



Job No: 8866/1
Our Ref: 8866/1-AA
8 November 2018

Mirvac Homes Pty Ltd
c/- Calibre Group
P O Box 8300
BAULKHAM HILLS BC NSW 2153

Attention: Ms N Franklin

Dear Madam

re: **Proposed Residential Subdivision – Stages 1 to 4
Menangle Road & Station Street, Menangle
Desktop Study – Geotechnical and Salinity Assessment**

This report presents the results of a desktop study for preliminary advice in relation to the site earthworks, salinity assessment, expected bedrock profile, preliminary pavement design and site fill specifications including compaction requirements.

The following reports were provided for this study:

- Report Ref: 272584Zrpt, dated 7 May 2014, prepared by JK Geotechnics (JK)
- Report Ref: E27284kBrpt, dated 13 May 2014, prepared by Environmental Investigation Services

Proposed Development

We understand that the proposed development of the site will include construction of internal roads, underground services, basins, swales, culvert and formation of lots for residential construction. Also the following external roads will be constructed:

- Menangle Road
- Steven Road
- Moreton Park Road
- Roundabout at the intersection of Station Street, Menangle Road & Woodbridge Road

Based on the information provided the earthworks area for Stage 1 is about 105,540m² and for Stage 2-4 is about 286,430m². Plan showing the outline of the proposed development are shown in the attached Drawing No 14305/1-AA1.

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Regional Geology

Review of the Geological map (1:100,000) of Wollongong & Port Hacking indicates the following:

The eastern and northern portions of Stage 1 are underlain by Quaternary deposits (Qal) comprising quartz and lithic "fluvial" sand, silt and clay. The remaining portion of Stage 1 is underlain by Ashfield Shale, belonging to the Wianamatta Group of rocks and comprising dark grey to black shale and laminite.

The northern most portion of Stage 2 is underlain by Quaternary deposits (Qal) comprising quartz and lithic "fluvial" sand, silt and clay. The remaining portion of Stage 2 to 4 are underlain by Hawkesbury sandstone, comprising medium to coarse grained quartz sandstone, very minor shale and laminite lenses.

The Soil Landscape map (1:100,000) of Wollongong & Port Hacking indicates that Stage 1 belongs to the fluvial landscape of Theresa Group and Stage 2 to 4 to the residual landscape of the Blacktown Group.

The Theresa Group is a Tertiary and Quaternary flood plain and terraces of the Nepean River south of Cobbitty Creek. This group is characterised by gently undulating slopes (<5%), almost completely cleared, low open woodland, with grass. Soils in this landscape are highly variable and include poorly structured orange to red silty loams, brown loams and sandy loams. Soil limitations include localised flooding, seasonal waterlogging, and very high soil erosion hazard for concentrated flows.

The Blacktown Group is characterised with gently undulating rises on Wianamatta Group Shales, with local relief to 30m, ground slope of less than 5%, broad rounded crests and gently inclined slopes. The sub-surface soil within this landscape is likely to be up to 3m thick, moderately reactive, high plasticity and with poor drainage.

Review of the Salinity Potential in Western Sydney (2002) map prepared by the Department of Infrastructure and Natural Resources (DINR) indicated generally moderate to low salinity potential. A small area to the north of Stage 1 has a high salinity potential.

Site Conditions

Based on the inspections carried out by our environmental engineer the site conditions are described below:

Stage 1

- At the time of site inspection (October 2018) the site was being used for grazing of cows. The site was accessed from Station Street to the south of the site and west of the railway line.
- A bitumen road diverted north off Station Street.
- The access gate was on the eastern portion of the cow pasture and a gravel driveway was at the entrance. The gravel driveway transitioned into a concrete driveway.
- A timber clad building with GI roof near the eastern boundary of the site.
- Scrap timber, oil drums, and car wheels with tyres were identified.
- A dilapidated Galvanised Iron (GI) shed was also identified near to the eastern cow pasture entrance, and a second GI shed was close by with an above ground storage tank (AST) within the vicinity.

