLE', provided the recommendations in **Section 7** & **16** are followed.	This level of risk is 'ACCEPTABLE'.

RISK ANALYSIS CONTINUES ON THE NEXT PAGE

HAZARDS	Hazard Three	Hazard Four
TYPE	The vibrations produced during the proposed excavation impacting on the surrounding structures.	The excavation (up to a maximum depth of 0.9m) collapsing onto the work site before retaining structures are in place.
LIKELIHOOD	'Possible' (10^{-3})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (15%)	'Medium' (15%)
RISK TO PROPERTY	'Moderate' (2×10^{-4})	'Moderate' (2×10^{-4})
RISK TO LIFE	5.3×10^{-7}/annum	8.3×10^{-6}/annum
COMMENTS	This level of risk to property is 'UNACCEPTABLE'. To move risk to 'ACCEPTABLE' levels, the recommendations in **Section 12** are to be followed.	This level of risk is 'ACCEPTABLE', provided the recommendations in **Section 13 and 14** are followed.

(See Aust. Geomech. Jnl. Mar 2007 Vol. 42 No 1, for full explanation of terms)

9. Suitability of the Proposed Development for the Site

The proposed development is suitable for the site. No geotechnical hazards will be created by the completion of the proposed development provided it is carried out in accordance with the requirements of this report and good engineering and building practice.

10. Stormwater

No significant additional stormwater runoff will be created by the proposed development.

Any roof water from the existing development that is not already adequately piped to the waterfront is to be piped to the waterfront through any tanks that may be required by the regulating authorities.

11. Excavations

An excavation up to a maximum depth of ~0.9m is required to install a spa on the downhill side of the property. The excavation is expected to be through sandy soils and sandy clays with Medium Strength Rock expected at depths of between ~0.3m and ~0.9m below the current surface in the area of the proposed works.

It is envisaged that excavations through sandy soils and sandy clays can be carried out with an excavator and bucket, and excavations through rock will require grinding or rock sawing and breaking.

Due to access difficulties, hand tools such as rock saws and jack hammers will be used for excavations through rock.

12. Vibrations

Possible vibrations generated during excavations through sandy soils and sandy clays will be below the threshold limit for building damage. It is expected that the base of the excavation will be through Medium Strength Sandstone or better.

Due to access difficulties, it is expected that hand tools such as rock saws and jack hammers will be used for excavations through rock. No vibration monitoring will be required if hand tools are used.

13. Excavation Support Requirements

The excavation for the proposed spa will reach a maximum depth of ~0.9m. The setbacks are as follows:

- Flush with the existing terrace.
- ~0.8m from the subject house.
- ~1.0m from the existing swimming pool.

As the existing house, pool and terrace are supported on Competent Medium Strength Sandstone or on piers taken below the zone of influence of the proposed excavation, no structures or boundaries will lie within the zone of influence of the proposed excavation. In this instance, the zone of influence is the area above a theoretical 30° line from the base of the excavation or top of Medium Strength Rock, whichever is encountered first, towards the surrounding structures and boundaries.

The soil and clay portions of the proposed spa excavation are expected to stand at near-vertical angles for short periods of time until the pool structure is installed, provided the cut batters are kept from becoming saturated. If the cut batters through soil and clay remain unsupported for more than a few days before pool construction commences, they are to be supported with typical pool shoring until the pool structure is in place. Excavations through Medium Strength Rock or better are expected to stand at vertical angles unsupported subject to approval by the geotechnical consultant.

Upslope runoff is to be diverted from the cut faces by sandbag mounds or other diversion works. Unsupported cut batters through fill, soil, and clay are to be covered to prevent access of water in wet weather and loss of moisture in dry weather. The covers are to be tied down with metal pegs or other suitable fixtures so they can’t blow off in a storm. The materials and labour to construct the spa structure are to be organised so on completion of the excavation they can be constructed as soon as possible. The excavation is to be carried out during a dry period. No excavations are to commence if heavy or prolonged rainfall is forecast.

All excavation spoil is to be removed from site following the current Environmental Protection Agency (EPA) waste classification guidelines.

