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Assessment of Fluvial Geomorphology:

Lot 21 DP 1000643, Gilead

Prepared for Australian Retirement Holdings Pty Ltd

Revision 00

15 July 2020



SEEC

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Document Certification

This report has been developed based on agreed requirements as understood by SEEC at the time of investigation. It applies only to a specific task on the nominated lands. Other interpretations should not be made, including changes in scale or application to other projects.

Any recommendations contained in this report are based on an honest appraisal of the opportunities and constraints that existed at the site at the time of investigation, subject to the limited scope and resources available. Within the confines of the above statements and to the best of my knowledge, this plan does not contain any incomplete or misleading information.

Andrew Macleod B.Sc (Hons) CPESC CPSS
Director and Principal Soil Conservationist
SEEC

15 July 2020



Version Register

Version	Date	Author	Reviewer	Notes	Other
Rev A	15/07/2020	AM	BJ	Draft issue for review	
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1 INTRODUCTION

1.1 Background

Strategic Environmental and Engineering Consulting (SEEC) Pty Ltd were engaged by HT Retirement Pty Ltd to assess the fluvial geomorphology of the natural drainage features on Lot 21 DP 1000643, Gilead ("the site").

This report provides a summary of the findings of that assessment. The assessment was undertaken by Andrew Macleod from SEEC. A site inspection was conducted on 13 July 2020. A CV for Andrew Macleod is contained in Appendix A of this report.

1.2 Purpose and Limitations

The purpose of this assessment is to determine the fluvial geomorphological conditions within the various natural drainage features on Lot 21 DP 1000643, Gilead. This will aid HT Retirement Pty Ltd and their consultants in planning and allowing for appropriate riparian buffers around any drainage features that might be considered as "watercourses".

In conducting this assessment, SEEC have only investigated the fluvial geomorphology of the drainage features. We have not assessed the flora and fauna of the drainage features, and our assessment is limited to observations and investigations of soils, geology, and drainage features (e.g. banks, beds, pools etc.), as typically occur in watercourses (Landcom, 2004).

2 ASSESSMENT OF CONDITIONS

2.1 Mapped Hydrolines

Figure 1 shows the mapped position of various “blue lines” from the NSW Government Hydroline Spatial Data (NSW Government, 2020), which is available online. Figure 2 shows the contours across the site, along with the cadastral boundary.

For ease of reference, various points along the natural drainage features have been labelled to define three separate reaches:

- A to C as marked on Figure 1 and Figure 2;
- B to C as marked on Figure 1 and Figure 2; and
- C to D as marked on Figure 1 and Figure 2.



Figure 1 - Hydrolines from NSW Government online spatial portal. Site boundary is shown in yellow. Existing features and key locations are marked.