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- Multiple concrete troughs along the concrete driveway.
- Uneven ground surface near the driveway and within the eastern vicinity.
- Depression/embankment drainage area with possible fill material in centre of site with likely flow from south to north.
- Concrete water trough near the western portion of the site.
- Monitoring well near the western boundary.
- Fill area creating what appears to be a level driveway for the cow pasture from Menangle Road.
- Clad fibro building with GI Roof close to the western boundary.
- Dilapidated GI structure near the dwelling with scrap metal and car tyres surrounding the structure.
- Uneven ground surface indicating fill area on the north western corner of the site.
- A dam occupied the northern most point of the site.
- A depression with associated embankment extended along the north eastern boundary.
- In general the site sloped towards the north.

Stage 2-4

- At the time of the site inspection (October 2018) the site was being used as a cow pasture. The site was accessed from two gates at the end of Station Street, and east of the railway line, which marks the centre point of the site. One gate was on the north side of Station Street, and the other to the south east of the streets end point.

Area to the north of Station Street

- Two gravel driveways in the site extending to the north, one of which forks to form an additional gravel driveway extending to the north east.
- Power lines were identified extending to north.
- A small stockpile near north site of the site entrance.
- A drainage area with associated embankment within the central northern portion of the paddock.
- A concrete structure was found at the northern point of the site.
- A fill area was found at the northern portion of the paddock.
- A pile of power poles was found on the northern portion of the paddock along the western site boundary.
- An embankment that may contain fill material was located northern portion of the paddock to along the western site boundary.
- A depression area and associated embankment was found on the North western boundary of the site.
- An embankment for a drainage area was found at the central northern portion of the paddock, a rusted steel pipe was found in the drainage area.
- Some scrap metal and a concrete water trough was found on the central northern portion of the site.

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- On the eastern corner of the site (within the northern paddock), footprints of previous buildings were made evident by the presence of fill material and concrete exposed on the ground surface.
- Adjoining the building footprints to the west was a GI/ fibro stable, and a timber clad building with GI roof, and a brick/ fibro house with GI roof.
- Mixed waste including general domestic waste, PVC pipes, used car batteries, oil/petrol drums, herbicide drums, fibro cement pipe sections and chlorine drums were observed surrounding the western frontage of the brick/fibro house.
- Three dilapidated GI sheds founded over bare ground were identified to the west of the brick/ fibro building.
- Scrap metal, an irrigation machine, and chemical drums were found near the dilapidated GI sheds.
- A steel/ timber fenced animal enclosure was found north of the dilapidated GI sheds.
- A large dilapidated Galvanized iron shed was found on the eastern boundary. It was observed it was founded over bare ground and within some car tires, oil drums, machinery, pile of fabric waste, pile of sawdust, shipping container, and large bag of granulox (heavy metal content disclosed on bag).
- In general, this portion of the site slopes towards the north and north east.

Area to the south east of Station Street

- This portion of the site was accessed via a cattle grid on the south eastern corner of Station Street.
- Directly south of the site entry was a timber clad/ brick dwelling with a GI roof.
- Directly east of the site entry was a fill area with plastic bags that appeared to contain straw and decomposed organic matter.
- Numerous stockpiles were identified to the south east of the site entry, most appeared to consist of clay or sand material composition. One stockpile appeared to contain waste concrete and demolition waste.
- Other site features found within the south western portion of the site were a dam area and concrete water troughs and a concrete structure with surrounding scattered scrap metal and timber.
- On the eastern portion of the site some scattered seeds mixed with sawdust, an obvious fill area, a concrete structure with surrounding GI sheets, scrap timber and some fill material.
- In general, the site sloped towards the central portion of the site where a creek flowed towards the north.

Subsurface Conditions

JK Geotechnics drilled fifteen (15) boreholes to depths ranging from 2m to 6m, using a drilling rig. The boreholes generally encountered 100mm to 200mm thick topsoil/fill, overlying natural silty clays extending to depths ranging from 0.4m to 2.1m, overlying shale/sandstone bedrock. The natural clayey soils were found to be of medium to high plasticity. Bedrock was initially found to be extremely weathered grading to slightly weathered with depth and medium strength grading to high strength with depth.