14. Retaining Structures

For cantilever or singly-propped retaining structures, it is suggested the design be based on a triangular pressure distribution of lateral pressures using the parameters shown in Table 1.

TABLE 1 ON THE NEXT PAGE

Table 1 – Likely Earth Pressures for Retaining Structures

Unit	Earth Pressure Coefficients		
	Unit weight (kN/m^3)	'Active' K_a	'At Rest' K_0
Fill and Sandy Soil	20	0.40	0.55
Clays	20	0.30	0.40
Medium Strength Sandstone	24	0.00	0.01

For rock classes refer to Pells et al "Design Loadings for Foundations on Shale and Sandstone in the Sydney Region". Australian Geomechanics Journal 1978.

It is to be noted that the earth pressures in Table 1 assume a level surface above the structure, do not account for any surcharge loads, and assume retaining walls are fully drained. Rock strength and relevant earth pressure coefficients are to be confirmed on site by the geotechnical consultant.

All retaining structures are to have sufficient back-wall drainage and be backfilled immediately behind the structure with free-draining material (such as gravel). This material is to be wrapped in a non-woven Geotextile fabric (i.e., Bidim A34 or similar), to prevent the drainage from becoming clogged with silt and clay. If no back-wall drainage is installed in retaining structures, the likely hydrostatic pressures are to be accounted for in the structural design.

15. Foundations

Due to the steep grade of the slope below the location of the proposed spa, piers potted at least ~0.3m into Medium Strength Sandstone are suitable footings for the proposed works. Alternatively, suitable rebar can be grouted / epoxied ~0.3m into a level rock surface to fix the foundation to the rock. Where this material is not exposed, it is expected at depths of between ~0.3 and ~0.9m below the current surface.

A maximum allowable bearing pressure of 1000kPa can be assumed for footings on Medium Strength Sandstone.

Naturally occurring vertical cracks (known as joints) commonly occur in sandstone. These are generally filled with soil and are the natural seepage paths through the rock. They can extend to depths of several metres and are usually relatively narrow but can range between 0.1 to 0.8m wide. If a footing falls over a joint in the rock, the construction process is simplified if, with the approval of the structural engineer, the joint can be spanned or, alternatively, the footing can be repositioned so it does not fall over the joint.

NOTE: If the contractor is unsure of the footing material required, it is more cost effective to get the geotechnical consultant on site at the start of the footing excavation to advise on footing depth and material. This mostly prevents unnecessary over-excavation in clay like shaly rock but can be valuable in all types of geology.

16. Site Maintenance

On steep slopes such as on this site, it is prudent for the owners to occasionally inspect the slope (say annually or after heavy rainfall events, whichever occurs first). Should any of the following be observed: movement or cracking in retaining walls or rock faces, cracking in any structures, cracking or movement in the slope surface, tilting or movement in established trees, leaking pipes, or newly observed flowing water, or changes in the erosional process or drainage regime, then a geotechnical consultant should be engaged to assess the slope. We can carry out these inspections upon request. The risk assessment in **Section 8** is subject to this site maintenance being carried out.

17. Inspections

The client and builder are to familiarise themselves with the following required inspections as well as council geotechnical policy. We cannot provide geotechnical certification for the owner or the regulating authorities if the following inspections have not been carried out during the construction process.

- All footings are to be inspected and approved by the geotechnical consultant while the excavation equipment and contractors are still onsite and before steel reinforcing is placed or concrete is poured.

White Geotechnical Group Pty Ltd.

Ben White M.Sc. Geol.,
AusIMM., CP GEOL.
No. 222757
Engineering Geologist.

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

Photo 11

Important Information about Your Report

It should be noted that Geotechnical Reports are documents that build a picture of the subsurface conditions from the observation of surface features and testing carried out at specific points on the site. The spacing and location of the test points can be limited by the location of existing structures on the site or by budget and time constraints of the client. Additionally, the test themselves, although chosen for their suitability for the particular project, have their own limiting factors. The testing gives accurate information at the location of the test, within the confines of the test's capability. A geological interpretation or model is developed by joining these test points using all available data and drawing on previous experience of the geotechnical consultant. Even the most experienced practitioners cannot determine every possible feature or change that may lie below the earth. All of the subsurface features can only be known when they are revealed by excavation. As such, a Geotechnical report can be considered an interpretive document. It is based on factual data but also on opinion and judgement that comes with a level of uncertainty. This information is provided to help explain the nature and limitations of your report.