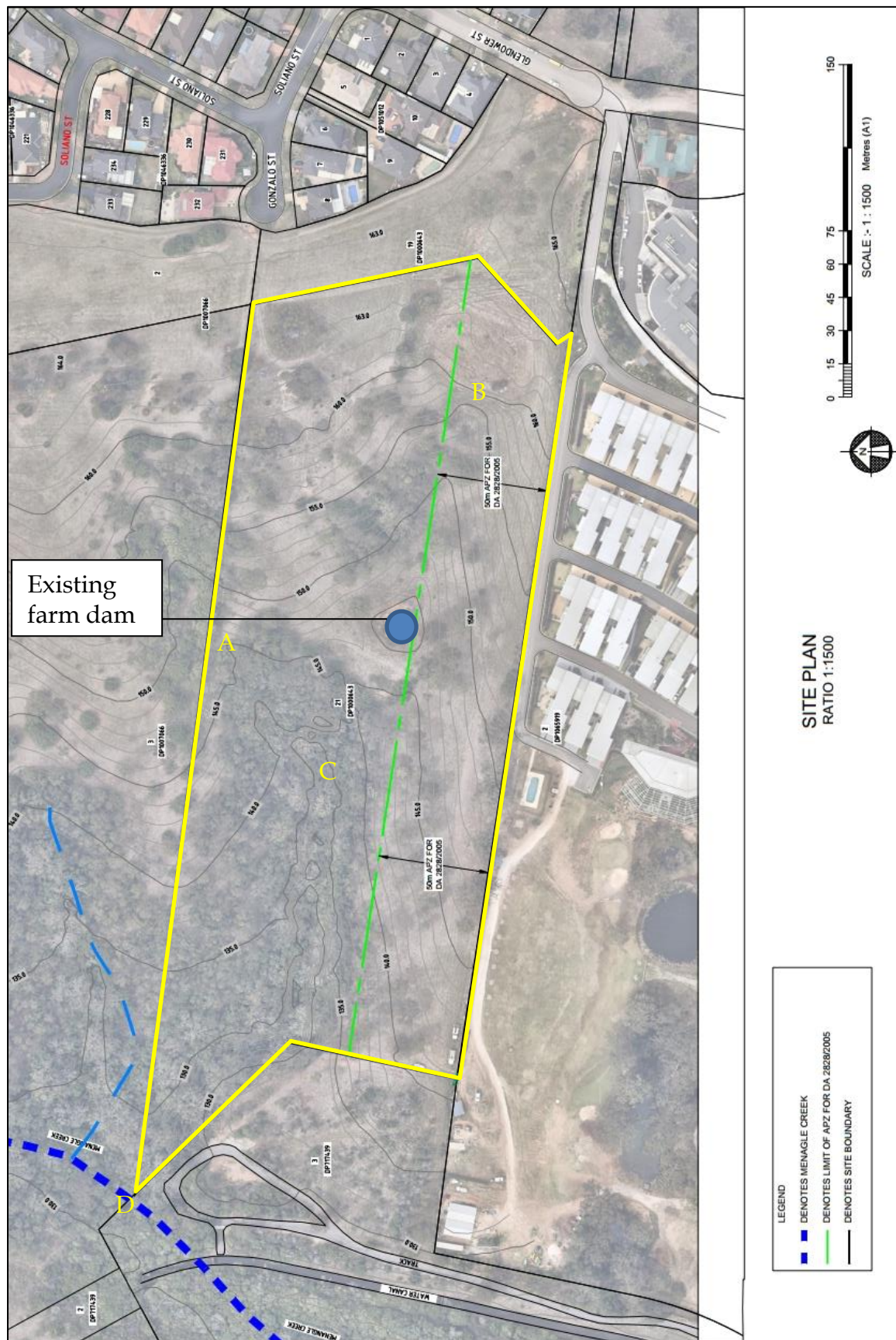


Figure 2 - Site plan, boundary and contours (provided by John M Daly & Associates).
Existing features and key locations are marked

2.2 Fluvial Assessment

Table 1 contains a summary of the three reaches of the drainage features, as marked on Figure 1 and Figure 2. Included in Table 1 is an assessment of the fluvial geomorphological characteristics of each reach. Note that Menangle Creek is a named watercourse and is excluded from the assessment in Table 1.

Table 1 – Assessment of Fluvial Features.

Parameters	A to C	B to C	C to D
Description	Drainage depression, partly gullied.	Drainage depression. Farm dam at the location shown in Figure 1 and Figure 2. Gully erosion in section between the dam and Point C.	Drainage line. Deeply incised with obvious gully erosion. Steep-sided, V-shaped valley.
Stream Order*	1	1	2
Photo(s) of typical conditions			
			
			
Soil Landscape	Blacktown Soil Landscape (undulating low hills on Wianamatta Group shales)	Blacktown Soil Landscape (undulating low hills on Wianamatta Group shales)	Luddenham Soil Landscape (rolling hills on Wianamatta Group shales)

Parameters	A to C	B to C	C to D
Fluvial geomorphology	No channel development. No stream bed or banks. No pool/riffle sequence within the drainage depression. No evidence of sedimentation. Erosional feature only.	No channel development. No stream bed or banks. No pool/riffle sequence within the drainage depression. No evidence of sedimentation, other than in the farm dam. Erosional feature only.	Minor channel development is evident, with shallow (less than 200mm) outer bend channels. Little or no evidence of channel braids. No depositional stream banks. Near-level bed with variable width, average 2m wide. Evidence of deposition to form the stream bed. Occasional shallow pools evident although with little or no alluvial deposition. Sedimentation of coarse fragments within and adjacent to the primary flow channel to form part of the stream bed. Bedrock exposed only from gully erosion, not as part of a residual stream feature.
Assessment	This is not a watercourse because it lacks fluvial features. There is no defined channel, no stream bed, and no defined stream banks. This is a depression only, and has been scoured as a result of modified runoff patterns (primarily from urbanisation and land clearing upslope).	This is not a watercourse because it lacks fluvial features. There is no defined channel, no stream bed, and no defined stream banks. This is a depression only. The reach downslope of the farm dam has scoured as a result of overflows from the dam, which only occur during prolonged heavy rainfall.	First order stream. Basic fluvial features are evident such as a depositional stream bed, occasional shallow pools and a defined channel.