Groundwater measured at the completion of drilling was not encountered to the terminated depths of the boreholes. However, some seepage water was encountered in the installed piezometers at depths of 2.4m to 4.6m below existing ground levels.

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Discussions & Recommendations

Geotechnical Model

Based on the subsurface conditions encountered in the boreholes and considering the geology of the area the following preliminary geotechnical model is developed.

Depth Range	Material Description
0.0 to 0.2m	Topsoil
0.2 – 1.5m	Natural clayey soils
>1.5m	Shale/Sandstone bedrock.

It should be noted that deeper clayey soils are likely to be encountered in the eastern portion of Stage 1 where the site is underlain by alluvium.

Considering the geology of the area we do not expect that groundwater will be encountered at shallow depths. However, some seepage should be expected at the interface of overburden soils and bedrock.

Fill

We expect that fill will be encountered at the site. The fill is likely to be encountered near the existing structures. Fill is likely to be uncontrolled and might be required to be removed and replaced with controlled fill.

Site Preparation

The following procedures are recommended for placement of controlled fill:

- Strip existing topsoil and stockpile separately for possible future use. Topsoil can be used for landscaping purposes.
- Excavate and remove existing fill, if encountered.
- Undertake proof rolling (using an 8 to 10 tonnes roller) of the exposed natural soils to detect potentially weak spots (ground heave). Excavate areas of localised heaving to a depth of about 300mm and replace with granular fill, compacted as described below.
- Undertake proof rolling of soft spots backfilled with granular fill, as described above. If the backfilled area shows movement during proof rolling, this office should be contacted for further recommendations.
- Place suitable fill in horizontal layers of 200mm to 250mm maximum loose thickness (depending on the size of equipment) and compacted to a Minimum Density Ratio (MDR) of 98% Standard, at moisture content within 2% of Optimum Moisture Content (OMC). The top 300mm of fill forming the pavement subgrade should be compacted to at least 100% Standard.
- Controlled fill should preferably comprise non-reactive fill (e.g. crushed sandstone) with a maximum particle size not exceeding 75mm, or low plasticity clay. Natural soils and bedrock obtained from excavations within the site may be used in controlled fill after removal of unsuitable materials, if any, crushing to sizes finer than 75mm, proper mixing and moisture conditioning.

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- Fill placement should be supervised to ensure that material quality, layer thickness, testing frequency and compaction criteria conform to the specifications. We recommend "Level 1" or better supervision, in accordance with AS3798. It should be noted that a Geotechnical Inspection and Testing Authority will generally provide certification on the quality of entire compacted fill only if Level 1 supervision and testing is carried out.

Excavation Condition

We consider that overburden soils (topsoil, fill and natural soils) and very low to low strength shale/sandstone bedrock could be excavated using conventional earthmoving equipment such as excavators and dozers. Based on our boreholes drilled by JK Geotechnics, we expect that low to medium strength bedrock is likely to extend to varying depths ranging from 1.5m to 3m. For excavation in low to medium strength bedrock a 25 tonne excavator with tiger teeth bucket may be required. Excavation in medium to high strength shale bedrock (possibly at depths greater than 8m) will require larger equipment such as Caterpillar D9 or D10 (or equivalent) attached with rippers or rock hammer or saw cutter.

Salinity Assessment

Based on the available mapping and field observations, the following salinity comments are given:

- The topsoil and natural soils up to 1m is likely to non-saline to slightly saline and below 1m the soils could be slightly to moderately saline. Pockets of highly saline conditions should also be expected.
- The soils are expected to be non-aggressive to iron/steel and low aggressive to concrete.
- The soils across the site could be sodic and susceptible to erosion.
- Therefore, the salinity of the site will not impose limitations on the use of soils obtained from excavations within the site in construction of building platforms and road subgrade. However, as the soils are susceptible to erosion, it is recommended to implement a Soil & Water Management Plan.
- It is also our opinion that the site is suitable for residential development.