With this in mind, the following points are to be noted:

- If upon the commencement of the works the subsurface ground or ground water conditions prove different from those described in this report, it is advisable to contact White Geotechnical Group immediately, as problems relating to the ground works phase of construction are far easier and less costly to overcome if they are addressed early.

- If this report is used by other professionals during the design or construction process, any questions should be directed to White Geotechnical Group as only we understand the full methodology behind the report's conclusions.

- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- This report should not be applied to any other project other than that outlined in section 1.0.

- This report is to be read in full and should not have sections removed or included in other documents as this can result in misinterpretation of the data by others.

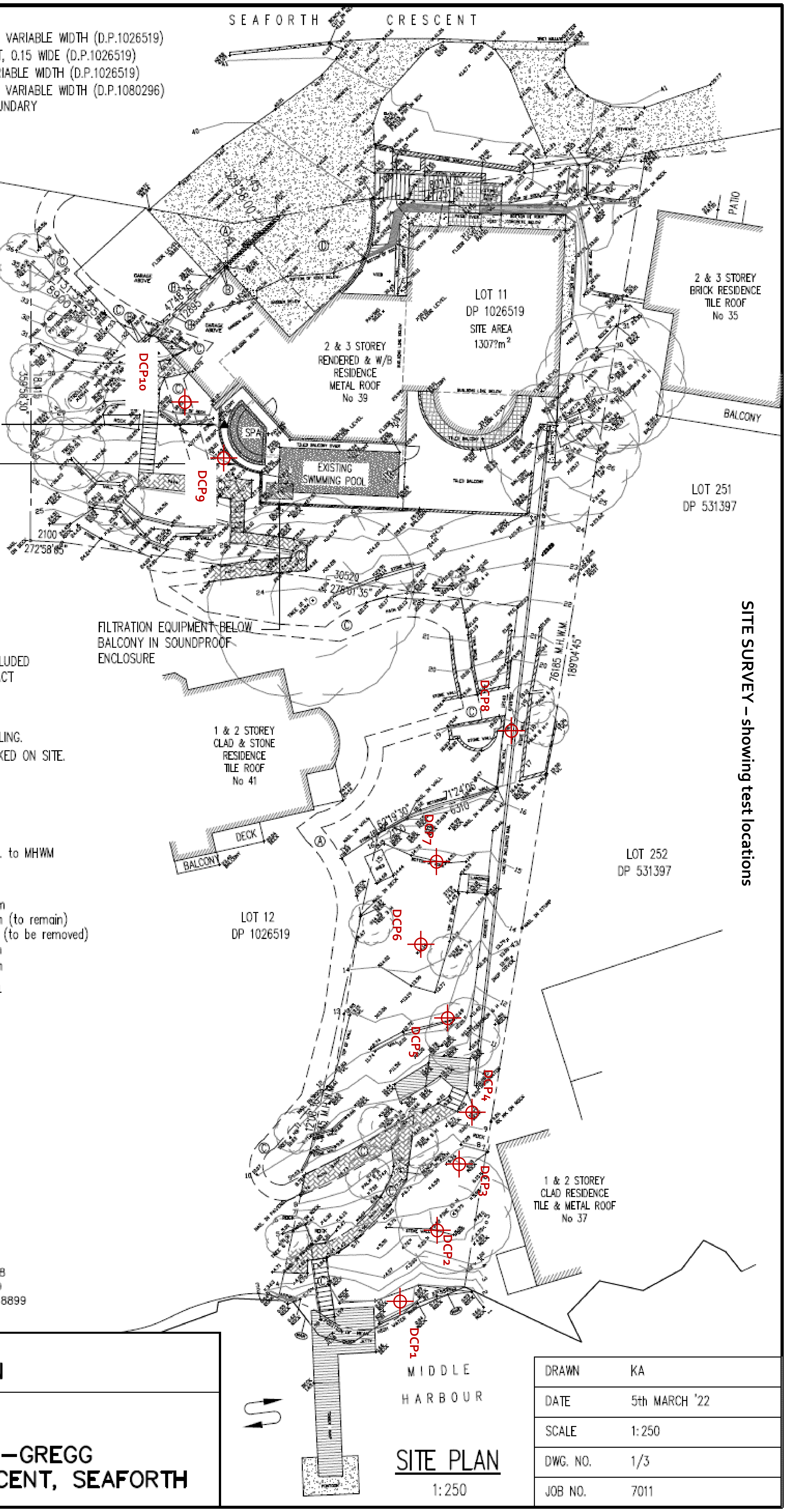
- It is common for the design and construction process to be adapted as it progresses (sometimes to suit the previous experience of the contractors involved). If alternative design and construction processes are required to those described in this report, contact White Geotechnical Group. We are familiar with a variety of techniques to reduce risk and can advise if your proposed methods are suitable for the site conditions.