* (Based on Strahler System and NSW Government (2020) Hydrolines portal.

3 NRAR ASSESSMENT TOOL

The NSW Natural Resources Access Regulator (NRAR) is part of the NSW Department of Planning, Industry and Environment (DPIE). The NRAR has developed a Waterfront Land Tool (NRAR, 2020) to “help applicants to determine what is waterfront land under the controlled activity provisions of the Water Management Act 2000.”

Table 2 provides a summary of the assessment of each reach of the drainage features based on the NRAR (2020) tool.

Table 2 – Results of assessment using NRAR waterfront land tool.

Question No.	Parameter	A to C	B to C	C to D
1	Is the location exempt from Controlled Activity provisions?	No	No	No
2a	Is it a Blue Line on the Hydrolines portal?	Yes	Yes	Yes
3	What order stream is it	1	1	2
4a	Does it have a defined bed or banks?	No	No	Yes
4b	What type of watercourse is it?	N/A	N/A	Type 1 – confined valley headwater
5a and 5c	Watercourse features present?	No	No	Yes
5b	What features?	N/A	N/A	Pools, erosion and deposition
8	Locate the high bank for the type of watercourse	N/A	N/A	Type 1 – confined valley headwater
9	Works within 40m of high bank?	N/A	N/A	Yes
12 and 14	Controlled activity approval applies?	No, not a watercourse	No, not a watercourse	Yes, controlled activity approval is required.

4 CONCLUSION

Table 1 contains a summary of the assessment of fluvial geomorphology in drainage features at Lot 21 DP 1000643, Gilead.

We have determined that there are no fluvial features in two of the mapped sections marked as “blue lines” from the NSW Government (2020) Hydrolines portal, and so these are not “watercourses” as understood by a fluvial geomorphologist .

As noted in Section 3, works within the sections from A to C and B to C (Figure 1) do not require a Controlled Activity Approval.

5 REFERENCES

Landcom (2004). *Managing Urban Stormwater: Soils and Construction*. Volume 1. NSW Government, Sydney.

NSW Government (2020). Water Management (General) Regulation 2018 hydroline spatial data 1.0. Accessed at:
<https://trade.maps.arcgis.com/apps/webappviewer/index.html?id=07b967fd0bdc4b0099fc5be45b6d1392>

Natural Resources Access Regulator (NRAR) (2020). Waterfront land tool (PDF version). May 2020.

OEH NSW Government eSpade web portal. www.espade.environment.nsw.gov.au

6 APPENDICES

6.1 CV for Andrew Macleod



Andrew Macleod

B.Sc (Hons.) CPSS CPESC

Director and Principal Scientist



Andrew is an expert in all aspects of soil and water management. He is a recognised industry leader in construction-phase erosion and sediment control and conducts regular training, consulting and expert witness services in this field.

Andrew has worked on a wide range of sites including mines, gas projects, major infrastructure projects (road and rail), pipelines and subdivisions. He is also the current President of the International Erosion Control Association (IECA) in Australasia.

Andrew is a Director of SEEC and one of our Principal Environmental Scientists. He is a Certified Professional in Erosion and Sediment Control (CPESC) and a Certified Professional Soil Scientist (CPSS).

Qualifications

- Bachelor of Science (Applied Physical Geography) with Honours. UNSW (1999)
- Certified Professional in Erosion and Sediment Control (CPESC #3678)
- Director, International Erosion Control Association (IECA) Australasian Chapter 2011 to present
- Certified Professional Soil Scientist (CPSS # 1152)
- President, International Erosion Control Association (IECA) Australasian Chapter 2012 to 2018, and 2019 onwards
- Director, Bowral Cricket Club 2011 to 2019
- Member of the Australian Society of Soil Science Incorporated (ASSSI)
- Member of the International Erosion Control Association (IECA)

Awards

- Kevin Bennet Memorial award for the Best Paper: "MUSIC Calibration Based on Soil Conditions." Stormwater Industry Association (SIA) NSW and Qld Joint Annual Conference, 2008.
- Merit Commendation for Education or Innovation: SEEC Half-Day Erosion and Sediment Control Workshop, Stormwater Industry Association Awards, 2010.