Pavement Thickness Design

Depending on cut and fill depths, the pavement subgrade for various sections of the proposed roads is likely to consists of either natural clays or controlled clayey fill or shale/sandstone bedrock. Based on our previous experiences the expected subgrade CBR values for the above subgrade conditions are likely to be as below:

Subgrade Condition	Design CBR
Natural clays / controlled clayey fill	3%
Sandstone/shale bedrock	6%

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Site Classification

It is our assessment that the site is suitable for construction of residential buildings after completion of site preparation works.

At completion of site preparation (cut and fill) for the proposed development works, when building platforms and footing subgrade are ready for construction of residences, sub-surface profiles within the residential lots are anticipated to comprise either of the following:

- Controlled fill overlying, natural clays overlying shale/sandstone bedrock; or
- Natural clays overlying shale/sandstone bedrock.

The magnitude of ground surface movement due to moisture variation, which is required for site classification, depends on shrink-swell index values and thickness of soils underlying a building slab. Based on the results of the investigation, natural clayey soils are generally medium to high plasticity. Hence, the natural soils and controlled fill are likely to be moderately to highly reactive. Shale bedrock would generally be non-reactive to slightly reactive.

Based on type of clayey soils encountered at the site, site classifications for future residential lots across the site are expected to be Class "M" (Moderately reactive) or "H1/H2" (Highly reactive), in accordance with AS2870-2011 (Residential Slabs and Footings).

Mine Subsidence

The Mine Subsidence District (MSD) map prepared by Subsidence Advisory NSW (NSW Government) indicates that the site falls within South Campbelltown Mine Subsidence District. However, the map does not show locations of underground mines. As per the website of Subsidence Advisory NSW any development falling within MSD must lodge a DA and obtain approval prior to starting work.

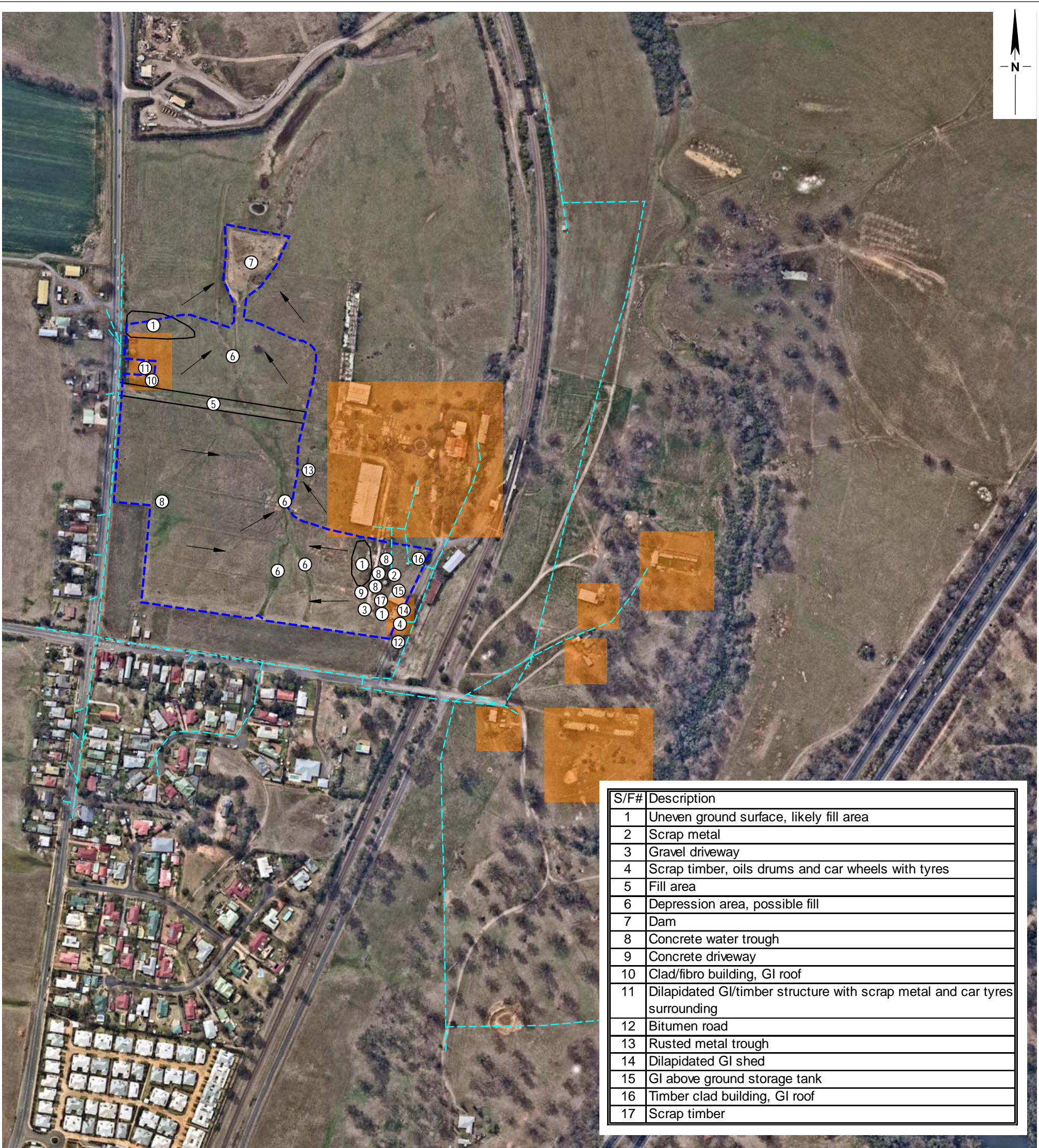
If you have any questions please do not hesitate to contact us.