– Ⓐ .. DENOTES RIGHT OF CARRIAGEWAY, VARIABLE WIDTH (D.P.1026519)
– Ⓑ .. DENOTES EASEMENT FOR SUPPORT, 0.15 WIDE (D.P.1026519)
– Ⓒ .. DENOTES RIGHT OF FOOTWAY, VARIABLE WIDTH (D.P.1026519)
– Ⓓ .. DENOTES RIGHT OF CARRIAGEWAY, VARIABLE WIDTH (D.P.1080296)
– .. DENOTES GIS MARITIME TITLE BOUNDARY

DATUM: STRUCTURAL LEVEL OF EXISTING TERRACE
TOP OF STRUCTURAL COPING TO BE LEVEL WITH THE DATUM POINT

EXISTING GLASS BALUSTRADE 1200mm MINIMUM HIGH WITH CHILDPROOF SELF-LOCKING GATE AS PER SWIMMING POOL FENCING AS 1926.1–2012 TO REMAIN

VOLUME OF WATER IN SPA = 3.0 KL



NOTES

ALL WORKS "BY CUSTOMER" ARE NOT INCLUDED IN WORKS UNDER PREMIER POOLS CONTRACT OR CONSTRUCTION CERTIFICATE.

THIS DRAWING IS NOT TO BE SCALED.
DIMENSIONS TO BE RECOGNISED OVER SCALING.
ALL DIMENSIONS AND LEVELS TO BE CHECKED ON SITE.

SITE COVERAGE CALC.

AREA OF BLOCK = 1307 sq m Approx. to MHWM

EXISTING IMPERVIOUS AREAS :

RESIDENCE	=	250.7 sq m
EXISTING BALCONY	=	91.5 sq m (to remain)
EXISTING BALCONY	=	7.7 sq m (to be removed)
EXISTING SWIMMING POOL	=	23.5 sq m
DRIVEWAY/PATHS	=	130.4 sq m
IMPERVIOUS AREA	=	503.8 sq m

PROPOSED spa BY PREMIER POOLS:

SPA WATER = 5.7 sq m
SPA COPING = 2.0 sq m

TOTAL PROPOSED IMPERVIOUS AREA
= 503.8 sq m = 38.5%

AVAILABLE SOFT/LANDSCAPE AREA
= 803.2 sq m = 61.5%

Premier Pools THE POOL PROFESSIONALS

Builders Licence No. 34971
Premier Pools Pty Ltd A.C.N. 002 664048
9/303 Pacific Hwy Lindfield NSW 2070
Telephone: 9415 8888 Facsimile: 9415 8899