Papers Presented

- "Working in and Around Watercourses – In-Stream Erosion and Sediment Control During Construction." IECA SIA Qld Joint Conference, Brisbane, 2017
- "50 Shade of Blue Book: Erosion and Sediment Control Compliance." IECA, SIA NSW, EA Joint Conference, Sydney, 2015
- "Watching the Grass Grow – A Field Study of Rehabilitation in Southern Queensland". IECA National Conference, Wellington, NZ 2014.
- "Erosion reductions using spray-on soil stabilisers." IECA National Conference, Gold Coast 2013, and IECA Environmental Connection Conference, Nashville, Tennessee, USA 2014.
- "CSG: Coal Seam Gas or Crops, Soils, Grasses. Lessons for Effective Rehabilitation on Gas Projects" IECA Mining Rehabilitation Conference, Hunter Valley 2013.

- “From Construction Phase to Completion: Sediment Pollution in Stormwater” SIA NSW and Vic Joint Annual Conference, Albury 2009.
- “MUSIC Calibration Based on Soil Conditions.” SIA NSW and Qld Joint Annual Conference, Gold Coast 2008.

Areas of Technical Expertise

- Construction site erosion and sediment control
- Water sensitive urban design
- Soil survey/soil landscape/land capability mapping
- Water quality modelling and surface water management
- Site rehabilitation and revegetation
- Research projects and field trials
- Dryland salinity (rural and urban)
- Fluvial and landscape geomorphology
- Onsite wastewater management
- Environmental impact assessment
- Presentation of seminars/workshops on soil and water management
- Water treatment, sediment and nutrient control

Short Courses/Workshops Completed

- WorkCover Occupational Health and Safety General Induction for Construction Work (CGI01253136SEQ1)
- Rail Industry Safety Induction Certificate (NSW Railcorp - No 0010052440)
- GIQ – Coal Industry Surface Induction. January 2013
- MUSIC Version 2 and 3 Training, CRC for Catchment Hydrology (now eWater). March 2004 and May 2005
- Arrow Energy Induction. January 2013
- Microsoft Access Database Management and Design Training. March 2001
- ESRI ArcGIS 8 Training. September 2003
- Air Photo Interpretation Course. November 2000
- Advanced driver training. December 2010
- 4WD Safe Operations. June 2001

Career Highlights

Director, SEEC; August 2007 to present.

- Staff, client and business management.
- Recruitment and training.
- Budgeting and project management.
- Expert advice on erosion and sediment control and soils.
- Expert advice on water cycle management and water quality modelling issues.
- Preparation and delivery of teaching programs on erosion and sediment control and soils.

Environmental Scientist, Morse McVey & Associates; Jan 2004 to Aug 2007.

- Preparation of soil and water management studies and reports.
- Preparation of water quality modelling and management plans.
- Preparation of erosion and sediment control plans.
- Teaching workshops on erosion and sediment control on construction sites.

Spatial Analyst, NSW Department of Infrastructure, Planning and Natural Resources; March 2003 to Jan 2004.

- Soil landscape mapping
- Map analysis and derivation using GIS
- Derivative map development
- Spatial database maintenance and development.

Soil Surveyor and Technical Officer, NSW Department of Land and Water Conservation; Feb 2000 to March 2003.

- Development and maintenance of soil landscape database
- Field soil survey and mapping
- Soil conservation and land management
- Interpretation of laboratory results.

Recent Projects

- Expert erosion and sediment control specialist for major projects including Hume Hwy Tarcutta (NSW), Bruce Highway C2CA3 (Qld), Gateway Upgrade (Qld), South-West Rail Link (NSW), Southern Sydney Freight Link (NSW), North-West Rail Link (NSW), WestConnex 1b, 2 and 3b (NSW), Sydney Metro 2 (NSW), Kingsford Smith Drive upgrade (Brisbane), Pacific Highway Woolgoolga to Ballina, Snowy 2.0.
- Wet-season ESCPs for Ichthys Project, Darwin, plus wet season NT EPA auditing and certification of contractor works for Ichthys Project, Darwin.
- Expert witness in the NSW Land and Environment Court on erosion and sediment control and water quality issues, numerous projects. For NSW
- Teaching comprehensive 4-day workshops about erosion and sediment control on construction sites. Recent workshops run over four days have been conducted in Sydney and Brisbane.
- Preparation of planning-phase erosion and sediment control plans for major projects including Batemans Bay Bridge, M1 Princes Highway, Newcastle Inner City Bypass, Lachlan Valley Way, The Northern Road.
- Preparation of Surface Water and Soils Assessments for Dargues Gold Mine near Braidwood, NSW. Expert witness in the NSW Land and Environment Court for same project.
- Pipeline erosion management, Goulburn and Oberon,

Department of Planning and Environment.