Yours faithfully
GEOTECHNIQUE PTY LTD








ZIAUDDIN AHMED
Associate Geotechnical Engineer

Attached: Drawing 14305/1-AA1 Site Features (Stage 1)
 Drawing 14305/2-AA1 Site Features (Stage 2 to 4)



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LEGEND

-  Area of Environmental Concern
(as identified by EIS Report Ref: E27284KBrpt dated 13 May 2014)
-  Slope
-  Power Line
-  Site Feature Number
-  Approximate Extent of Bulk Earthworks

0 50 100 150 200 250m
Scale 1:5000



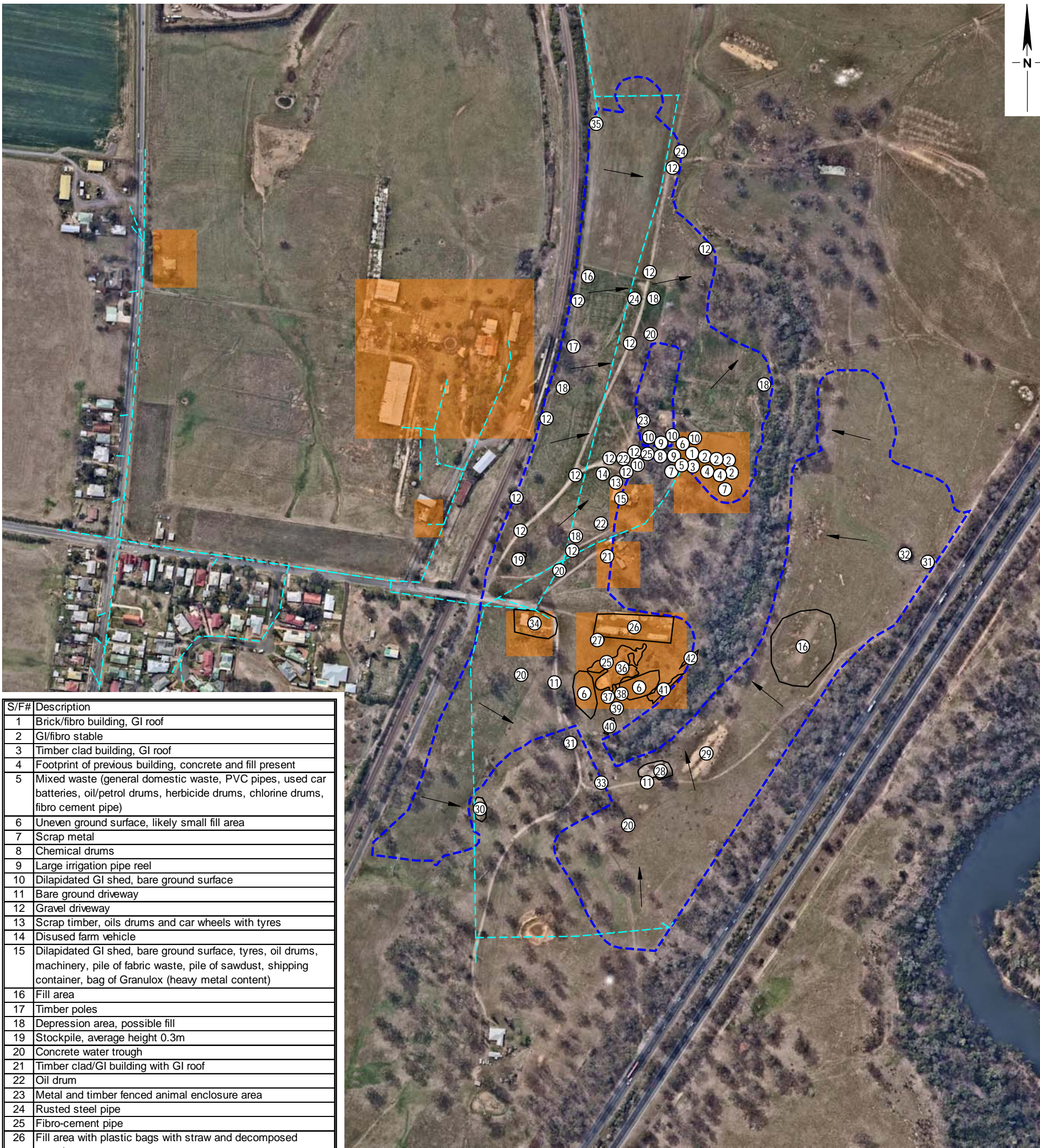
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Station Street
Menangle