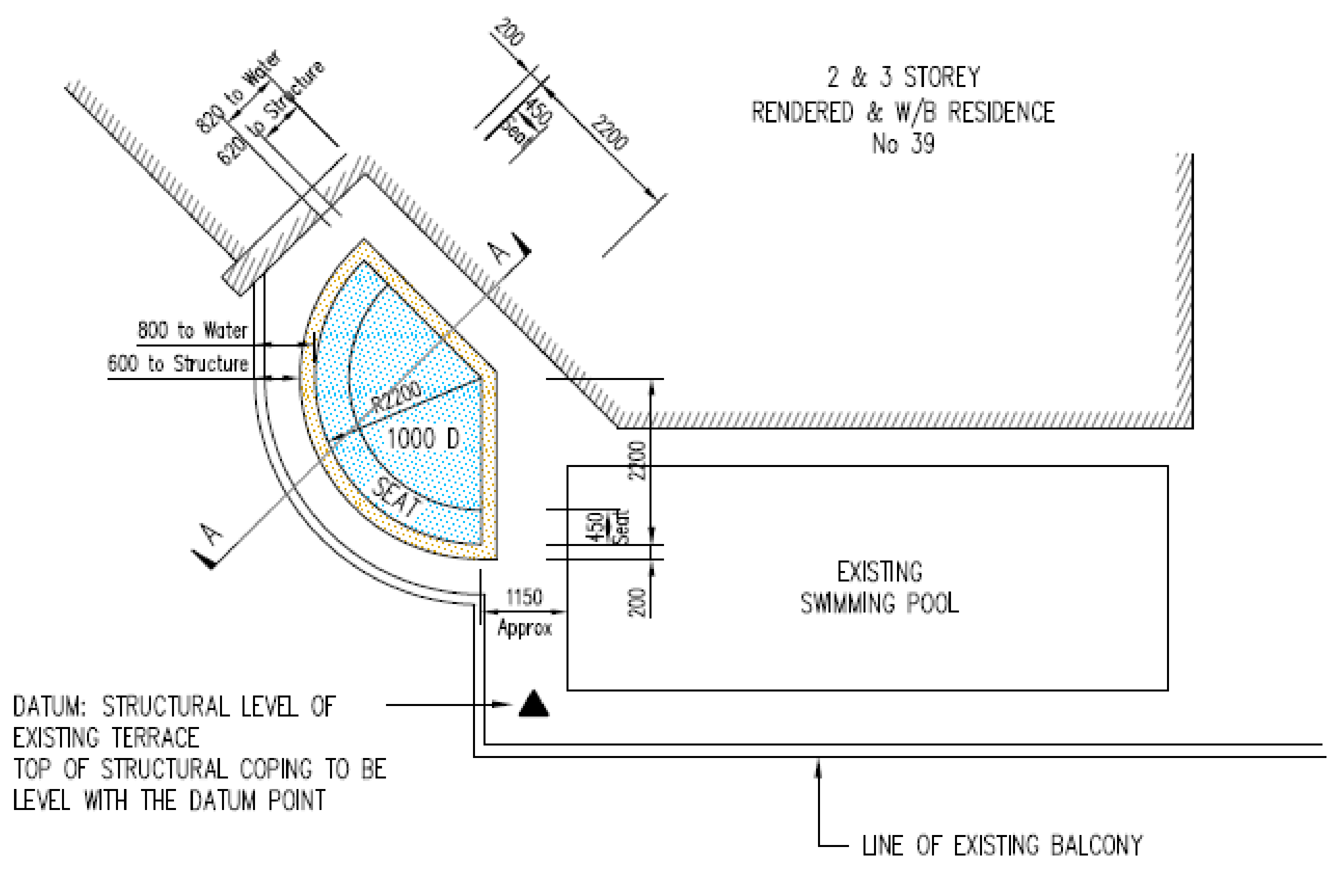
TITLE
SITE ANALYSIS PLAN

CLIENT
RON THOMSON & PAMELA ROBERTSON–GREGG
39 SEAFORTH CRESCENT, SEAFORTH