- Coordination of rehabilitation trials, Dalby Qld (Surat Basin). For Arrow Energy.
- Preparation of Surface and Ground Water Management Plans, Nowra Brickworks Quarry, Dargues Reef Gold Mine, Rocla Green Valley Quarry, Tomingley Gold Project.
- Erosion and sediment control management for MCJV Narrows, Gladstone Qld.
- Preparation of demonstration erosion and sediment control drawings for inclusion in Technical Guides, Sunshine Coast City Council (SE Queensland).
- Preparation and delivery of half and full-day workshops on best-practice erosion and sediment control throughout NSW and Qld. Recent clients include Camden Council, MidCoast Council, Wyong Council, Burton Contractors, Gympie Shire Council, Hunter Water, Leighton Contractors, Fulton Hogan, Gold Coast City Council, Downer EDI, Transport for NSW, Railcorp, Lake Macquarie City Council and Arrow Energy.
- Develop and prepare template deemed-compliance Erosion and Sediment Control Plans (ESCPs) for Arrow Energy gathering network, Surat and Bowen Basins, Qld and for Santos, NSW Pilliga Gas Exploration.
- Preparation and delivery of erosion and sediment control workshops on main road and rail projects. For the Centre for Environmental Training (CET).
- Expert advice regarding erosion and sediment control for Sydney rail projects including Glenfield to Leppington Rail Line, Southern Sydney Freight Link, Glenfield Transport Interchange, North-west Rail Link, North Strathfield Rail Underpass.
- Expert advice and planning for soil and water management - proposed downhill mountain bike track, Hassans Walls (Lithgow).
- Pre-tender and design assessment of construction-phase soil and water management issues; proposed Nelligen Bridge, NSW, Bega Bypass, NSW, Burrill Lake Bridge, NSW, Kapooka Bridge realignment, Wagga Wagga, NSW, Batemans Bay Bridge, NSW.
- Review of river diversion geomorphology and stability, major zinc and lead mine, NT, Australia.
- Auditing of erosion and sediment controls, Bruce Highway C2C-C and Mackay Ring Road, Qld.

NSW (APA Group) and Moranbah (Arrow Energy).

- Preparation of Technical Guidance Manual for cross-formation drainage and erosion and sediment control during major road construction (for NSW RTA).
- Prepare and deliver toolbox training sessions for contractors on the commuter carparks program, Sydney Greater Metropolitan area; TfNSW.
- Preparation of numerous Water Cycle Management Studies and Surface Water Management Plans for various projects including:
 - Rural residential subdivision, Goulburn
 - Golf resort, Darkes Forest
 - Quarry and mine developments, Southern Highlands and Central West.
- Coordination of field trials of soil stabilisers to determine erosion reductions under rainfall, Toowoomba, Qld and Picton, NSW.
- Soil surveys to identify development constraints and opportunities for proposed bypass road, Orange.
- Fluvial geomorphology assessment of parts of the Nepean and Georges Rivers for proposed Sewage Treatment Plant discharge points (Sydney Water).
- Preparation of Onsite Wastewater Management Studies for numerous rural and rural residential developments; Southern Highlands, Hunter, Blue Mountains etc. Also for a commercial and tourist development at Darkes Forest, NSW.
- Preparation of Construction-phase Soil and Water Management Plans for various developments including:
 - Residential and industrial subdivisions, Southern Highlands
 - M4 Smart Motorways, Sydney
 - North-West Rail Link, Sydney.
- Assessment of water sensitive urban design principles for proposed redevelopment of Lawson Town Centre in the Blue Mountains.
- Preparation of water cycle modelling templates and input data for MUSIC modelling. Direct appointment tenders by the Sydney Catchment Authority (SCA).

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