Site Features - Stage 1

Drawing No: 14305/1-AA1
Job No: 14305/1
Drawn By: MH
Date: 6 November 2018
Checked By: JH/AB

File Ref: 14305-1
Layers: 0, AA1



Imagery ©2018 NearMap.com

S/F#	Description
1	Brick/fibro building, GI roof
2	GI/fibro stable
3	Timber clad building, GI roof
4	Footprint of previous building, concrete and fill present
5	Mixed waste (general domestic waste, PVC pipes, used car batteries, oil/petrol drums, herbicide drums, chlorine drums, fibro cement pipe)
6	Uneven ground surface, likely small fill area
7	Scrap metal
8	Chemical drums
9	Large irrigation pipe reel
10	Dilapidated GI shed, bare ground surface
11	Bare ground driveway
12	Gravel driveway
13	Scrap timber, oils drums and car wheels with tyres
14	Disused farm vehicle
15	Dilapidated GI shed, bare ground surface, tyres, oil drums, machinery, pile of fabric waste, pile of sawdust, shipping container, bag of Granulox (heavy metal content)
16	Fill area
17	Timber poles
18	Depression area, possible fill
19	Stockpile, average height 0.3m
20	Concrete water trough
21	Timber clad/GI building with GI roof
22	Oil drum
23	Metal and timber fenced animal enclosure area
24	Rusted steel pipe
25	Fibro-cement pipe
26	Fill area with plastic bags with straw and decomposed organic matter
27	Stockpile of building rubble, average height 1.2m
28	Soil stockpile, average height 2.5m
29	Grain with sawdust
30	Dam
31	Concrete structure, scattered GI and timber and fill area
32	GI structure and scattered GI with timber supports
33	Scrap timber and tree branches
34	Timber clad with GI roof structure, brick chimney shed, GI and timber surrounding
35	Concrete structure
36	Soil stockpile, average height 0.6m
37	Soil stockpile, average height 0.3m
38	Soil stockpile, average height 0.3m
39	Soil stockpile, average height 0.4m
40	Soil stockpile, average height 0.3m
41	Soil stockpile, average height 0.4m
42	Soil stockpile, average height 0.4m

LEGEND

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(as identified by EIS Report Ref: E27284KBrpt dated 13 May 2014)
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