SITE PLAN
1:250

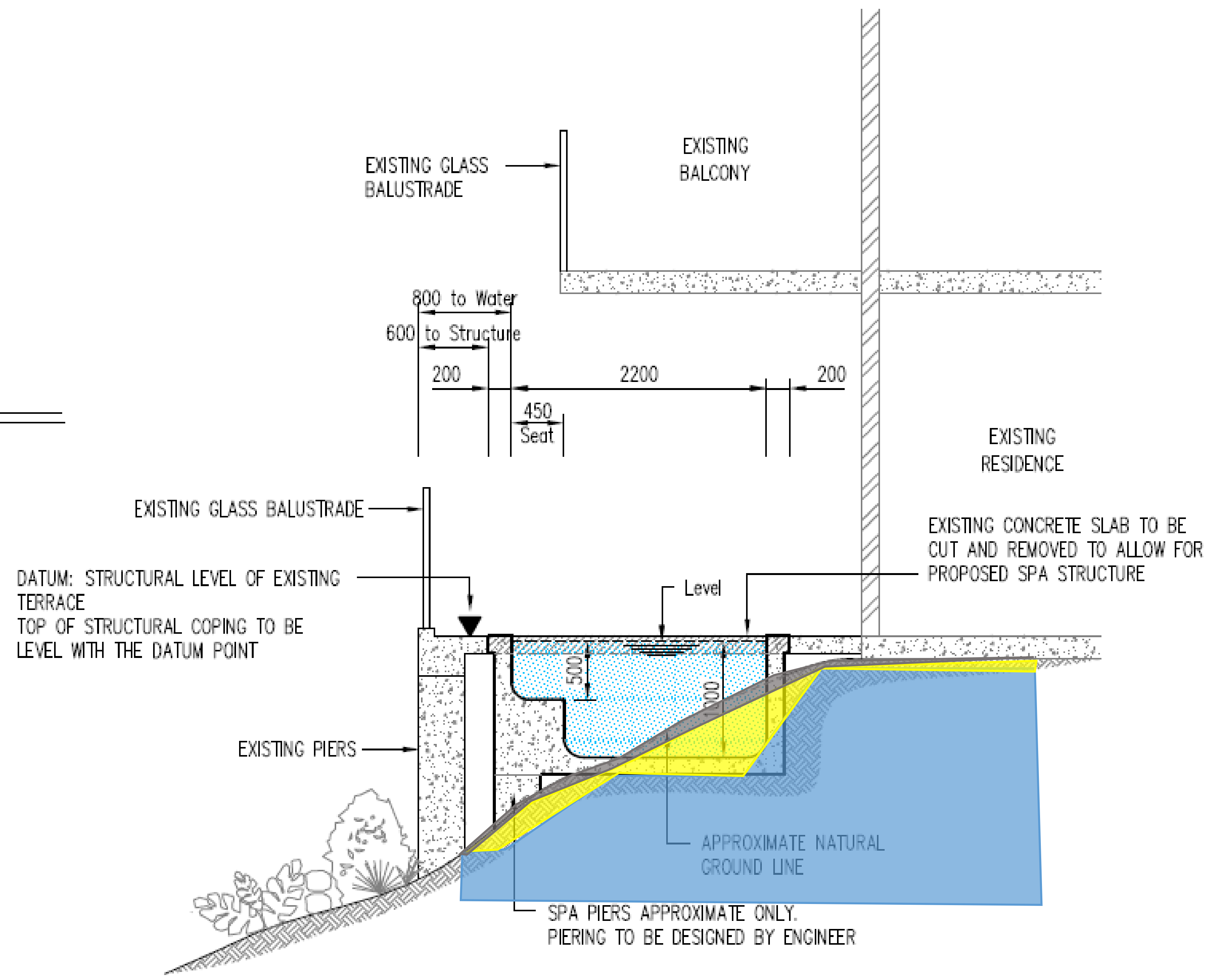
DRAWN	KA
DATE	5th MARCH '22
SCALE	1:250
DWG. NO.	1/3
JOB NO.	7011

TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



SPA PLAN

1 :100



SECTION A – A

1 : 50

Expected Ground Materials

- Fill
- Topsoil
- Clay – Firm to Stiff
- Hawkesbury Sandstone – Medium Strength

(+100) DENOTES APPROXIMATE HEIG
ABOVE/BELOW EXISTING GROU

NOTE: THIS DRAWING IS NOT
DIMENSIONS TO BE RECOGNIS
ALL DIMENSIONS AND LEVELS

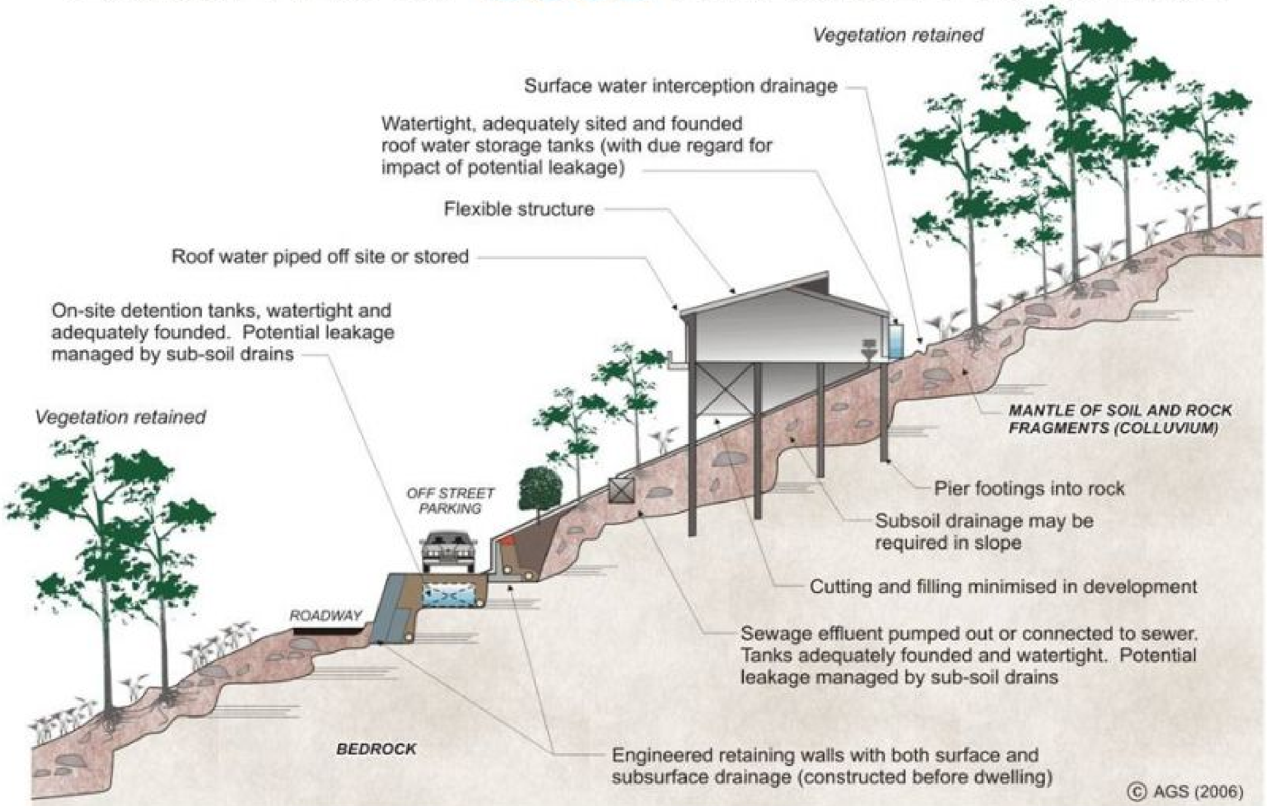
TOTAL VOLUME OF WATER IN SPA
= 3.0 Kilolitres Approx.

Premier Pools
THE POOL PROFESSIONALS

Builders Licence No. 34971
Premier Pools Pty Ltd A.C.N. 002 664048
9/303 Pacific Hwy Lindfield NSW 2070
Telephone: 9415 8888 Facsimile: 9415 8899

TITLE SPA PLAN & SECTIONAL ELEVATION	DRAWN KA DATE 5th MAR. 2022
CLIENT RON THOMSON & PAMELA ROBERTSON–GREGG 39 SEAFORTH CRESCENT, SEAFORTH	SCALE AS SHOWN DWG. NO. 2/3 JOB NO. 7011

EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE