gy	GYMEA	Erosional

Landscape—undulating to rolling rises and low hills on Hawkesbury Sandstone. Local relief 20–80 m, slopes 10–25%. Rock outcrop <25%. Broad convex crests, moderately inclined side slopes with wide benches, localised rock outcrop on low broken scarps. Extensively cleared open forest (dry sclerophyll forest) and eucalypt woodland.

Soils—shallow to moderately deep (30–100 cm) yellow earths (Gn2.24) and earthy sands (Uc5.11, Uc5.2) on crests and insides of benches; shallow (<20 cm) siliceous sands (Uc1.21) on leading edges of benches; localised gleyed podzolic soils (Dg4.21) and yellow podzolic soils (Dy4.11, Dy5.11, Dy5.41) on shale lenses; shallow to moderately deep (<l00 cm) siliceous sands (Uc1.2) and leached sands (Uc2.21) along drainage lines.

Limitations—steep slopes, water erosion hazard, rock outcrop, localised rockfall hazard, localised non-cohesive soils, shallow highly permeable soil, very low soil fertility.

LOCATION

Occurs extensively throughout the Blue Mountains Plateau (e.g., Red Hand Cave at Glenbrook) and on the Woronora Plateau (e.g., Deadmans Creek).

LANDSCAPE

Geology

Hawkesbury Sandstone which is a medium to coarse-grained quartz sandstone with minor shale and laminite lenses.

Topography

Undulating to rolling low hills with local relief 20–80 m and slopes of 10–25%. Side slopes with narrow to wide outcropping sandstone rock benches (10–100 m), often forming broken scarps of <5 m.

Vegetation

Dry sclerophyll woodland and open-forest predominate. Common species include *Eucalyptus gummifera* (red bloodwood), *E. eximia* (yellow bloodwood), *E. haemastoma* (scribbly gum), *E. capitellata* (brown stringybark), *E. fibrosa* (broad-leaved ironbark), *E. agglomerata* (blue-leaved stringybark) and *Banksia serrata* (old man banksia).

On the more sheltered slopes, *E. sieberi* (black ash), *E. piperita* (Sydney peppermint) and *Angophora costata* (smooth-barked apple) are common tree species. The dry sclerophyll understorey consists of shrubs from the families Epacridaceae, Myrtaceae, Fabaceae and Proteaceae, as well as *Acacia* spp. and *Casuarina* spp.

Landuse

Mostly uncleared bushland reserved as National Park (e.g., Blue Mountains National Park). Urban development occurs on the lower Woronora Plateau.

Existing Erosion

Severe sheet erosion occurs following bushfires which destroy or damage stabilising vegetative cover. Minor gully erosion occurs along unpaved or poorly maintained roads and fire trails especially those frequented by four wheel drive vehicles and trail bikes.

Associated Soil Landscapes

This soil landscape includes small areas (<40 ha) of Hawkesbury (**ha**) soil landscape which has many qualities in common with the Gymea soil landscape. Woodlands (**wl**) soil landscape is also associated with Gymea soil landscape.

SOILS

Dominant Soil Materials

gy1—Loose, coarse sandy loam.

This is a loamy sand to sandy loam with loose, apedal single grained structure and porous sandy fabric. It occurs as topsoil (A1 horizon).

The colour often becomes lighter with depth and ranges from dull yellowish brown (10YR 5/3), when organic matter is present,to brown (10YR 4/4). It is often water repellent under native vegetation. The pH varies from strongly acid (pH 4.5) to slightly acid (pH 6.0). Small sandstone and platy ironstone fragments, charcoal fragments and roots are common.

gy2—Earthy, yellowish brown clayey sand.

This is commonly a yellowish brown clayey sand with apedal massive structure and porous earthy fabric. It generally occurs as subsoil over sandstone bedrock (B horizon). Where it is exposed at the surface it forms a hardsetting topsoil.

Texture may increase gradually to a light sandy clay loam with depth. Colour is yellowish brown (10YR 6/8) and red and orange mottles are occasionally present with depth. The pH varies from strongly acid (pH 4.0) to slightly acid (pH 6.5). Sandstone and ironstone fragments (60–200 mm) are common and are often concentrated in stone lines in the upper parts of this material. Charcoal fragments are common whilst roots are rare.

gy3—Earthy, yellowish sandy clay.

This is a yellowish sandy clay with apedal massive structure and porous earthy fabric. It occurs as subsoil (B or C horizon) over coarse sandstone.

Occasionally weak subangular blocky porous peds are present. These range in size from 5–20 mm. Colour is brownish yellow (10YR 6/8). Red and orange mottles may occur with depth. The pH varies from strongly

acid (pH 4.0) to slightly acid (pH 6.5). Strongly weathered sandstone fragments are common. Roots and charcoal fragments are rare.

gy4—Strongly pedal, yellowish brown clay.

This is a yellowish brown sandy clay to medium clay material, with a strongly pedal structure and either smooth or rough-faced ped fabric. It occurs as subsoil on shale bedrock (B and C horizons).

Texture ranges from sandy clay to medium clay with 5–50 mm subangular-angular blocky peds. Structure is occasionally moderate. Peds range in size from 5–50 mm, and are subangular blocky. Colour is bright yellowish brown (10YR 6/6) but can vary from dark reddish brown (2.5YR 3/6) to light grey (7.5YR 8/1). Red, orange and grey mottles are occasionally present at depth. The pH varies from strongly acid (pH 4.0) to slightly acid (pH 6.0). Shale and ironstone fragments (6–20 mm) are often present but charcoal fragments are absent and roots are rare.

Associated Soil Materials

Litter and decomposing organic debris.

In areas of natural bushland, litter and organic debris occur on the soil surface.The litter layer can be developed to depths of up to 10 cm. Charcoal fragments are common. This material is often found in debris dams in association with white, loose quartz sand.

White, loose quartz sand.

A surface wash of quartz sand grains occurs in depositional areas such as behind small debris dams and on fans on breaks of slope. It is often mixed with the litter layer and is usually water repellent.

Occurrence and Relationships

Crests. Generally up to 30 cm of loose, quartz sandy loam (**gy1**) overlies bedrock [siliceous sands and lithosols (Uc1.21)] or <30 cm of earthy,yellowish brown clayey sand (**gy2**) [earthy sands (Uc5.11)]. Occasionally **gy2** overlies up to 30cm of yellow earthy weakly pedal sandy clay loam (**gy3**) [yellow earths (Gn2.24). Boundaries between soil materials are gradual. Total soil depth is <50 cm.

Where severe erosion has occurred **gy2** or **gy3** is often exposed as a hardsetting layer at the surface. Bedrock is exposed in some areas, particularly where bushfires are frequent.

Sideslopes. The soils on the sideslopes are discontinuous and rock outcrop may cover up to 25% of the ground surface. On the outside of benches and areas close to rock outcrop, up to 20 cm of **gy1** overlies bedrock [silicious sands/lithosols (Uc1.21)].On the inside of benches up to 30 cm of **gy1** overlies 10–30 cm of **gy2**. Occasionally **gy2** overlies up to 30 cm of **gy3** [yellow earths (Gn2.24), earthy sands (Uc5.11)]. The boundaries between soil materials are gradual. Total soil depth is 30–70 cm.

Shale lenses. Where shale lenses occur on the inside of benches, up to 30cm of **gy1** overlies up to 100 cm of strongly pedal yellowish-brown clay (**gy4**) [gleyed podzolic soils (Dg4.21), yellow podzolic soils (Dy5.41)]. The boundary between soil materials is sharp to clear Total soil depth is <100 cm.

Drainage lines. Up to 100 cm of **gy1** overlies bedrock [siliceous sands (Uc1.2) and leached sands (Uc2.21)].

LIMITATIONS TO DEVELOPMENT

Soil Limitations

gy1 High permeability
Stoniness
Low fertility
Very strongly acid
Very high aluminium toxicity

gy2 Low available water capacity
Stoniness
Very low fertility
Very strongly acid

gy3 Stoniness (localised)
Very low fertility
Very strongly acid

gy4 Low permeability
Stoniness (localised)
Very low fertility
Very strongly acid
High erodibility

Fertility

Very low. The soils of this unit are generally shallow, stony, very strongly acid and highly permeable with low available water capacities. They also have a low to very low nutrient status with very low phosphorus and nitrogen levels and very low CEC.

Erodibility

gy1 and **gy2** are composed of coarse sand grains and have very low erodibilities as they are freely drained and are held together by high organic matter contents (**gy1**) and/or nondispersive clays (**gy2**). However, **gy3** is moderately erodible as it has a weakly coherent earthy fabric with low organic matter content. **gy4** is highly erodible as it is very low in organic matter and consists predominantly of fine sands in a clay matrix.

Erosion Hazard

The erosion hazard for non-concentrated flows is generally high to very high but can range from moderate to extreme. Calculated soil loss for the first twelve months of development ranges up to 19 t/ha for topsoil and 464 t/ha for subsoil. Soil erosion hazard for concentrated flows is high to extreme.

Surface Movement Potential

The shallow sandy soils are stable to lightly reactive. In isolated instances where **gy4** is >100 cm thick soils may be moderately reactive.

Landscape Limitations

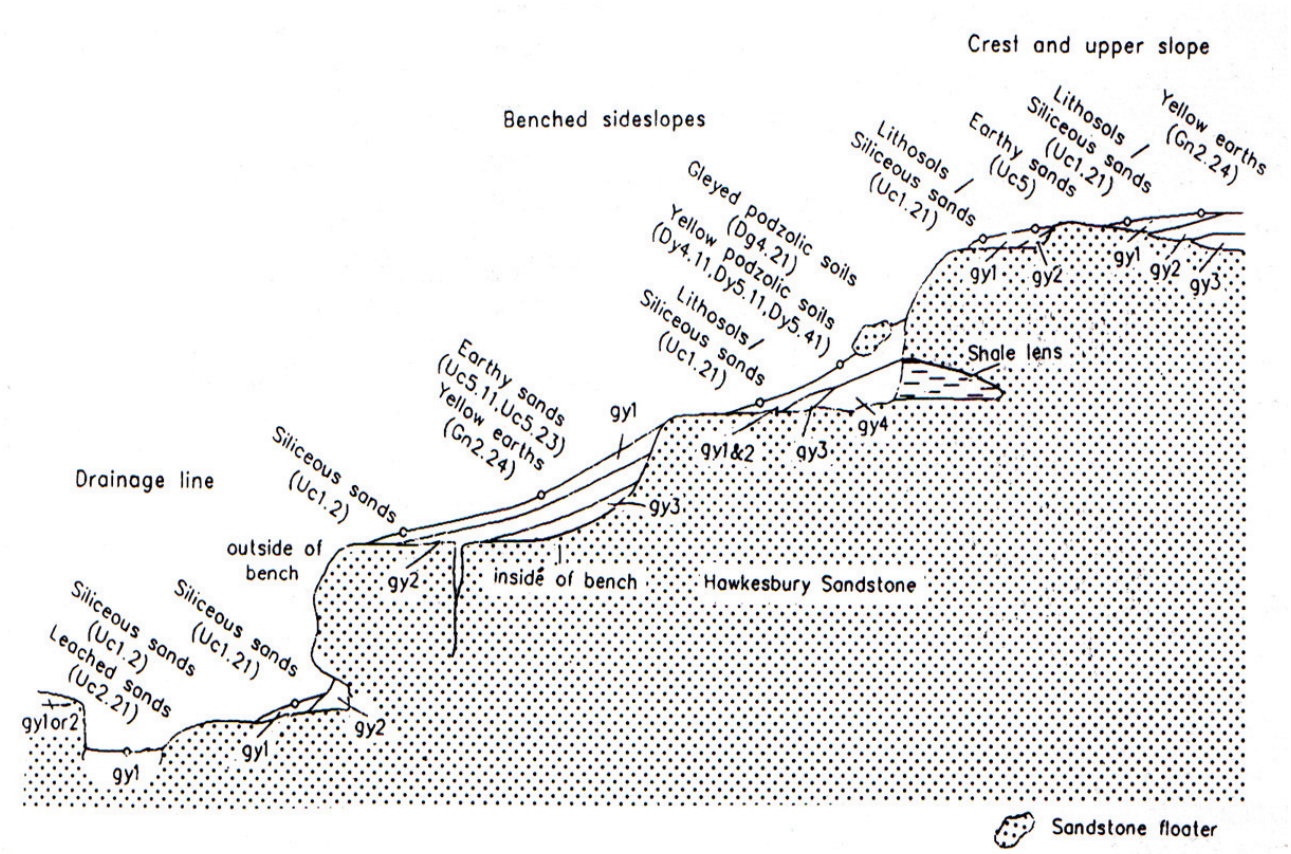
Steep slopes, water erosion hazard, shallow soils, rock outcrop, rockfall hazard (localised), non-cohesive soils (localised).

Urban Capability

Generally, low to moderate capability for urban development.

Rural Capability

Land not capable of being grazed or cultivated.



Distribution diagram of the Gymea soil landscape showing the occurrence and relationship of dominant soil materials.

Landscape—rugged, rolling to very steep hills on Hawkesbury Sandstone. Local relief 40–200 m, slopes >25%. Rock outcrop >50%. Narrow crests and ridges, narrow incised valleys, steep sideslopes with rocky benches, broken scarps and boulders. Mostly uncleared Eucalypt open-woodland (dry sclerophyll forest) and tall open-forest (wet sclerophyll forest).

Soils—shallow (<50 cm), discontinuous lithosols/siliceous sands (Uc1.21) associated with rock outcrop; earthy sands (Uc5.11, Uc5.23), yellow earths (Gn2.24) and some locally deep sands on inside of benches and along joints and fractures; localised yellow and red podzolic soils (Dy4.11, Dy5.21, Dr5.11, Dr5.21) associated with shale lenses; siliceous sands (Uc1.2) and secondary yellow earths (Gn2.41) along drainage lines.

Limitations—steep slopes, mass movement hazard, rockfall hazard, water erosion hazard, shallow soils, rock outcrop, non-cohesive soils (localised), stony, highly permeable soils of low fertility.

LOCATION

Steep, rugged Hawkesbury Sandstone slopes and ridges of the Hornsby Plateau in the north east, the Blue Mountains Plateau in the west and Woronora Plateau in the south east.

LANDSCAPE

Geology

Hawkesbury Sandstone consisting of medium to coarse-grained quartz sandstone with minor shale and laminite lenses. Sandstones are either massive or crossbedded sheet facies with vertical or subvertical joint sets. The combination of bedding planes and widely spaced joints gives sandstone outcrops a distinctive blocky appearance.

Topography

Rolling to very steep hills. Local relief varies from 40–200 m. Slope gradients range from 25–70%. Crests and ridges are convex and narrow, and <300 m wide Slopes are moderately inclined to precipitous. Rock outcrop occurs as horizontal benches and broken scarps up to 10 m high. Boulders and cobbles cover up to 50% of the ground surface. Valleys are narrow and incised.

Vegetation

Mostly uncleared open-woodland (dry sclerophyll) with pockets of tall open-forest (wet sclerophyll) and closed-forest (rainforest).

On exposed crests and ridges there is usually a low open woodland containing *Eucalyptus gummifera* (red bloodwood), *E. oblonga* (narrow-leaved stringybark), *E. haemastoma* (scribbly gum) and *E. sclerophylla* (hard-leaved scribbly gum), *E. capitellata* (brown stringybark) and *Banksia serrata* (old man banksia). On the more sheltered sideslopes a dry sclerophyll open-forest containing *E.sieberi* (black ash), *E. piperita* (Sydney peppermint), *Angophora costata* (smooth-barked apple) and *Allocasuarina littoralis* (black she-oak) predominates.The understorey is dominated by shrub species of the families Epacridaceae, Myrtaceae, Fabaceae and Proteaceae.

Within sheltered gullies, wet sclerophyll closed-forests of *Eucalyptus pilularis* (blackbutt), *E. saligna* (Sydney blue gum), *Tristaniopsis laurina* (water gum) and occasionally *Ceratopetalum apetalum* (coachwood) occur. *Callicoma serratifolia* (black wattle), *Backhousia myrtifolia* (native myrtle) and *Pteridium esculentum* (bracken) form a closed scrubby understorey.

Landuse

Mostly National Park (Blue Mountains National Park at Glenbrook) which is used for nature conservation, education and recreation, and Water Board catchment.

Existing Erosion

Severe sheet erosion often occurs during storms and after ground cover is destroyed by bushfires (Atkinson, 1984). Minor gully erosion occurs along unpaved tracks and fire trails, especially those used regularly by four wheel drive vehicles, motorcycles and horses.

Associated Soil Landscapes

Small areas of Faulconbridge (**fb**), Lucas Heights (**lh**), Gymea (**gy**) and Volcanic (**vo**) soil landscapes occur in association with the Hawkesbury soil landscape.

SOILS

Dominant Soil Materials

ha1—Loose, coarse quartz sand.

This is a sand to sandy loam with loose, apedal single-grained structure and porous sandy fabric. It generally occurs as topsoil (A1 horizon).

Colour ranges from brownish black (10YR 3/2) when abundant organic matter is present, to bright yellowish brown (10YR 7/6) and often becomes lighter with depth. The pH ranges from strongly acid (pH 4.0) to moderately acid (pH 5.5). Weakly weathered sandstone fragments may be present whilst charcoal fragments and roots are common. This material is commonly water repellent.

ha2—Earthy, yellowish brown sandy clay loam

This is a clayey sand to sandy clay loam with apedal massive or occasionally weakly pedal structure and a distinctly porous, earthy fabric. It generally occurs as subsoil, often in association with sandstone bedrock (B or C horizon).

Where peds are present they are large sub-angular blocky and rough-faced. Ped sizes range from 30–60 mm. Common colours include yellow orange (10YR 7/8), bright yellowish brown (10YR 6/8, 6/6) and yellowish brown (10YR 5/6) The pH ranges from strongly acid (pH 4.0) to moderately acid (pH 5.5). Gravels, stones and ironstone-plated sandstone fragments are common but roots and charcoal fragments are rare.

ha3—Pale, strongly pedal light clay.

This is fine sandy clay loam to medium clay with strongly pedal structure and rough-faced ped fabric. It commonly occurs as subsoil derived from shale lenses within the Hawkesbury Sandstone (B or C horizons) but does not always occur.

Structure is strongly pedal when dry and apedal when saturated. Peds range in size from 20–60 mm and are subangular blocky to angular blocky in shape. Colours are most often pale but can vary according to site drainage characteristics. Colour ranges from bright yellowish brown (10YR 6/6) to reddish brown (5YR 5/6). Red, orange and grey mottles are often present. The pH varies from strongly acid (pH 4.0) to moderately acid (pH 5.5). Stratified iron-stone gravels are common but roots and charcoal fragments are usually rare or absent.

Associated Soil Materials

Litter and decomposing organic debris. Surface litter consists of decomposing remnants of leaves and twigs, fungal and root mats, and quartz sand grains. Distribution depends on site productivity, fire regime, location of nearby species and surface wetness. More than 10 cm of decomposing organic debris often accumulates indebris dams and small fans on breaks of slope, as well as in joint crevices of rock outcrops. There is usually a sharp boundary with the mineral soil.

White loose sand.

This material is found on the surface and is composed of quartz sand grains found in recently deposited surface washes such as small debris dams and fans found on breaks of slope. This material is often mixed with litter and charcoal fragments.

Occurrence and Relationships

Crests and ridges. Up to 20 cm of loose, coarse quartz sand (**ha1**) overlies either bedrock [lithosols Uc1.21) or <30 cm of earthy, yellowish brown sandy clay loam subsoil (**ha2**) [earthy sands Uc5.11), yellow earths (Gn2.24, Gn2.31)]. Total soil depth is <50 cm. The boundary between soil materials is usually gradational. Texture often increases gradually with depth.

Sideslopes and benches. Soils are discontinuous. Sandstone outcrop and boulders may cover >50% of the ground surface. Usually 10–30 cm of **ha1** overlies bedrock [lithosols and siliceous sands (Uc1.22)] on outsides of benches whilst on higher sides of benches 5–15 cm of **ha1** overlies up to 50 cm of **ha2** [yellow earths (Gn2.24)] or locally deep sands. Boundaries between soil materials are either gradual or clear and total soil depth, although variable, is usually <70 cm. In some instances, especially along joint lines, soil depth may exceed 200 cm. Often **ha2** is found along bedding planes in the sandstone.

Minor lenses of shale are occasionally associated with higher sides of benches and have up to 30 cm of **ha1** which overlies up to 50 cm of strongly pedal clay subsoil (**ha3**). There is a clear to sharp boundary between soil materials [yellow podzolic soils Dy4.11, Dy5.21) with occasional red podzolic soils (Dr5.11, Dr52.1)]. Total soil depth is usually <150 cm.

Drainage lines. Drainage lines are either on exposed bedrock or have deposits of gravel or loose quartz sand (**ha1**) [siliceous sands (Uc1.2)] which occasionally overlie **ha2** [yellow earths (Gn2.41)]. Total soil depth is usually <100 cm.

LIMITATIONS TO DEVELOPMENT

Soil Limitations

ha1
- High permeability
- Low available water capacity
- Low fertility
- High erodibility
- Strongly acid

ha2
- Stoniness (localised)
- High permeability (localised)
- Very low fertility
- High erodibility

ha3 Very low fertility
Strongly acid
High erodibility

Fertility

General fertility is very low. The soils of this unit are moderately to strongly acid with a low to very low nutrient status. The soils are severely deficient in nitrogen and phosphorus and they have very low CEC. They are also shallow and stony with low available water capacities and high aluminium toxicity.

Erodibility

The topsoil **ha1** has low erodibility. It consists of highly permeable, loose, coarse sands and organic matter. ha1 is highly susceptible to concentrated flow erosion, especially when the organic matter is removed by hot bushfires. **ha2** and **ha3** have moderate erodibility. They have low organic matter contents and weak fabrics.

Erosion Hazard

Erosion hazard for non-concentrated flows is generally very high and ranges from moderate to extreme.

Surface Movement Potential

The shallow sandy soils are stable to slightly reactive.

Landscape Limitations

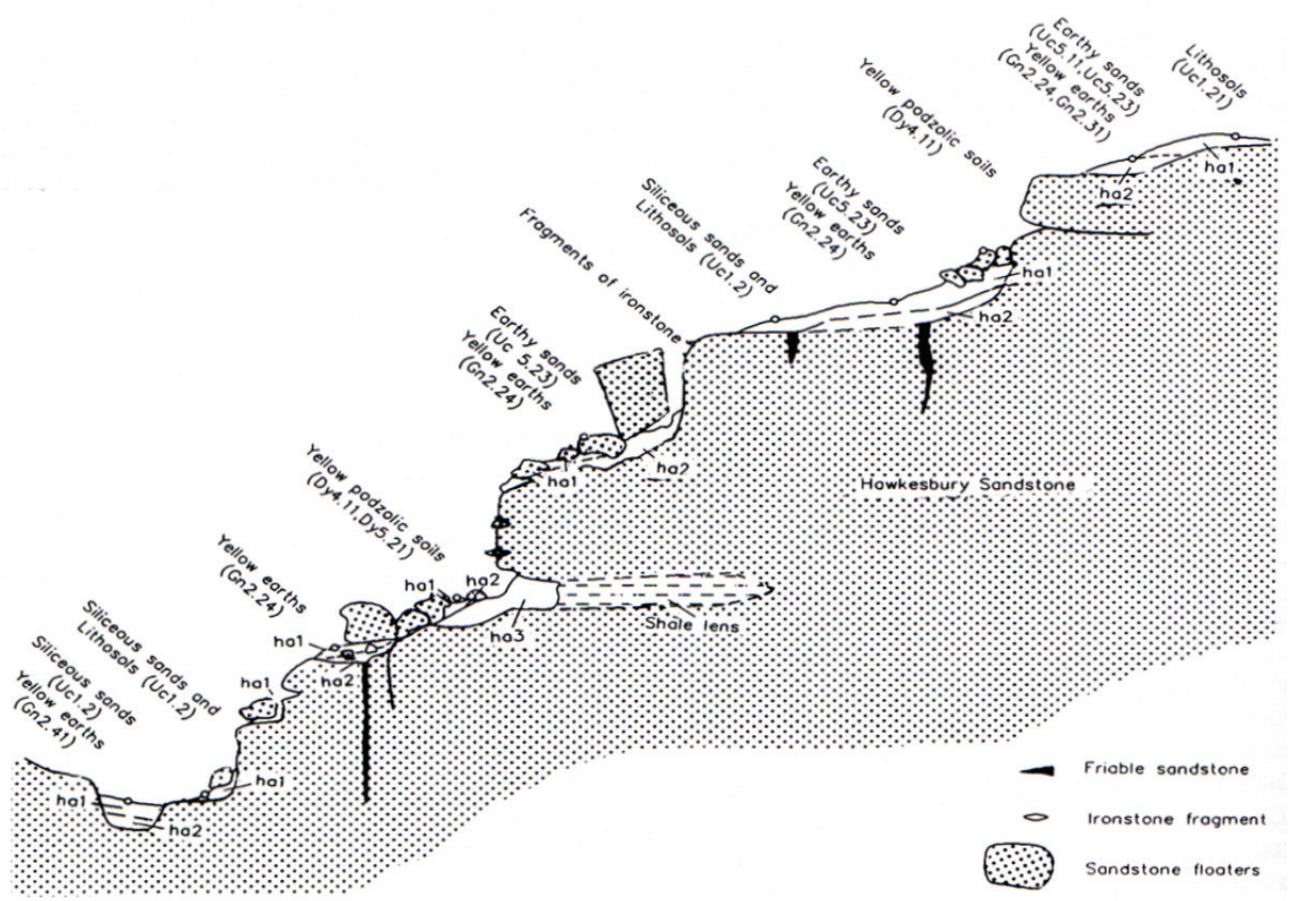
Steep slopes, mass movement hazard, rockfall hazard, water erosion hazard, shallow soils, rock outcrop, non-cohesive soils (localised).

Urban Capability

Generally not capable of urban development.

Rural Capability

Not capable of being cultivated or grazed.



Distribution diagram of the Hawkesbury soil landscape showing the occurrence and relationship of dominant soil materials.

hw	HAZELWOOD	Colluvial

Landscape—a very narrow unit of steep concave east facing slopes intersected by parallel drainage lines. Local relief to 100 m; sideslope >60% with undulating colluvial footslopes >10%.

Soils—highly variable soils due to the nature of the colluvial parent material. Yellow solodic soils (Dy5.42), chocolate soils (Dr4.11, Db3.2) and earthy sands (Uc4.21). Lithosols (Uc4.21) occur on upper slopes and occasionally elsewhere.

Limitations—localised steep slopes, localised mass movement hazard as minor slipping on midslopes, localised water erosion hazard, localised non-cohesive soils as relatively unconsolidated materials on lower slopes; low fertility, sodic subsoil.

LOCATION

This landscape comprises the Tertiary talus slope between the escarpment at the eastern side of the Blue Mountains and the Nepean River south of Blaxland Crossing to Bents Basin.

LANDSCAPE

Geology

Unconsolidated scree of mixed size range. Debris is mostly derived from Tertiary sediments at top of the Lapstone monocline.

Topography

Generally steep east-facing slopes of more than 60% on upper slopes to 5% on footslopes. Local relief >100 m. Slopes are concave and are intersected with deeply incised parallel drainage lines.

Vegetation

Trees have been mostly cleared from the lower slopes. Regrowth is dominated by *Acacia* spp. (wattles) and *Leptospermum* spp. (tea-trees). Taller trees include *Eucalyptus crebra* (narrow-leaved ironbark) and *E. tereticornis* (red gum). Vegetation on upper slopes reflects the transition between the Hawkesbury Sandstone and Quaternary alluvium vegetation. It is dominated by *E. piperita* (Sydney peppermint), *Anphora costata* (smooth-barked apple), *E. tereticornis* (forest red gum) and *A. subvelutina* (broad-leaved apple).

Landuse

Lower slopes, where cleared, are used for small holdings of mixed pasture and market gardens or subsistence type farming. Upper slopes are unused and remain under natural vegetation.

SOILS

Dominant Soil Materials

hw1—Dark brown clayey sand.

This is an apedal single-grained clayey or loamy sand with porous sandy fabric. It occurs as topsoil (A horizon).

This material has a very narrow colour range of brown (7.5YR 4/3) to dark brown (7.5YR 3/3). It is slightly acid (pH 6.0) to neutral (pH 7.0). There are many roots to depths >100 cm. A few small (2–6 mm) subrounded, iron-coated quartz stones occur dispersed through this material. Charcoal and other inclusions are absent.

hw2—Olive brown sandy clay loam.

This is apedal single-grained loam to light sandy clay loam,with porous earthy fabric. It occurs as topsoil (A horizon).

This material occasionally has very weak subangular blocky structure. Colour ranges from olive brown (2.5Y 4/6) to dark brown (7.5YR 3/3). This material is neutral (pH 7.0). Many roots occur to a depth of 60 cm decreasing rapidly below this. A few rounded, small (2–6 mm) quartz gravel-sized fragments are found dispersed throughout this material. Charcoal and other inclusions do not occur.

hw3—Bright brown sandy loam.

This is a sandy loam with variable structure and slowly porous sandy fabric. It occurs as topsoil or subsoil (A or B horizon).

This material is often apedal as a topsoil and weakly pedal as subsoil. Peds, when they occur, are moderately sized (50–100 cm) subangular blocky. Colour varies with depth. As subsoil it is usually bright brown (7.5YR 4/6) but ranges to yellowish brown (10YR 5/6). As topsoil, it is darker with a narrow range from dark brown (7.5YR 3/3) to brown (7.5YR 4/3). This material is occasionally moderately acid (pH 5.5) but is more usually only slightly acid (up to pH 6.5). A few small iron-indurated stones occur but no charcoal or other inclusions.

hw4—Dark reddish brown light clay.

This is a strongly pedal light to light medium clay with porous rough-faced ped fabric. It occurs as subsoil (B horizon).

Peds are columnar and 20–50 mm diameter. Structure may decrease with depth. Colour is dark reddish brown (2.5YR 3/3 to 5YR 3/6). This material is slightly acid (pH 6.0). 20% of the volume is taken up by dispersed, moderately large (60–200 mm) subrounded and subangular weakly weathered stones. There are few roots and no charcoal or other inclusions.

hw5—Greyish brown medium to heavy clay. This is a sometimes sandy, medium or heavy clay with moderate structure and slightly porous rough-faced ped fabric. It occurs as subsoil (B horizon).

Structure decreases with depth. Peds are moderate (50–100 mm) polyhedral.

Moist colour ranges from greyish brown (7.5YR 4/2) to brownish grey (5YR 6/1). Dry colours are frequently in the bleached range. This material is moderately acid (pH 5.5) to slightly acid (pH 6.5). There are a few roots to 100 cm but generally none below that depth.

A few rounded strongly weathered stones (60–200 mm) of sedimentary origin are stratified or less commonly dispersed in this material. Charcoal and other inclusions do not occur.

hw6—Brown columnar structured sandy clay loam.

This is a moderately structured sandy clay loam to fine sandy clay loam with porous earthy fabric. It occurs as subsoil (B horizon).

Structure is sometimes weak. Primary peds are columnar with a 50–100 mm diameter. Secondary peds are platy or, more rarely, lenticular. A few cutans occur at depth. Colour is brown (7.5YR 4/4, 4/6) but ranges to dull yellowish brown (10YR 5/4).

This material is slightly acid (pH 6.0). A few small (2–6 mm) iron-indurated stones occur as well as small (5–15 mm) hard nodules of ferromanganiferous material. These make up to 20% of the volume. There are no roots.

Occurrence and Relationships

The soils of this landscape are highly variable over short distances. In some locations up to 150 cm of clayey sand (**hw1**) overlies >100 cm sandy loam (**hw3**) which may overlie >100 cm sandy clay loam (**hw6**) [chocolate soil (Db3.21)]. In other sites the topsoil is often shallow (<10 cm) but can be up to 50 cm of light sandy clay loam (**hw2**). This overlies >200 cm of light or medium to heavy clay (**hw4** or **hw5**) [yellow solodic soil (Dy5.42), chocolate soil (Dr4.12)]. Sometimes <150 cm **hw1** overlies >100 cm **hw3** [earthy sand (Uc4.21)].

Boundaries between soil materials are sharp to gradual. Total soil depth is usually >300 cm.

LIMITATIONS TO DEVELOPMENT

Soil Limitations

hw1 High erodibility
High permeability
Very high aluminium toxicity
Very low fertility
Very low available water capacity

hw2 Very high permeability
Low fertility

hw3 Low fertility

hw4 Very high erodibility
Low fertility

hw5 High erodibility
Low fertility

hw6 Sodic
Very low fertility

Fertility

The fertility is low. The topsoils (**hw1**, **hw3**) are generally acid and have low to very low water capacity, organic matter and CEC. Nutrient status is generally low.

The soils (**hw2**, **hw4-6**) have low to moderate available water capacity and low nutrient status, except for magnesium and potassium. **hw6** may also be sodic.

Erodibility

The erodibility of the topsoils (**hw1**, **hw3**) is low. They are dominated by coarse sand, poorly bound with clay and silt fractions. The subsoils are moderately erodible. **hw2** is similar to **hw1** but has an earthy fabric.

hw4 and **hw5** are generally moderately erodible having a high percentage of coarse sand, although they may be dispersible. **hw6** is moderately graded porous earthy material with moderate erodibility.

Erosion Hazard

Erosion hazard for this soil landscape for non-concentrated flows is high to very high. The calculated soil loss for the first twelve months of urban development ranges up to 172 t/ha for topsoils and 300 t/ha for exposed subsoils. The erosion hazard for concentrated flows is high to extreme.

Surface Movement Potential

These materials are slightly reactive to stable.

Landscape Limitations

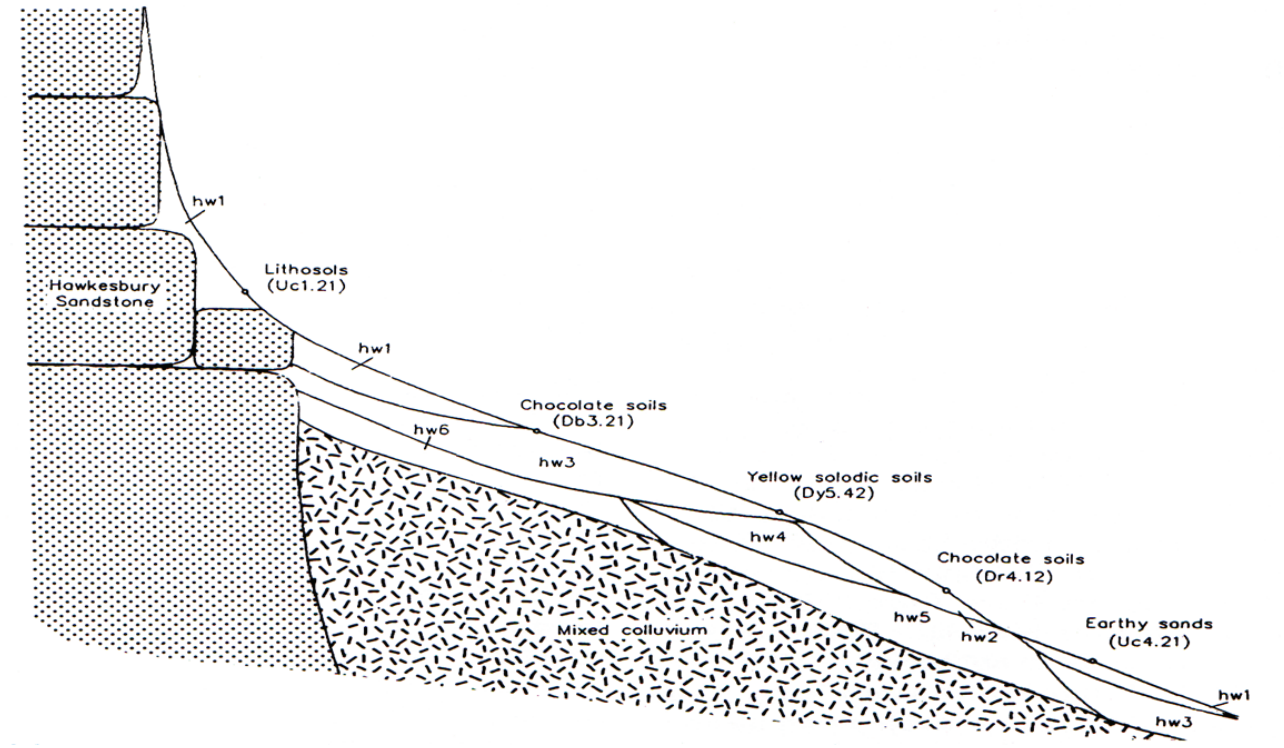
Steep slopes (localised), mass movement hazard (localised), water erosion hazard (localised), non-cohesive soils (localised) as unconsolidated materials on lower slopes.

Urban Capability

Not capable of urban development.

Rural Capability

Not capable of supporting cultivation but capable of limited grazing with appropriate soil conservation measures. Steeper slopes are not capable of being grazed or cultivated.



Distribution diagram of the Hazelwood soil landscape showing the occurrence and relationship of dominant soil materials.

lu	LUDDENHAM	Erosional

Landscape—undulating to rolling low hills on Wianamatta Group shales, often associated with Minchinbury Sandstone. Local relief 50–80 m, slopes 5–20%. Narrow ridges, hillcrests and valleys. Extensively cleared tall open forest (wet sclerophyll forest).

Soils—shallow (<100 cm) dark podzolic soils (Dd3.51) or massive earthy clays (Uf6.71) on crests; moderately deep (70–150 cm) red podzolic soils (Dr2.11, Dr2.41, Dr3.11) on upper slopes; moderately deep (<150 cm) yellow podzolic soils (Dy4.22) and prairie soils (Gn3.26) on lower slopes and drainage lines.

Limitations—water erosion hazard, localised steep slopes, localised mass movement hazard, localised shallow soils, localised surface movement potential; localised impermeable highly plastic subsoil, moderately reactive.

LOCATION

This unit occurs mainly towards the south and west in the Cumberland Lowland. Good examples can be found on the dissected ridges running from Denham Court north to Cecil Park. Another major occurrence lies east of the Nepean River, south of Penrith. A smaller area is found near Luddenham and minor examples occur in the north bordering the Hawkesbury Sandstone units on the Homsby Plateau.

LANDSCAPE

Geology

This soil landscape is underlain by Wianamatta Group Ashfield Shale and Bringelly Shale formations. The Ashfield Shale consists of laminite and dark grey shale. Bringelly Shale consists of shale, calcareous claystone, and laminite. Between these two shale members is the Minchinbury Sandstone consisting of fine to medium-grained lithic quartz sandstone.

Topography

Low rolling to steep low hills. Local relief 50–120 m, slopes 5–20%. Convex narrow (20–300 m) ridges and hillcrests grade into moderately inclined sideslopes with narrow concave drainage lines. Moderately inclined slopes of 10–15% are the dominant landform elements.

Vegetation

Extensively cleared open forest (dry sclerophyll forest). Dominant tree species include *Eucalyptus maculata* (spotted gum) and *E. moluccana* (grey box). Lesser occurrences of *E. fibrosa* (broad-leaved ironbark), *E. crebra* (narrow-leaved ironbark), *E. tereticornis* (forest red gum) and *E. longifolia* (woollybutt) occur. Understorey shrub species include *Bursaria spinosa* (blackthorn), *Breynia oblongifolia* (coffee bush), *Allocasuarina torulosa* (forest oak), *Acacia implexa* (hickory) and *Clerodendrum tomentosum* (hairy clerodendrum). Grasses are commonly *Aristida vagans* (speargrass), *Entolasia marginata* (bordered panic), *Eragrostis leptostachya* (paddock lovegrass) and *Themeda australis* (kangaroo grass) (Benson, 1981). Examples of natural vegetation can be found near Werombi and Floxton Park.

Landuse

Grazing is the dominant landuse over much of this soil landscape. Examples are found east of Bents Basin and south west of Bringelly. Low density housing occurs at West Floxton and Mulgoa. Increasing pressure for home-sites is resulting in more areas of this landscape changing from semi-rural to suburban land use.

Existing Erosion

Minor gully erosion is evident along unpaved roads. Moderate sheet erosion occurs on disturbed areas (e.g. cultivated lands). Small areas of moderate to severe sheet erosion occur in overgrazed paddocks on many hobby farms. Evidence of previous erosion is commonplace, especially where eroded topsoil has been deposited against fences.

Associated Soil Landscapes

Small unmapped areas of Picton (**pn**) soil landscape occur on steeper slopes especially those facing south and east. Blacktown (**bt**) soil landscape is also associated with Luddenham soil landscape.

SOILS

Dominant Soil Materials

lu1—Friable dark brown loam.

This is a dark brown, friable loam, silt loam or silty clay loam with moderate to strong structure and porous rough-faced ped fabric. This material occurs as topsoil (A1 horizon).

Peds are commonly subangular blocky to polyhedral, 2–10 mm in size and are rough-faced and porous. In uncompacted soils these peds break down readily to very small crumbs. Surface condition is distinctly friable but may become hardsetting when compacted and dry. Colour is dark brown (10YR 3/3, 7.5YR 3/3) but can range from brownish black (5YR 3/1) to brown (10YR 4/4). This material is occasionally water repellent. The pH varies from moderately acid (pH 5.0) to slightly acid (pH 6.5). A few small, subrounded-rounded weakly weathered shale fragments occur. Roots are common to 10 cm becoming fewer with increasing depth. Charcoal fragments occur occasionally.

lu2—Hardsetting brown clay loam.

This is a clay loam to fine sandy clay loam with an apedal massive or weakly pedal structure and an earthy or porous, rough-faced ped fabric. This material occurs as an A2 horizon and is occasionally hardsetting when exposed at the surface.

Peds, when present, are sub-angular blocky, 10–50 mm in size, and are rough faced and porous. Otherwise this material has apedal massive structure with an earthy porous fabric. Colour is brown (7.5YR 4/4) but can range between dull yellowish brown (10YR 5/4) and reddish brown (5YR 4/6). The pH varies between strongly acid (pH 4.0) and slightly acid (pH 6.5). Shale rock fragments, charcoal fragments and roots are present.

lu3—Whole coloured, strongly pedal clay.

This is a medium clay with strong structure and smooth-faced, dense ped fabric. It occurs as subsoil (B horizon).

Texture is commonly medium clay bit can range from silty clay to heavy clay. The peds are sub-angular blocky or polyhedral and range in size from 5–20 mm. They are smooth-faced and dense. Cutans are also present. Colour is reddish brown (5YR 4/6-8) and can range from bright reddish brown (2.5YR 4/8) to bright yellowish brown (10YR 6/6). The pH varies from strong y acid (pH 4.0) to moderately acid (pH 5.5). Shale rock fragments are common. Roots are rare and charcoal fragments are absent.

lu4—Mottled grey plastic clay.

This is a grey, mottled, medium clay with strongly pedal structure and dense, smooth-ped fabric. It occurs as deep subsoil.

Texture ranges to heavy clay. The peds are usually sub-angular blocky, 10–20 mm in size, and are smooth-faced and dense. These can be broken down easily to smaller (2–5 mm) polyhedral peds. Colour is usually light grey (10YR 7/1) but ranges to light reddish grey (2.5YR 7/1). Yellow and red mottles are common. It is usually moist and is very plastic. The pH varies from strongly acid (pH 4.0) to moderately acid (pH 5.5). Shale rock fragments and gravels are common. Roots are rare, and other inclusions are absent.

lu5—Apedal brown sandy clay.

This is an apedal massive brown, sandy clay to light clay with dense earthy fabric. It occurs as subsoil (B horizon).

Occasionally weak subangular blocky or polyhedral structure is evident. Colour is usually brown (7.5YR 4/4–6) but ranges from dull reddish brown (5YR 4/4) to dull yellowish brown (10YR 5/4). This material is moderately acid (pH 5.0) to neutral (pH 7.0). Roots are common. Up to 10% of the volume may be small (2–6 mm) angular, well weathered shale fragments. Charcoal and other inclusions do not occur.

Associated Soil Materials

Greyish brown loamy or clayey sand.

This material occurs on lower slopes and in drainage lines as a shallow (<50 cm) surface material. It has a neutral pH (pH 7.0) and frequently contains small amounts of gravels 2–20 mm and charcoal fragments.

Occurrence and Relationships

Crests. Up to 10 cm of friable dark brown loam (**lu1**) overlies <40 cm sandy clay (**lu5**) which usually directly overlies deeply weathering shale bedrock. The boundary between materials is sharp to clear. Total soil depth <40 cm [dark podzolic soils (Dd3.51)]. In some places **lu1** is not present [massive earthy clay (Uf6.71)]. More rarely **lu1** and **lu5** overlie >200 cm mottled grey plastic clay (**lu4**). Boundaries between soil materials are sharp to clear. Total soil depth >200 cm [yellow podzolic soils (Dy2.21)].

Upper slopes and mid-slopes. Sandy clay (**lu1**) is rare but <10 cm may occur on surface. Up to 40 cm of clay loam (**lu2**) overlies >50 cm medium or heavy clay (**lu3**) which overlies <90 cm of grey mottled clay (**lu4**) [red podzolic soils (Dr2.11), yellow podzolic soils (Dy3.51, Gn3.71)]. Where underlying lithology is Minchinbury Sandstone up to 60 cm **lu5** occurs between **lu2** and **lu3**. In this instance **lu4** does not often occur. Total soil depth >100 cm. Boundaries between soil materials are generally clear but can be gradual [red podzolic soils (Dr2.41, Dr3.11), chocolate soils (Db3.11)].

Lower slopes and drainage lines. Up to 50 cm of loamy sand overlies >100 cm sandy clay (**lu5**) [yellow podzolic soils (Dy4.22)]. In other locations up to 40 cm clay loam (**lu2**) overlies <50 cm sandy clay (**lu5**) and >100 cm whole-coloured medium clay (**lu3**). This is occasionally underlain by >150 cm mottled grey plastic clay (**lu4**) [prairie soils (Gn3.26)]. The boundaries between materials are clear or, less often, gradual. Total soil depth >200 cm.

LIMITATIONS TO DEVELOPMENT

Soil Limitations

lu1 High erodibility
Stoniness (localised)

lu2 Very hardsetting surface
Stoniness (localised)
Low available water capacity

lu3 Low wet strength
Low permeability (localised)
Low fertility
High shrink-swell (localised)
Low available water capacity

lu4 Low wet strength
Low permeability
Low available water capacity
Stoniness
Low fertility
High shrink-swell (localised)

lu5 Low wet strength
Low fertility
High shrink-swell (localised)
Very high aluminium toxicity
Low available water capacity

Fertility

The general fertility is low to moderate. The topsoil (**lu1**) has moderate fertility with high available water capacity, moderate amounts of organic matter, and moderate nutrient status. **lu2** normally has low to moderate fertility with low available water capacity, moderate organic matter content, low CEC, and intrinsically low nutrient status. All the other soil materials have low fertility with low available water capacities, moderate CEC and generally low nitrogen and very low phosphorus levels (**lu3**–**lu5**).

Erodibility

lu1 and **lu2** have moderate erodibility as they have moderate organic matter percentage, have stable aggregates and are well graded. All the other soil materials are moderately erodible as they are finely graded with relatively stable aggregates. **lu3**–**lu5** clays may be locally dispersible and,in those circumstances, should be considered highly erodible.

Erosion Hazard

The erosion hazard for non-concentrated flows ranges from moderate to very high. The calculated soil loss for the first twelve months of urban development ranges up to 135 t/ha for topsoil and up to 97 t/ha for exposed subsoil. The erosion hazard for concentrated flows is high to very high.

Surface Movement Potential

Moderately reactive soil materials. Soils are deep and have high clay content. Clay often has low to moderate shrink-swell potential. Tall trees are common on this landscape.

Landscape Limitations

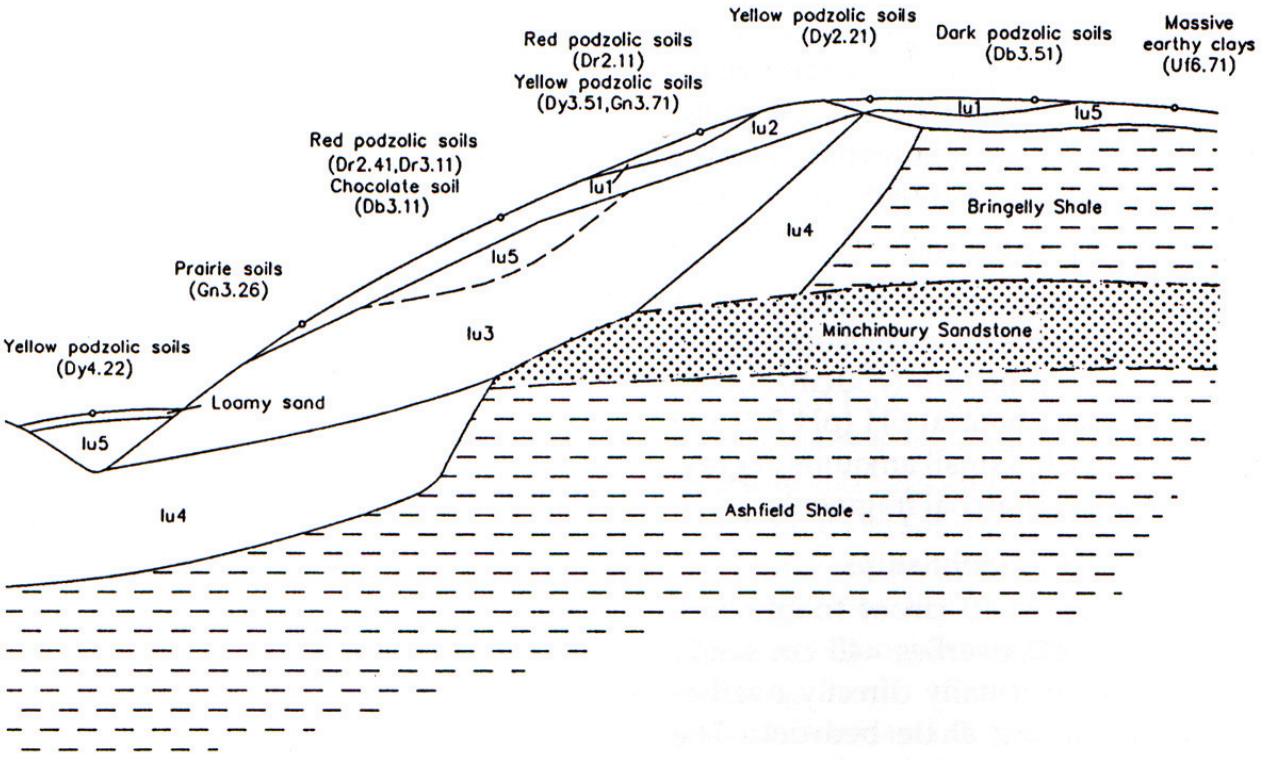
Water erosion hazard, steep slopes (localised), mass movement hazard (localised), shallow soils (localised), surface movement potential (localised).

Urban Capability

Low to moderate capability for urban development.

Rural Capability

Land generally capable of being grazed and regularly cultivated.



Distribution diagram of the Luddenham soil landscape showing the occurrence and relationship of dominant soil materials.

pn	PICTON	Colluvial

Landscape—steep sideslopes, Wianamatta Group shale and shale colluvial materials usually with a southerly aspect. Local relief 90–300 m, slope gradients >20%. Extensively cleared tall open-forest.

Soils—shallow to deep (50–200 cm) red and brown podzolic soils (Dr2.11, Dr3.11, Db1.11) on upper slopes. Brown and yellow podzolic soils on colluvial material (Db1.11, Dy4.11, Dy5.11). Yellow podzolic soils (Dy3.11) on lower slopes and in drainage lines.

Limitations—steep slopes, mass movement (slump) hazard, water erosion hazard, localised shallow soils, localised surface movement potential; some impermeable and highly plastic subsoils.

LOCATION

This soil landscape occurs as small discontinuous narrow sections near Werombi, and on south-facing ridges west of Nepean Road in the southern portion of the map area. A more continuous occurrence lies between Kemps Creek and Bonnyrigg and north to Cecil Park.

LANDSCAPE

Geology

Wianamatta Group: Ashfield Shale which consists of laminite and dark grey shale and Bringelly Shale which consists of shale, calcareous claystone, laminite, fine to medium-grained lithic quartz sandstone, and rare coal.

Topography

Steep low hills on fine textured Wianamatta Group shales. Local relief 90–300 m, slope gradients >20%. Steep slopes with southerly and south westerly aspects are the dominant landform elements. Mass movement processes, predominantly soil creep and slump, are evident.

Vegetation

Extensively cleared tall open-forest (wet sclerophyll forest). Dominant tree species include *Eucalyptus saligna* (Sydney blue gum) and *E. pilularis* (blackbutt). Other species include *Syncarpia glomulifera* (turpentine), *E. paniculata* (grey ironbark), *E. globoidea* (white stringybark), *Angophora floribunda* (rough-barked apple) and *A. subvelutina* (broad-leaved apple). *Pittosporum* spp. (Pittosporum) and *Breynia oblongifolia* (coffee bush) are common understorey species (Benson, 1981).

Landuse

Improved, volunteer and native pastures (e.g., near Bringelly), low density residential (e.g., Castle Hill and Cutt Hill) timber and recreation areas.

Existing Erosion

Slumps and sheet erosion occur throughout this soil landscape. Small discontinuous gullies occur where subsoils are more plastic.

Associated Soil Landscapes

Luddenham soil landscape (**lu**) is often adjacent to this soil landscape but is less steep and is not subject to mass movement.

SOILS

Dominant Soil Materials

pn1—Dark brown clay loam.

This is an apedal massive clay loam to fine sandy clay loam with porous earthy fabric. It occurs as topsoil (A horizon).

Structure is occasionally single-rained. The surface condition is usually friable. Colour ranges from dark reddish brown (2.5YR 3/3) to dark brown (10YR 3/3) This material is usually slightly acid (pH 6.0) but varies to moderately acid (pH 5.5) In some locations stones may constitute up to 60% of the volume of this material. These stones are small (2–20 mm), weakly weathered and subrounded or angular. Roots are abundant in the top 5 cm but few occur below this depth. Charcoal fragments and other inclusions are rare.

pn2—Reddish brown sticky clay.

This is a strongly pedal medium or light medium clay, with smooth-faced ped fabric. It occurs as subsoil (B horizon).

Structure may decrease with depth. Peds are small (2–5 mm), polyhedral and slowly porous. Colour is dark reddish brown (5YR 3/2, 5YR 3/4). This material varies from moderately acid (pH 5.0) to slightly acid (pH 6.5). Occasional red or grey mottles occur at depth. There are few roots. Small (6–20 mm) subangular stones make up to 20% of the volume. Hard nodules of manganese occur but there are no other inclusions.

pn3—Brown stony light clay.

This is a brown structured light to light medium clay with porous peds and smooth-faced fabric. It occurs as subsoil (B horizon).

Structure ranges from strong polyhedral with small (6–20 mm) peds to weak sub-angular blocky with small (2–20 mm) peds. Texture may become lighter with depth. Colour ranges from bright brown (7.5YR 3/4) to dark reddish brown (2.5YR 3/4) with up to 25% light grey mottles. This material varies from strongly acid (pH 4.0) to moderately acid (pH 5.0). Small weakly weathered subangular to platy stones make up to 80% of the volume. Roots are rare and charcoal is absent.

Occurrence and Relationships

Crests and upper slopes. Up to 80 cm of clay loam (**pn1**) overlies a similar depth of light clay (**pn3**) which directly overlies the weathering shale bedrock [red podzolic soils (Dr2.1l,Dr3.11)].

Total depth of soil is usually >150 cm. Where there has been more recent downslope movement **pn1** is much shallower (<30 cm) on the source slope and this overlies up to 40 cm of medium clay (**pn2**) and up to

50 cm of **pn3** [red and brown podzolic soils (Dr2.11, Dr3.11, Db1.11)]. Boundaries between soil materials are clear. Total soil depth may be <100 cm.

Downslope, on the colluvial benches. The materials are occasionally more mixed and the soils are highly variable over short distances. Up to 80 cm of **pn1** overlies up to 100 cm of **pn2** and >100 cm of **pn3** [brown and yellow podzolic soils (Dbl.11, Dy4.11 and Dy5.11)]. Total soil depth is >200 cm. Boundaries between soil materials are gradual to clear.

On footslopes and in drainage lines. Up to 50 cm of **pn1** overlies up to 150 cm of **pn3**. This overlies strongly weathered shale [yellow podzolic soils (Dy3.11)]. The boundary between soil materials is clear to sharp. Total soil depth is <200 cm.

LIMITATIONS TO DEVELOPMENT

Soil Limitations

pn1 High erodibility (localised)
Strongly acid

pn2 Sodicity
Low permeability
Strongly acid
Low fertility

pn3 Extreme stoniness
Sodicity
Extreme erodibility
Low fertility
Shrink-swell (localised)

Fertility

The general fertility is moderate to low. The topsoil (**pn1**) has high organic matter content, moderate CEC and high levels of nitrogen. It is strongly acid and may have high potential for aluminium toxicity. The other soil materials have low fertility with very low phosphorus and low nitrogen. They are also slightly sodic.

Erodibility

Picton soil materials **pn1** and **pn2** are moderately erodible. The topsoil (**pn1**) is coherent with earthy fabric, has high organic matter content, but has a relatively high percentage of silt and fine sand. **pn2** is moderately erodible, having small smooth-faced aggregates which contain a large percentage of silt and are prone to slaking. **pn3** is highly erodible,consisting of somewhat structured, dispersible clay and silt. Slope failure due to throughflow and development of percolines is common.

Erosion Hazard

The erosion hazard for this soil landscape for non-concentrated flows is high. The steep slopes are subject to mass movement when saturated. Calculated soil loss for the first twelve months of urban development ranges to 295 t/ha for topsoil on steeper slopes and up to 171 t/ha for exposed subsoil. Soil erosion hazard for concentrated flows is high to very high.

Surface Movement Potential

Slightly reactive in areas of deep clayey soils with tall trees in a landscape with complex drainage. There are isolated areas of moderately reactive soils.

Landscape Limitations

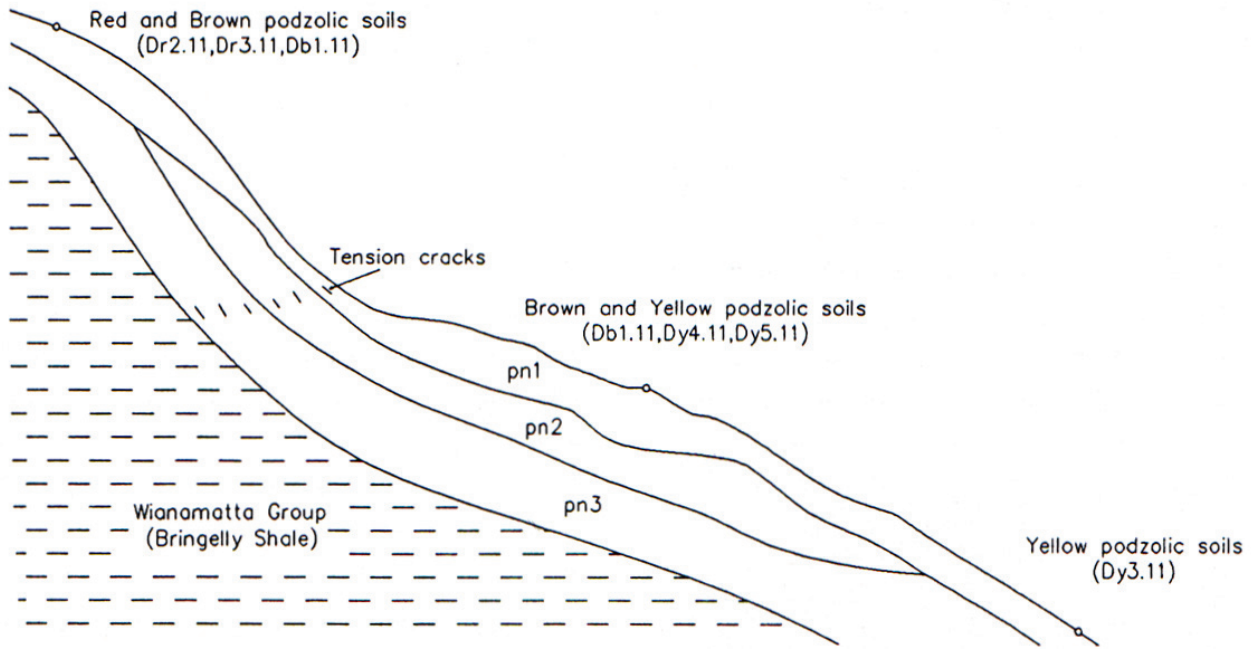
Steep slopes, mass movement hazard, water erosion hazard, shallow soils (localised), surface movement potential (localised).

Urban Capability

Not capable of urban development.

Rural Capability

Not capable of being cultivated or grazed.



Distribution diagram of the Picton soil landscape showing the occurrence and relationship of dominant soil materials.

ri	RICHMOND	Alluvial

Landscape—Quaternary terraces of the Nepean and Georges Rivers. Mainly flat (slopes <1%). Splays and levees provide local relief (<3 m). Tree cover, now almost completely cleared, was formerly a low open-woodland (dry sclerophyll).

Soils—poorly structured orange to red clay loams, clays and sands. Texture may increase with depth. Ironstone nodules may be present. Plastic clays (U46.12) in drainage lines. Deep acid non-calcic brown soils (Gn3.14, Gn4.34), red earths (Gn2.11) and red podzolic soils (Dr2.41), occur on terrace surfaces with earthy sands (Uc5.21, Uc1.23) on terrace edges.

Limitations—localised flood hazard, localised seasonal waterlogging, localised water erosion hazard on terrace edges.

LOCATION

This soil landscape occurs on the higher Quaternary terraces of the Hawkesbury, Nepean and Georges Rivers. There is an extensive area from Richmond east to Rickabys Creek; another large occurrence is on the west bank of the Nepean at Emu Plains. Further examples are found on both banks of the Nepean south of Wallacia. Smaller pockets of this landscape are found on the Georges River both up and down-stream from Liverpool.

LANDSCAPE

Geology

Quaternary alluvium consisting of sand, silt and gravels derived from sandstone and shale.

Topography

Mostly flat (slope <1%) terrace tops; terrace edges and levees provide low relief of up to 10 m.

Vegetation

Extensively cleared open forest. Original tree species included *Toona ciliata* (red cedar), *Ceratopetalum apetulum* (coachwood), *Melaleuca* spp. (paperbarks) and aquatic plants such as *Typha orientalis* (cumbungi), *Cyperus* spp. and *Phragmites australis* (common reed) (Neil Dusty pers. comm.). Regrowth vegetation is dominated by *Acacia* spp. (wattles). *Eucalyptus piperita* (Sydney peppermint) is the most usual Eucalypt.

The grass understorey is commonly *Paspalum* sp. (paspalum), with abundant weeds e.g., *Senecio* sp. (groundsel).

Landuse

In the Richmond and Liverpool areas this unit is now extensively urbanised. Along the Nepean River some areas remain as pasture, small hobby farms and some citrus orchards. Native vegetation has been extensively cleared.

SOILS

Dominant Soil Materials

ri1—Loose reddish brown loamy sand.

This is a reddish brown loamy sand with apedal single-grained structure and porous sandy fabric. It occurs as topsoil (A horizon).

Texture may range to sandy loam when organic matter content is high. Colour has a narrow range between brown (7.5YR 4/4) and very dark reddish brown (5YR 4/2). This material varies from moderately acid (pH 5.5) to slightly acid (pH 6.5). Roots are common near the surface but rare at depth. Stones and charcoal are absent.

ri2—Brown sandy clay loam.

This is a brown sandy clay loam to fine sandy clay loam with apedal massive structure and earthy fabric. It occurs as topsoil (A horizon).

Structure often increases with depth to moderately pedal subangular blocky peds which are porous rough-faced and range in size from 50–100 mm. Colour is brown (7.5YR 4/4,4/6) but varies from dull reddish brown (2.5YR 4/3) to bright brown (7.5YR 5/8). This material is typically slightly acid (pH 6.0) with few roots and no stones or charcoal fragments.

ri3—Brown mottled light day.

This is a reddish to yellowish brown light or light medium clay with apedal massive structure, an earthy fabric increasing to moderate structure, with porous rough-faced ped fabric at depth. It occurs as subsoil (B horizon).

At depth peds are large (50–100 mm) and angular blocky in shape. There is a wide colour range from dark reddish brown (2.5YR 3/6) to greyish yellow brown (10YR 5/2).Yellow or orange mottles often occur. This material varies from strongly acid (pH 4.0) to slightly alkaline (pH 8.0). Small (2–20 mm) iron-indurated gravels may occur in concentrated bands or dispersed throughout this material. There are few roots, and charcoal and other inclusions are rare.

ri4—Brown mottled stiff medium-heavy clay.

This is a reddish brown to yellowish brown, mottled, occasionally subplastic medium to heavy clay with variable structure and dense smooth-faced ped fabric. It occurs as subsoil (B horizon).

Structure increases with depth from weak small (<2 mm) crumb structure to strong subangular blocky with ped size range of 20–100 mm. Colour ranges from dark reddish brown (2.5YR 3/4) to yellowish brown (10YR 5/8). Light grey mottles are common, especially at depth. This material has a pH range of strongly acid (pH 4.5) to neutral (pH 7.0). Stones, roots, charcoal and other inclusions are generally absent.

Associated Soil Materials

Reddish brown sandy (occasionally silty) clay.This material is a sandy clay with weak or moderate structure.It occurs in stratified layers or lenses to a maximum thickness of 220 cm. Ironstone nodules and lateritic bands are also associated with this material.

Occurrence and Relationships

Near terrace edge. Up to 40 cm of reddish brown loamy sand (**ri1**) occurs as a surface layer. This overlies 40–100 cm brown sandy clay loam (**ri2**). The underlying layers are stratified with alternating layers of **ri3** and heavier **ri4** clays with occasional lenses of reddish brown sandy clay [red earths (Gn2.11) and red podzolic soils (Dr2.41)]. Boundaries between soil materials are gradual to sharp. Total soil depth is >200 cm.

Back of terrace. Up to 100 cm brown sandy clay loam (**ri2**) can overlie up to 150 cm of light clay (**ri3**) and >100 cm medium or heavy clay (**ri4**) [deep acid non-calcic brown soil (Gn3.14, Gn4.34)]. Total soil depth is >300 cm. **ri2** is occasionally absent. Boundaries between soil materials are gradual.

Drainage lines incise into both front and back of terrace and sedimentary deposition can cause interspersing of the layers within the channel and on the immediate floodplain. Boundaries and soil depth vary [structured plastic clays (Uf5.12)].

LIMITATIONS TO DEVELOPMENT

Soil Limitations

ri1 High erodibility
Very high aluminium toxicity
Very low fertility
Low available water capacity
Salinity (localised)

ri2 High erodibility (localised)

ri3 Stoniness (localised)
Sodic
Very high erodibility
Very high aluminium toxicity
Very low fertility
Low to moderate shrink swell

ri4 High erodibility (localised)
Low to moderate shrink swell

Fertility

The general fertility of this soil landscape is low to very low. The materials have very low CEC, low nutrient storage capacity, and high levels of aluminium which gives a high potential for toxicity should the pH become lower.

Erodibility

The surface soils are moderately erodible. They have a high fine sand fraction and have low organic matter content. They are, however, not dispersible. The subsoils have very high erodibility due to very low organic matter and a high fine sand and silt content. They are also moderately dispersible.

Erosion Hazard

Due to low slopes and generally good vegetation cover the erosion hazard for non-concentrated flows on the Richmond soil landscape is low. During periods of drought or dry seasons this may increase in some areas. The calculated soil loss on the terrace surface in the first twelve months of urban development is low at 29 t/ha for topsoil and 49 t/ha for exposed subsoil. The erosion hazard for concentrated flows is moderate to high.

Surface Movement Potential

These materials are generally slightly to moderately reactive although the surface sand is stable.

Landscape Limitations

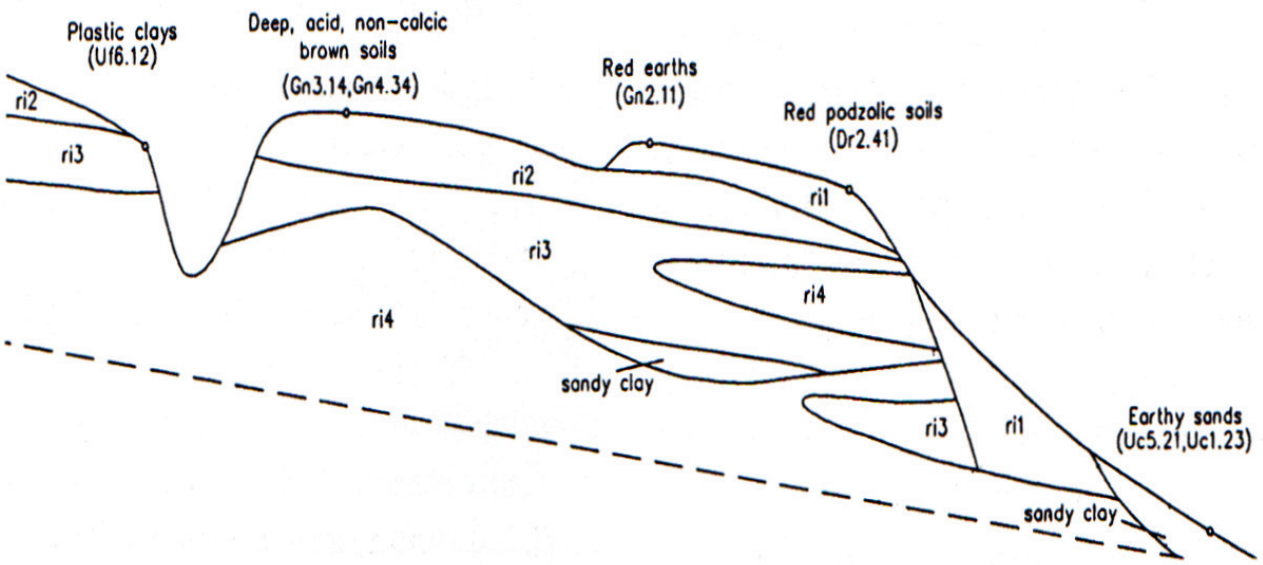
Flood hazard (localised), seasonal waterlogging (localised), water erosion hazard (localised).

Urban Capability

High capability for urban development in flood free areas.

Rural Capability

Capable of regular cultivation and grazing.



Distribution diagram of the Richmond soil landscape showing the occurrence and relationship of dominant soil materials.

Landscape—floodplains, valley flats and drainage depressions of the channels on the Cumberland Plain. Usually flat with incised channels; mainly cleared.

Soils—often very deep layered sediments over bedrock or relict soils. Where pedogenesis has occurred structured plastic clays (Uf6.13) or structured loams (Um6.1) in and immediately adjacent to drainage lines; red and yellow podzolic soils (Dr5.11, Dy2.41, Dr2.21) are most common terraces with small areas of structured grey clays (Gn4.54), leached clay (Uf4.42) and yellow solodic soils (Dy4.42, Dy5.23).

Limitations—flood hazard, seasonal waterlogging, localised permanently high watertables, localised water erosion hazard, localised surface movement potential.

LOCATION

This soil landscape comprises the present active floodplain of many drainage networks of the Cumberland Plain. This includes the South Creek, Eastern Creek, Ricabys Creek and Prospect Creek systems. Typical profiles and landscape can be seen on South Creek between Bringelly Road and Elizabeth Drive.

LANDSCAPE

Geology

Quaternary alluvium derived from Wianamatta Group shales and Hawkesbury Sandstone.

Topography

Flat to gently sloping alluvial plain with occasional terraces or levees providing low relief. Slopes <5%. Local relief <10m.

Vegetation

The vegetation of this soil landscape reflects its frequent inundation. Common tree species include *Angophora subvelutina* (broad-leaved apple), *Eucalyptus amplifolia* (cabbage gum) and *Casuarina glauca* (swamp oak). Still water species such as *Eleocharis sphacelata* (tall spike rush), *Juncus usitatus* and

Polygonum spp. occur where channels are silted up. On more elevated streambanks a tall shrubland of *Melaleuca* spp. (paperbarks) and *Leptospermum* spp. (tea trees) may occur. However much of this soil landscape has been previously cleared and is now dominated by exotic species such as *Rubus vulgaris* (blackberry) and other weeds.

Landuse

Most of this land is reserved for recreational use (playing fields, parks and reserves) or left unused. Some areas in the Prospect Creek system have been altered to provide lakes and dryland recreation space.

Existing Erosion

This is a dynamic soil landscape; there are many areas of erosion and deposition. Streambank erosion and sheet erosion of floodplains are common. In depositional phases streams may be partially or completely blocked by sedimentation or vegetated bars.

Associated Soil Landscapes

Small areas of Bakers Lagoon (**ba**) soil landscape occur in areas of interrupted drainage.

SOILS

Dominant Soil Materials

sc1—Brown apedal single-grained loam.

This is a brown sandy loam to sandy clay loam with generally apedal single-grained structure and porous earthy fabric. It commonly occurs as topsoil (A horizon).

Colours range from dull reddish brown (5YR 4/3) to dull yellowish brown (10YR 4/3). This material is usually moderately acid (pH 5.5) but varies from strongly acid (pH 4.5) to slightly acid (pH 6.5). Small (2–6 mm) angular or rounded gravels may occur. Roots are abundant in surface layers, charcoal and other inclusions do not occur.

sc2—Dull brown clay loam.

This is a hardsetting dull brown clay loam to fine sandy clay loam, usually with apedal massive structure and porous earthy fabric. It occurs as topsoil (A horizon).

Occasionally, weak structure occurs with small (2–5mm) rough-faced subangular blocky peds. Colour is usually dull brown (7.5YR 5/4) but has a range from greyish brown (5YR 4/2) to yellowish brown (10YR 5/6). pH varies from moderately acid (pH 5.5) to neutral (pH 7.0). Stones and other inclusions do not occur, and roots are rarely found.

sc3—Bright brown clay.

This is a bright brown light to medium clay with strongly pedal structure and dense smooth-faced ped fabric. This material usually occurs as subsoil (B horizon).

Occasionally this material contains sufficient fine sand to reach the texture grade of sandy clay. Peds are smooth-faced angular blocky or polyhedral and 20–50 mm in size. This material is generally whole-coloured ranging from reddish brown (5YR 4/8) to bright yellowish brown (10YR 5/1). Mottles, when they do occur, are yellow or grey and occupy up to 15% of the volume of the material. pH is highly variable, ranging from extremely acid (pH 3.0) to neutral (pH 7.0). Roots are only present where this material occurs as topsoil. There is no charcoal but small (2–20 mm) subrounded or subangular gravels may make up to 50% of the volume.

Associated Soil Materials

Dark brown sand. This material is a sandy layer which occurs on the surface as splay deposits in some swales. Texture ranges from sand to clayey sand. It is apedal single-grained and depth varies from 50–100 cm. It is highly erodible and has a pH range of 5.0 to 6.0.

Occurrence and Relationships

In channel. Variable depth sandy clay loam (**sc1**) over bright brown mottled medium clay (**sc3**) [brown and yellow podzolic.soils (Dy3.51, Db2.21, Dy4.42, Dy3.11, Db2.41)]. Soil materials reoccur down through the

soils in layers which can sometimes be related to major flood events. Smaller events either remove, or remove and replace, surface material. Sedimentation has a greater influence than pedogenesis in this environment.

Near channel. 30–50 cm friable to loose sandy loam (**sc1**) overlies 15 cm apedal massive clay loam (**sc2**), and 70 cm of light-medium clay (**sc3**). Swales are sometimes filled by sand splays [structured plastic clays (Uf6.12) or structured loams (Um6.1)].

Low terrace. 2–50 cm sandy clay loam (**sc1**) overlies 15 cm apedal massive clay loam (**sc2**) and 60–85 cm whole coloured medium to heavy clay (sometimes medium textured sandy clay) (**sc3**) [red and yellow podzolic soils (Dr5.11, Dr2.21, Dy141)].

High terrace. Up to 190 cm of stratified clay (light to medium) (**sc3**) over shale bedrock [leached clays (Uf4.43).

LIMITATIONS TO DEVELOPMENT

Soil Limitations

sc1 High erodibility

sc2 High erodibility (localised)
Hardsetting surface
Strongly acid
Low fertility

sc3 Shrink-swell potential (localised)
Stoniness (localised)
Very high erodibility
Saline
Low fertility

Fertility

General fertility is low. The surface soil material (**sc1**) has low CEC and low nitrogen and phosphorus. It is moderately acid and has low available water capacity. **sc2** also has low CEC with very low nitrogen and phosphorus. It is strongly acid and has a potential for a low level of aluminium toxicity. The deep subsoil material (**sc3**) has a high CEC and high intrinsic nutrient storage, but is sodic and saline in some locations.

Erodibility

The erodibility of these soil materials is high. The topsoil (**sc1**) is moderately dispersible and has more than 50% fine sand, but it contains moderate amounts of organic matter. The subsoils (**sc2**, **sc3**) have high fine sand and silt fractions with a very low percentage of organic matter.

Erosion Hazard

The erosion hazard for South Creek soil landscape is potentially very high to extreme. This is an active floodplain and is presently being reworked by fluvial processes. Apparent stability is probably short term. Streambank and gully erosion are common results of concentrated flow.

Surface Movement Potential

Generally low. Soils are often deep with high clay content. Subsoil materials are moderately reactive in some locations, while surface soils are generally stable.

Landscape Limitations

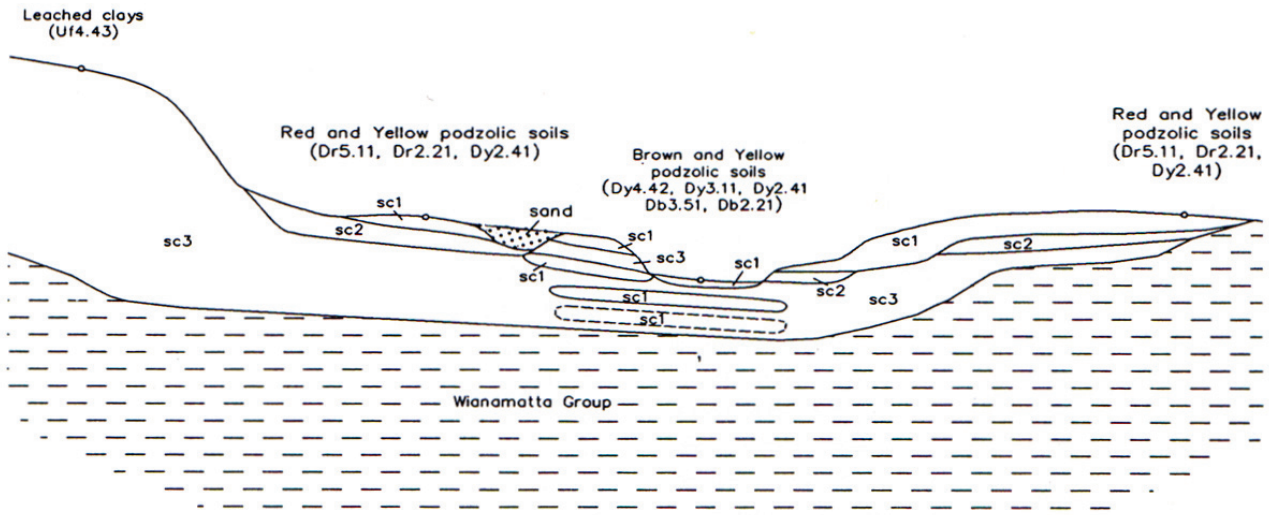
Flood hazard, seasonal waterlogging, permanently high watertables (localised), water erosion hazard (localised), surface movement potential (localised).

Urban Capability

Not capable of urban development due to flood hazard.

Rural Capability

Capable of supporting both grazing and regular cultivation.



Distribution diagram of the South Creek soil landscape showing the occurrence and relationship of dominant soil materials.

Appendix B – Soil Analytical Results Tables

Table 1a: Soil Analytical Results - Cations and Anions, and Inorganics

Sample Date - 2020-02-25 - 2020-09-24
Site ID: Sydney Water - AWRC

					Cations and Anions														Inorganics
					Sulphate as SO4 2-	Chloride	Cation Exchange Capacity	Exchangeable Magnesium	Exchangeable Potassium	Exchangeable Sodium Percentage (ESP)	Exchangeable Sodium	Exchangeable Calcium	Conductivity (1:5 aqueous extract at 25°C)	Conductivity (1:5 aqueous extract at 25°C)	Soil Texture Group Multiplication Factor (Light medium clay)	ECe	Salinity Classification (DLWC, 2002)**	Sodic Classification	Resistivity at 80°C
				LOR	10	5	0.05	0.1	0.1	0.1	0.1	0.1	10	0.001	-	-	-	-	0.5
				Units	mg/kg	mg/kg	meq/100g	meq/100g	meq/100g	%	meq/100g	meq/100g	us/cm	ds/m	-	ds/m	-	-	ohm.m
				Action Levels															
Sample Location	Date Sampled	Sample ID	Depth Range (m)	Sample Type															
ENV_AWRC_BH14	7/3/2020	ENV_AWRC_BH14_0.0-0.2_030720	0-0.2	N	**28**	< 10	**4.6**	**2.1**	**0.1**	**7.0**	< 0.1	**2.1**	**18**	**0.018**	**9**	**0.2**	Non Saline	Moderately sodic	**570**
	7/3/2020	ENV_AWRC_BH14_0.9-1.1_030720	0.9-1.1	N	**53**	**41**	**12**	**9.1**	**0.2**	**19**	**2.2**	< 0.1	**35**	**0.035**	**8.5**	**0.3**	Non Saline	Highly sodic	**290**
	7/3/2020	ENV_AWRC_BH14_1.9-2.1_030720	1.9-2.1	N	**31**	**79**	**9.9**	**6.8**	**0.2**	**28**	**2.8**	< 0.1	**60**	**0.06**	**9**	**0.5**	Non Saline	Highly sodic	**170**
	7/3/2020	ENV_AWRC_BH14_2.9-3.1_030720	2.9-3.1	N	**89**	**210**	**10.0**	**5.7**	< 0.1	**40**	**4.0**	**0.2**	**130**	**0.13**	**9**	**1.2**	Non Saline	Highly sodic	**75**
ENV_AWRC_BH15	7/3/2020	ENV_AWRC_BH15_0.4-0.6_030720	0.4-0.6	N	**240**	**360**	**17**	**12**	**0.2**	**25**	**4.2**	**0.4**	**170**	**0.17**	**8.5**	**1.4**	Non Saline	Highly sodic	**59**
	7/3/2020	ENV_AWRC_BH15_0.9-1.1_030720	0.9-1.1	N	**170**	**650**	**22**	**13**	**0.2**	**39**	**8.6**	**0.3**	**280**	**0.28**	**8.5**	**2.4**	Slightly Saline	Highly sodic	**36**
	7/3/2020	ENV_AWRC_BH15_1.4-1.6_030720	1.4-1.6	N	**190**	**920**	**6.1**	**3.2**	< 0.1	**44**	**2.7**	**0.1**	**410**	**0.41**	**8.5**	**3.5**	Slightly Saline	Highly sodic	**25**
	7/3/2020	ENV_AWRC_BH15_2.4-2.6_030720	2.4-2.6	N	**140**	**780**	**15**	**8.5**	**0.2**	**40**	**5.9**	**0.3**	**320**	**0.32**	**9**	**2.9**	Slightly Saline	Highly sodic	**32**
ENV_AWRC_BH16	7/3/2020	ENV_AWRC_BH16_0.0-0.2_030720	0-0.2	N	**46**	**35**	**7.8**	**3.3**	**1.1**	**4.0**	< 0.1	**3.0**	**48**	**0.048**	**8.5**	**0.4**	Non Saline	Non-sodic	**210**
	7/3/2020	ENV_AWRC_BH16_0.9-1.1_030720	0.9-1.1	N	**270**	**610**	**15**	**9.5**	**0.1**	**30**	**4.3**	**0.6**	**350**	**0.35**	**8.5**	**3.0**	Slightly Saline	Highly sodic	**29**
	7/3/2020	ENV_AWRC_BH16_1.9-2.1_030720	1.9-2.1	N	**180**	**1300**	**15**	**11**	**0.2**	**25**	**3.8**	**0.6**	**540**	**0.54**	**8.5**	**4.6**	Moderately Saline	Highly sodic	**19**
	7/3/2020	ENV_AWRC_BH16_3.0-3.2_030720	3-3.2	N	**170**	**1300**	**5.2**	**3.0**	< 0.1	**38**	**2.0**	**0.2**	**610**	**0.61**	**14**	**8.5**	Very Saline	Highly sodic	**16**
ENV_AWRC_BH24	7/2/2020	ENV_AWRC_BH24_0.0-0.2_020720	0-0.2	N	**43**	**9.1**	**5.7**	**2.9**	**0.1**	**10**	**0.6**	**2.1**	**23**	**0.023**	**7**	**0.2**	Non Saline	Moderately sodic	**440**
	7/2/2020	ENV_AWRC_BH24_0.4-0.6_020720	0.4-0.6	N	**110**	**66**	**15**	**12**	**0.2**	**19**	**2.8**	**0.5**	**71**	**0.071**	**7**	**0.5**	Non Saline	Highly sodic	**140**
	7/2/2020	ENV_AWRC_BH24_0.9-1.1_020720	0.9-1.1	N	**54**	**280**	**14**	**8.1**	**0.2**	**38**	**5.3**	**0.3**	**190**	**0.19**	**7**	**1.3**	Non Saline	Highly sodic	**52**
	7/2/2020	ENV_AWRC_BH24_3.6-3.8_020720	3.6-3.8	N	**120**	**890**	**5.4**	**2.9**	< 0.1	**44**	**2.4**	< 0.1	**440**	**0.44**	**7**	**3.1**	Slightly Saline	Highly sodic	**23**
ENV_AWRC_BH25	7/2/2020	ENV_AWRC_BH25_0.0-0.2_020720	0-0.2	N	**48**	< 5	**3.5**	**1.8**	**0.2**	**10**	< 0.1	**1.1**	**15**	**0.015**	**7**	**0.1**	Non Saline	Moderately sodic	**650**
	7/2/2020	ENV_AWRC_BH25_0.4-0.6_020720	0.4-0.6	N	**170**	**180**	**19**	**13**	**0.3**	**27**	**5.2**	**0.2**	**150**	**0.15**	**7**	**1.1**	Non Saline	Highly sodic	**69**
	7/2/2020	ENV_AWRC_BH25_2.4-2.6_020720	2.4-2.6	N	**88**	**69**	**13**	**8.8**	**0.2**	**33**	**4.4**	< 0.1	**65**	**0.065**	**8.5**	**0.6**	Non Saline	Highly sodic	**150**
	7/2/2020	ENV_AWRC_BH25_4.0-4.2_020720	4-4.2	N	**65**	**800**	**6.1**	**3.3**	< 0.1	**42**	**2.6**	**0.1**	**480**	**0.48**	**9**	**4.3**	Slightly Saline	Highly sodic	**21**
ENV_AWRC_TP06	6/29/2020	ENV_AWRC_TP06_0.0-0.1_290620	0-0.1	N	**57**	**59**	**4.5**	**2.3**	< 0.1	**7.6**	**0.3**	**1.8**	**21**	**0.021**	**14**	**0.3**	Non Saline	Moderately sodic	**470**
	6/29/2020	ENV_AWRC_TP06_0.9-1.0_290620	0.9-1	N	**55**	**64**	**8.6**	**6.3**	**0.1**	**24**	**2.1**	**0.2**	**50**	**0.05**	**14**	**0.7**	Non Saline	Highly sodic	**200**
	6/29/2020	ENV_AWRC_TP06_1.9-2.0_290620	1.9-2	N	**20**	**27**	**11**	**7.8**	**0.2**	**27**	**3.0**	< 0.1	**26**	**0.026**	**14**	**0.4**	Non Saline	Highly sodic	**380**
	6/29/2020	ENV_AWRC_TP06_2.9-3.0_290620	2.9-3	N			**7.9**	**5.1**	**0.2**	**32**	**2.6**	< 0.1	**52**	**0.052**	**14**	**0.7**	Non Saline	Highly sodic	
ENV_AWRC_TP11	6/29/2020	ENV_AWRC_TP11_0.0-0.1_290620	0-0.1	N	**18**	**19**	**16**	**9.9**	**0.2**	**8.0**	**1.3**	**4.3**	**22**	**0.022**	**8.5**	**0.2**	Non Saline	Moderately sodic	**470**
	6/29/2020	ENV_AWRC_TP11_0.9-1.0_290620	0.9-1	N	**180**	**810**	**14**	**9.4**	**0.1**	**15**	**2.1**	**2.6**	**420**	**0.42**	**8.5**	**3.6**	Slightly Saline	Highly sodic	**24**
	6/29/2020	ENV_AWRC_TP11_1.9-2.0_290620	1.9-2	N	**770**	**1400**	**15**	**9.4**	**0.2**	**20**	**3.0**	**2.2**	**420**	**0.42**	**9**	**3.8**	Slightly Saline	Highly sodic	**24**
	6/29/2020	ENV_AWRC_TP11_2.9-3.0_290620	2.9-3	N			**13**	**8.2**	**0.2**	**20**	**2.6**	**1.7**	**350**	**0.35**	**14**	**4.9**	Moderately Saline	Highly sodic	
ENV_AWRC_TP15	7/3/2020	ENV_AWRC_TP15_0.0-0.1_030720	0-0.1	N	**24**	< 10	**7.6**	**4.8**	**0.3**	**8.8**	**0.7**	**1.8**	**25**	**0.025**	**10**	**0.3**	Non Saline	Moderately sodic	**400**
	7/3/2020	ENV_AWRC_TP15_0.9-1.0_030720	0.9-1	N	**230**	**850**	**14**	**9.4**	< 0.1	**29**	**4**	**0.4**	**450**	**0.45**	**8**	**3.6**	Slightly Saline	Highly sodic	**22**
	7/3/2020	ENV_AWRC_TP15_1.9-2.0_030720	1.9-2	N	**210**	**1600**	**12**	**7.9**	**0.1**	**33**	**4**	< 0.1	**700**	**0.7**	**8.5**	**6.0**	Moderately Saline	Highly sodic	**14**
	7/3/2020	ENV_AWRC_TP15_2.9-3.0_030720	2.9-3	N			**20**	**11**	**0.2**	**43**	**8.4**	**0.1**	**580**	**0.58**	**9**	**5.2**	Moderately Saline	Highly sodic	
ENV_AWRC_TP16	6/30/2020	ENV_AWRC_TP16_0.4-0.5_300620	0.4-0.5	N	**120**	**31**	**10**	**7.5**	**0.1**	**21**	**2.2**	**0.7**	**60**	**0.06**	**14**	**0.8**	Non Saline	Highly sodic	**170**
	6/30/2020	ENV_AWRC_TP16_0.9-1.0_300620	0.9-1	N	**68**	**26**	**10**	**7.8**	**0.1**	**23**	**2.5**	< 0.1	**39**	**0.039**	**14**	**0.5**	Non Saline	Highly sodic	**260**
	6/30/2020	ENV_AWRC_TP16_1.9-2.0_300620	1.9-2	N			**8.6**	**5.0**	< 0.1	**39**	**3.4**	**0.1**	**43**	**0.043**	**14**	**0.6**	Non Saline	Highly sodic	
	6/30/2020	ENV_AWRC_TP16_2.9-3.0_300620	2.9-3	N	**31**	**39**	**8.7**	**4.8**	**0.2**	**41**	**3.5**	**0.2**	**50**	**0.05**	**8.5**	**0.4**	Non Saline	Highly sodic	**200**
ENV_AWRC_TP21	6/30/2020	ENV_AWRC_TP21_0.4-0.5_300620	0.4-0.5	N	**92**	**76**	**9.9**	**7.3**	**0.2**	**19**	**1.9**	**0.6**	**72**	**0.072**	**14**	**1.0**	Non Saline	Highly sodic	**140**
	6/30/2020	ENV_AWRC_TP21_0.9-1.0_300620	0.9-1	N	**85**	**160**	**9.2**	**6.1**	**0.1**	**31**	**2.9**	< 0.1	**110**	**0.11**	**14**	**1.5**	Non Saline	Highly sodic	**92**
	6/30/2020	ENV_AWRC_TP21_1.9-2.0_300620	1.9-2	N			**16**	**9.8**	**0.2**	**35**	**5.5**	< 0.1	**240**	**0.24**	**14**	**3.4**	Slightly Saline	Highly sodic	
	6/30/2020	ENV_AWRC_TP21_2.9-3.0_300620	2.9-3	N	**99**	**450**	**16**	**9.9**	**0.3**	**37**	**6.1**	< 0.1	**250**	**0.25**	**9**	**2.3**	Slightly Saline	Highly sodic	**40**
ENV_AWRC_TP22	6/30/2020	ENV_AWRC_TP22_0.0-0.1_300620	0-0.1	N	**40**	< 10	**10**	**7.0**	**0.1**	**15**	**1.5**	**1.4**	**31**	**0.031**	**8.5**	**0.3**	Non Saline	Highly sodic	**330**
	6/30/2020	ENV_AWRC_TP22_0.9-1.0_300620	0.9-1	N	**140**	**340**	**13**	**8.4**	**0.1**	**32**	**4.1**	**0.2**	**210**	**0.21**	**8.5**	**1.8**	Non Saline	Highly sodic	**47**
	6/30/2020	ENV_AWRC_TP22_1.9-2.0_300620	1.9-2	N	**92**	**490**	**16**	**9.6**	**0.2**	**37**	**5.9**	**0.1**	**250**	**0.25**	**14**	**3.5**	Slightly Saline	Highly sodic	**41**
	6/30/2020	ENV_AWRC_TP22_2.9-3.0_300620	2.9-3	N			**13**	**7.5**	**0.2**	**39**	**5.0**	< 0.1	**230**	**0.23**	**14**	**3.2**	Slightly Saline	Highly sodic	
ENV_AWRC_TP23	7/1/2020	ENV_AWRC_TP23_0.4-0.5_010720	0.4-0.5	N	**56**	< 10	**22**	**14**	**0.2**	**8.8**	**1.9**	**6.0**	**53**	**0.053**	**8.5**	**0.5**	Non Saline	Moderately sodic	**190**
	7/1/2020	ENV_AWRC_TP23_0.9-1.0_010720	0.9-1	N	**100**	**22**	**15**	**11**	**0.2**	**17**	**2.6**	**0.9**	**46**	**0.046**	**8.5**	**0.4**	Non Saline	Highly sodic	**220**
	7/1/2020	ENV_AWRC_TP23_1.9-2.0_010720	1.9-2	N			**12**	**8.4**	**0.2**	**30**	**3.8**	< 0.1	**150**	**0.15**	**9**	**1.4**	Non Saline	Highly sodic	**69**
	7/1/2020	ENV_AWRC_TP23_2.9-3.0_010720	2.9-3	N	**120**	**300**	**15**	**9.4**	**0.2**	**34**	**5.1**	**0.4**	**180**	**0.18**	**14**	**2.5**	Slightly Saline	Highly sodic	**55**
ENV_AWRC_TP29	7/3/2020	ENV_AWRC_TP29_0.9-1.0_030720	0.9-1	N	**80**	**65**	**9.2**	**1.6**	**0.2**	**4.3**	**2.2**	**1.8**	**49**	**0.049**	**14**	**0.7**	Non Saline	Non-sodic	**200**
	7/3/2020	ENV_AWRC_TP29_1.9-2.0_030720	1.9-2	N	**82**	**300**	**13**	**8.8**	**0.2**	**33**	**4.4**	< 0.1	**140**	**0.14**	**14**	**2.0**	Slightly Saline	Highly sodic	**72**
	7/3/2020	ENV_AWRC_TP29_2.9-3.0_030720	2.9-3	N			**14**	**8.6**	**0.2**	**36**	**5**	< 0.1	**200**	**0.2**	**14**	**2.8**	Slightly Saline	Highly sodic	
ENV_AWRC_TP30	7/1/2020	ENV_AWRC_TP30_0.4-0.5_010720	0.4-0.5	N	**44**	**23**	**3.9**	**2.7**	< 0.1	**20**	**0.8**	**0.3**	**30**	**0.03**	**14**	**0.4**	Non Saline	Highly sodic	**340**
	7/1/2020	ENV_AWRC_TP30_0.9-1.0_010720	0.9-1	N	**42**	**78**	**14**	**11**	**0.1**	**18**	**2.5**	**0.1**	**48**	**0.048**	**9**	**0.4**	Non Saline	Highly sodic	**210**
	7/1/2020	ENV_AWRC_TP30_1.9-2.0_010720	1.9-2	N			**8.9**	**6.7**	**0.1**	**23**	**2.0**	< 0.1	**53**	**0.053**	**14**	**0.7**	Non Saline	Highly sodic	
	7/1/2020	ENV_AWRC_TP30_2.9-3.0_010720	2.9-3	N	**35**	**31**	**12**	**8.5**	**0.2**	**27**	**3.3**	< 0.1	**43**	**0.043**	**14**	**0.6**	Non Saline	Highly sodic	**230**
ENV_AWRC_TP41	7/3/2020	ENV_AWRC_TP41_0.0-0.1_030720	0-0.1	N	**12**	**24**	**7.6**	**2.8**	< 0.1	**2.7**	< 0.1	**4.5**	**32**	**0.032**	**10**	**0.3**	Non Saline	Non-sodic	**310**
	7/3/2020	ENV_AWRC_TP41_0.9-1.0_030720	0.9-1	N	**160**	**350**	**13**	**8.3**	**0.1**	**28**	**3.8**	**1.3**	**220**	**0.22**	**8.5**	**1.9**	Non Saline	Highly sodic	**46**
	7/3/2020	ENV_AWRC_TP41_1.9-2.0_030720	1.9-2	N	**100**	**660**	**19**	**12**	**0.3**	**35**	**6.8**	**0.1**	**300**	**0.3**	**9**	**2.7**	Slightly Saline	Highly sodic	**34**
	7/3/2020	ENV_AWRC_TP41_2.9-3.0_030720	2.9-3	N			**14**	**8.2**	**0.2**	**39**	**5.4**	**0.1**	**300**	**0.3**	**14**	**4.2**	Moderately Saline	Highly sodic	
ENV_AWRC_TP42	7/1/2020	ENV_AWRC_TP42_0.4-0.5_010720	0.4-0.5	N	**52**	**24**	**11**	**7.7**	**0.2**	**23**	**2.4**	**0.3**	**24**	**0.024**	**14**	**0.3**	Non Saline	Highly sodic	**420**
	7/1/2020	ENV_AWRC_TP42_0.9-1.0_010720	0.9-1	N	**44**	**19**	**10**	**7.6**	**0.1**	**23**	**2.4**	**0.1**	**27**	**0.027**	**14**	**0.4**	Non Saline	Highly sodic	**370**
	7/1/2020	ENV_AWRC_TP42_1.9-2.0_010720	1.9-2	N			**11**	**7.1**	**0.1**	**31**	**3.2**	< 0.1	**52**	**0.052**	**14**	**0.7**	Non Saline	Highly sodic	
	7/1/2020	ENV_AWRC_TP42_2.9-3.0_010720	2.9-3	N	**31**	**110**	**10.0**	**6.4**	**0.1**	**34**	**3.4**	< 0.1	**76**	**0.076**	**14**	**1.1**	Non Saline	Highly sodic	**130**
ENV_AWRC_TP44	7/2/2020	ENV_AWRC_TP44_0.9-1.0_020720	0.9-1	N	**190**	**430**	**12**	**7.6**	**0.1**	**33**	**4**	**0.3**	**250**	**0.25**	**14**	**3.5**	Slightly Saline	Highly sodic	**41**
	7/2/2020	ENV_AWRC_TP44_1.9-2.0_020720	1.9-2	N	**86**	**640**	**15**	**8.9**	**0.2**	**39**	**5.9**	**0.2**	**260**	**0.26**	**14**	**3.6**	Slightly Saline	Highly sodic	**39**
	7/2/2020	ENV_AWRC_TP44_2.9-3.0_020720	2.9-3	N			**4.4**	**2.9**	< 0.1	**31**	**1.4**	< 0.1	**490**	**0.49**	**14**	**6.9**	Moderately Saline	Highly sodic	
ENV_AWRC_TP49	7/3/2020	ENV_AWRC_TP44_0.0-0.1_030720	0-0.1	N	**14**	**13**	**3.5**	**1.3**	**0.2**	**2.5**	< 0.1	**2**	**12**	**0.012**	**10**	**0.1**	Non Saline	Non-sodic	**830**
	7/2/2020	ENV_AWRC_TP49_0.4-0.5_020720	0.4-0.5	N	**150**	**71**	**14**	**11**	< 0.1	**22**	**3**	**0.3**	**77**	**0.077**	**14**	**1.1**	Non Saline	Highly sodic	**130**
	7/2/2020	ENV_AWRC_TP49_0.9-1.0_020720	0.9-1	N	**93**	**64**	**13**	**9.8**	**0.1**	**23**	**3.1**	< 0.1	**68**	**0.068**	**9**	**0.6**	Non Saline	Highly sodic	**150**
	7/2/2020	ENV_AWRC_TP49_1.9-2.0_020720	1.9-2	N			**15**	**11**	**0.2**	**27**	**4.1**	< 0.1	**89**	**0.089**	**9**	**0.8**	Non Saline	Highly sodic	
	7/2/2020	ENV_AWRC_TP49_2.9-3.0_020720	2.9-3	N	**92**	**210**	**15**	**9.4**	**0.2**	**37**	**5.7**	< 0.1	**140**	**0.14**	**8.5**	**1.2**	Non Saline	Highly sodic	**71**
ENV_AWRC_TP50	7/2/2020	ENV_AWRC_TP50_0.0-0.1_020720	0-0.1	N	**32**	**12**	**2.6**	**1.1**	**0.3**	**3.9**	< 0.1	**1.2**	**17**	**0.017**	**14**	**0.2**	Non Saline	Non-sodic	**610**
	7/2/2020	ENV_AWRC_TP50_0.9-1.0_020720	0.9-1	N	**74**	**130**	**11**	**8.6**	**0.1**	**23**	**2.6**	**<0.1**	**79**	**0.079**	**9**	**0.7**	Non Saline	Highly sodic	**130**
	7/2/2020	ENV_AWRC_TP50_1.9-2.0_020720	1.9-2	N	**87**	**140**	**16**	**11**	**0.1**	**27**	**4.2**	**<0.1**	**84**	**0.084**	**8.5**	**0.7**	Non Saline	Highly sodic	**120**
	7/2/2020	ENV_AWRC_TP50_2.9-3.0_020720	2.9-3	N			**18**	**13**	**0.2**	**29**	**5.3**	**<0.1**	**84**	**0.084**	**14**	**1.2**	Non Saline	Highly sodic	

Statistical Summary

Number of Results	59	59	72	72	72	144	144	72	72							60
Number of Detects	59	54	72	72	60	138	138	49	72							60
Number of non-Detects	0	5	0	0	12	6	6	23	0							0
Minimum Concentration	12	< 5	2.6	1.1	0.1	< 0.1	< 0.1	< 0.1	12							14
Minimum Detect	12	9.1	2.6	1.1	0.1	0.3	0.3	0.1	12							14
Maximum Concentration	770	1600	22	14	1.1	44	44	6	700							830
Maximum Detect	770	1600	22	14	1.1	44	44	6	700							830
Mean Concentration	105.949	313.366	11.589	7.444	0.168	14.684	14.684	0.716	174.056							186.117
Geometric Average	76.714	103.272	10.575	6.505	0.139	6.897	6.897	0.243	101.344							107.942
Standard Deviation	108.231	404.347	4.438	3.189	0.133	14.171	14.171	1.153	171.828							185.904
Median Average	86	78	12	8	0.2	5.9	5.9	0.2	83							135
Geometric Standard Deviation	2.24	5.652	1.593	1.804	1.842	4.736	4.736	4.399	3.022							3.07
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	0	0	0							0

Legend:
- Not analysed / not calculated
LOR – Limit of Recording
* LOR Exceeds Guideline Trigger Value
Sample Type: N - Primary, FD - Duplicate, FT - Triplicate
% = Percent
meq/100g = meq / 100g
mg/kg = milligrams per kilogram
ohm.m =
us/cm = Microsiemens per centimetre

Action Levels:
1. Non Saline (Salinity effects mostly negligible).
2. Slightly Saline (Yields of very sensitive crops may be affected).
3. Moderately Saline (Yield of many crops affected).
4. Very Saline (Only tolerant crops yield satisfactorily).
5. Highly Saline (Only a few very tolerant crops yield satisfactorily).

1. Non-sodic (Soil with an ESP of less than 5%)
2. Moderately sodic (Soil with an ESP between 5 and 10%)
3. Highly sodic (Soil with an ESP of more than 10%)

Table 1b: Soil Analytical Results - Cations and Anions, sodic classification, salinity and Inorganics

Sample Date - 2020-02-25 - 2020-09-24
Site ID: Sydney Water - Upper South Creek Brine Pipelines

					Cations and Anions														Inorganics
					Sulphate as SO4 2-	Chloride	Cation Exchange Capacity	Exchangeable Magnesium	Exchangeable Potassium	Exchangeable Sodium Percentage (ESP)	Exchangeable Sodium	Exchangeable Calcium	Conductivity (1:5 aqueous extract at 25°C	Conductivity (1:5 aqueous extract at 25°C	Soil Texture Group Multiplication Factor (Light medium clay)	ECe	Salinity Classification (DLWC, 2002)**	Sodic Classification	Resistivity at 80°C
				LOR	30	5	0.05	0.1	0.1	0.1	0.1	0.1	10	0.001	-	-	-	-	0.5
				Units	mg/kg	mg/kg	meq/100g	meq/100g	meq/100g	%	meq/100g	meq/100g	us/cm	ds/m	-	ds/m	-	-	ohm.m
Sample Location	Date Sampled	Sample ID	Depth Range (m)	Action Levels / Sample Type															
BDNO5_BH03B	5/21/2020	BDNO5_BH03B_0.0-0.2_210520	0-0.2	N	43	14	9.0	5.0	0.4	6.2	0.6	3.1	42	0.042	10	0.4	Non Saline	Moderately sodic	240
	5/21/2020	BDNO5_BH03B_0.2-0.4_210520	0.2-0.4	N			12	7.9	0.3	10	1.2	2.4	60	0.06	8	0.5	Non Saline	Moderately sodic	
	5/21/2020	BDNO5_BH03B_0.4-0.6_210520	0.4-0.6	N	190	75	13	9.0	0.3	18	2.3	1.2	120	0.12	8	1.0	Non Saline	Highly sodic	87
	5/21/2020	BDNO5_BH03B_0.9-1.1_210520	0.9-1.1	N	120	330	14	10	0.3	24	3.4	0.3	350	0.35	8	2.8	Slightly Saline	Highly sodic	28
	5/21/2020	BDNO5_BH03B_1.4-1.6_210520	1.4-1.6	N	94	230	12	7.3	0.3	35	4.2	0.1	300	0.3	9	2.7	Slightly Saline	Highly sodic	33
BDNO5_BH04	5/8/2020	BDNO5_BH04_0.9-1.1_080520	0.9-1.1	N	35	82	18	10	0.4	12	2.2	5.3	110	0.11	7	0.8	Non Saline	Highly sodic	94
	5/8/2020	BDNO5_BH04_1.4-1.6_080520	1.4-1.6	N	36	210	21	12	0.4	17	3.6	4.5	140	0.14	7	1.0	Non Saline	Highly sodic	74
	5/11/2020	BDNO5_BH04_0.0-0.2_110520	0-0.2	N	< 30	6.1	24	6.7	1.1	1.5	< 0.1	16	37	0.037	9	0.3	Non Saline	Non-sodic	270
	5/11/2020	BDNO5_BH04_0.2-0.4_110520	0.2-0.4	N			29	10	0.6	3.1	0.9	17	30	0.03	9	0.3	Non Saline	Non-sodic	
	5/11/2020	BDNO5_BH04_0.4-0.6_110520	0.4-0.6	N	89	15	32	13	0.4	5.1	1.6	17	55	0.055	7	0.4	Non Saline	Moderately sodic	180
BDNO5_BH06	5/12/2020	BDNO5_BH06_0.0-0.2_120520	0-0.2	N	78	6.0	18	6.6	0.6	3.7	0.7	9.8	25	0.025	8.5	0.2	Non Saline	Non-sodic	390
	5/12/2020	BDNO5_BH06_0.2-0.4_120520	0.2-0.4	N			25	12	0.4	9.0	2.2	9.8	58	0.058	7	0.4	Non Saline	Moderately sodic	
	5/12/2020	BDNO5_BH06_0.4-0.6_120520	0.4-0.6	N	170	120	26	13	0.3	15	3.8	8.3	130	0.13	7	0.9	Non Saline	Highly sodic	76
	5/12/2020	BDNO5_BH06_1.4-1.6_120520	1.4-1.6	N	< 30	610	23	13	0.2	13	3.1	7.2	400	0.4	9	3.6	Slightly Saline	Highly sodic	25
BDNO5_BH07	5/7/2020	BDNO5_BH07_0.0-0.1_070520	0-0.1	N	< 30	18	6.5	2.6	0.4	6.4	0.4	3.1	40	0.04	10	0.4	Non Saline	Moderately sodic	250
	5/7/2020	BDNO5_BH07_0.2-0.3_070520	0.2-0.3	N			10	6.3	0.1	9.0	0.9	2.9	31	0.031	8.5	0.3	Non Saline	Moderately sodic	
	5/7/2020	BDNO5_BH07_0.4-0.6_070520	0.4-0.6	N	230	9.3	12	8.9	0.2	11	1.4	1.9	25	0.025	8.5	0.2	Non Saline	Highly sodic	410
	5/7/2020	BDNO5_BH07_1.4-1.6_070520	1.4-1.6	N	150	390	12	8.2	0.2	27	3.2	0.4	280	0.28	9	2.5	Slightly Saline	Highly sodic	35
BDNO5_BH12	4/9/2020	BDNO5_BH12_0.0-0.15_090420	0-0.15	N	160	20	15	8.9	0.3	13	1.9	3.6	73	0.073	14	1.0	Non Saline	Highly sodic	140
	4/9/2020	BDNO5_BH12_0.4-0.5_090420	0.4-0.5	N	240	65	13	5.7	0.3	20	2.7	4.8	130	0.13	14	1.8	Non Saline	Highly sodic	76
	4/9/2020	BDNO5_BH12_0.9-1.0_090420	0.9-1	N	260	560	11	6.5	0.2	20	2.2	2.0	510	0.51	8.5	4.3	Moderately Saline	Highly sodic	20
	4/9/2020	BDNO5_BH12_2.9-3.0_090420	2.9-3	N	150	850	12	7.9	0.2	27	3.2	0.7	750	0.75	8.5	6.4	Moderately Saline	Highly sodic	13
BDNO5_BH13	4/8/2020	BDNO5_BH13_0.0-0.2_080420	0-0.2	N	< 30	44	18	6.8	0.3	4.3	0.8	9.7	180	0.18	14	2.5	Slightly Saline	Non-sodic	55
	4/8/2020	BDNO5_BH13_0.4-0.5_080420	0.4-0.5	N	< 30	93	8.7	4.4	0.2	11	1.0	3.2	91	0.091	8.5	0.8	Non Saline	Highly sodic	110
	4/8/2020	BDNO5_BH13_0.9-1.0_080420	0.9-1	N	120	380	8.8	5.7	0.1	18	1.6	1.3	350	0.35	9	3.2	Slightly Saline	Highly sodic	28
	4/8/2020	BDNO5_BH13_1.9-2.0_080420	1.9-2	N			11	6.4	< 0.1	37	3.9	0.3	830	0.83	8	6.6	Moderately Saline	Highly sodic	
	4/8/2020	BDNO5_BH13_2.9-3.0_080420	2.9-3	N	< 30	180	12	6.2	< 0.1	38	4.4	0.9	360	0.36	14	5.0	Moderately Saline	Highly sodic	27
BDNO5_BH16	3/17/2020	BDNO5_BH16_0.0-0.2_170320	0-0.2	N	< 30	11	20	4.2	0.5	2.3	0.5	15	110	0.11	9	1.0	Non Saline	Non-sodic	88
	3/17/2020	BDNO5_BH16_0.4-0.5_170320	0.4-0.5	N	< 30	19	25	5.3	2	2.6	0.7	19	130	0.13	9	1.2	Non Saline	Non-sodic	75
	3/17/2020	BDNO5_BH16_0.7-0.8_170320	0.7-0.8	N	200	190	7.7	3.5	< 0.1	21	1.6	2.5	430	0.43	8.5	3.7	Slightly Saline	Highly sodic	23
	3/17/2020	BDNO5_BH16_2.4-2.5_170320	2.4-2.5	N	200	530	4.0	2.1	< 0.1	42	1.6	0.2	560	0.56	8.5	4.8	Moderately Saline	Highly sodic	18
	3/17/2020	BDNO5_BH16_3.4-3.5_170320	3.4-3.5	N			3.8	1.8	< 0.1	38	1.4	0.4	630	0.63	10	6.3	Moderately Saline	Highly sodic	
BDNO5_BH17	3/16/2020	BDNO5_BH17_0.0-0.2_160320	0-0.2	N	53	39	16	5.3	0.6	3.1	0.5	9.2	71	0.071	10	0.7	Non Saline	Non-sodic	140
	3/16/2020	BDNO5_BH17_0.4-0.5_160320	0.4-0.5	N	69	64	16	5.7	0.3	6.6	1.0	8.7	96	0.096	10	1.0	Non Saline	Highly sodic	100
	3/16/2020	BDNO5_BH17_0.9-1.0_160320	0.9-1	N	290	220	17	7.4	0.2	30	5.1	4.3	260	0.26	10	2.6	Slightly Saline	Highly sodic	39
	3/16/2020	BDNO5_BH17_1.9-2.0_160320	1.9-2	N	670	600	8.3	4.1	0.1	35	2.9	1.2	670	0.67	8.5	5.7	Moderately Saline	Highly sodic	15
	3/16/2020	BDNO5_BH17_3.4-3.5_160320	3.4-3.5	N			6.6	3.2	0.1	34	2.3	1.0	510	0.51	8.5	4.3	Moderately Saline	Highly sodic	
BDNO5_BH18	3/12/2020	BDNO5_BH18_0.0-0.2_120320	0-0.2	N	71	80	17	3.0	0.2	5.7	1.0	1.3	160	0.16	9	1.4	Non Saline	Moderately sodic	62
	3/12/2020	BDNO5_BH18_0.4-0.5_120320	0.4-0.5	N	56	140	5.0	1.4	< 0.1	18	0.9	2.6	140	0.14	14	1.96	Non Saline	Highly sodic	69
	3/12/2020	BDNO5_BH18_0.9-1.0_120320	0.9-1	N	< 30	540	6.9	3.3	< 0.1	6.7	0.5	3.1	480	0.48	14	6.7	Moderately Saline	Moderately sodic	21
	3/12/2020	BDNO5_BH18_1.9-2.0_120320	1.9-2	N			5.2	2.7	< 0.1	27	1.4	1.0	520	0.52	8.5	4.4	Moderately Saline	Highly sodic	
	3/12/2020	BDNO5_BH18_3.4-3.5_120320	3.4-3.5	N	61	570	8.4	5.1	0.1	35	2.9	0.2	680	0.68	9	6.1	Moderately Saline	Highly sodic	15
BDNO5_BH19	3/13/2020	BDNO5_BH19_0.0-0.2_130320	0-0.2	N	53	33	18	4.7	1.0	2.7	0.5	12	64	0.064	8.5	0.5	Non Saline	Non-sodic	160
	3/13/2020	BDNO5_BH19_0.4-0.5_130320	0.4-0.5	N	41	10	20	5.4	0.3	1.4	0.3	14	57	0.057	8.5	0.5	Non Saline	Non-sodic	180
	3/13/2020	BDNO5_BH19_0.9-1.0_130320	0.9-1	N	< 30	100	7.0	1.3	< 0.1	3.2	0.2	5.4	36	0.036	8	0.3	Non Saline	Non-sodic	280
	3/13/2020	BDNO5_BH19_3.4-3.5_130320	3.4-3.5	N			8.0	4.2	0.1	41	3.3	0.4	510	0.51	8.5	4.3	Moderately Saline	Highly sodic	
BDNO5_BH21	3/13/2020	BDNO5_BH21_0.1-0.2_130320	0.1-0.2	N	< 30	10	21	3.2	0.7	3.7	0.8	16	99	0.099	14	1.4	Non Saline	Non-sodic	100
	3/13/2020	BDNO5_BH21_0.4-0.5_130320	0.4-0.5	N	< 30	< 5	32	4.3	0.7	2.6	0.8	26	82	0.082	14	1.1	Non Saline	Non-sodic	120
BDNO5_BH23C	4/22/2020	BDNO5_BH23C_0.1-0.2_220420	0.1-0.2	N	170	9.1	5.7	1.7	0.3	4.3	0.3	3.4	49	0.049	14	0.7	Non Saline	Non-sodic	200
	4/22/2020	BDNO5_BH23C_0.4-0.5_220420	0.4-0.5	N			2.8	1.3	0.2	10.0	0.3	1.0	45	0.045	14	0.6	Non Saline	Moderately sodic	
	4/22/2020	BDNO5_BH23C_0.9-1.0_220420	0.9-1	N	94	11	3.2	1.2	0.2	7.9	0.3	1.6	54	0.054	9	0.5	Non Saline	Moderately sodic	190
	4/22/2020	BDNO5_BH23C_1.8-1.9_220420	1.8-1.9	N	60	13	5.6	1.1	0.2	14	0.8	3.5	59	0.059	9	0.5	Non Saline	Highly sodic	170
	4/22/2020	BDNO5_BH23C_2.8-2.9_220420	2.8-2.9	N	95	200	1.6	0.4	< 0.1	54	0.9	0.2	180	0.18	9	1.6	Non Saline	Highly sodic	57
BDNO5_BH24	4/21/2020	BDNO5_BH24_0.0-0.1_210420	0-0.1	N	< 30	< 5	18	4.4	0.8	1.7	0.3	12	49	0.049	9	0.4	Non Saline	Non-sodic	200
	4/21/2020	BDNO5_BH24_0.2-0.3_210420	0.2-0.3	N			10	2.9	0.5	2.5	0.3	6.7	41	0.041	8	0.3	Non Saline	Non-sodic	
	4/21/2020	BDNO5_BH24_0.4-0.6_210420	0.4-0.6	N	35	7.6	12	4.4	0.3	3.0	0.4	6.6	29	0.029	8	0.2	Non Saline	Non-sodic	350
	4/21/2020	BDNO5_BH24_1.9-2.1_210420	1.9-2.1	N	84	28	9.2	3.1	0.4	11	1.0	4.6	95	0.095	8	0.8	Non Saline	Highly sodic	110
BDNO5_BH25	4/22/2020	BDNO5_BH25_0.0-0.1_220420	0-0.1	N	< 30	6.8	19	5.4	0.6	1.9	0.4	13	41	0.041	8.5	0.3	Non Saline	Non-sodic	240
	4/22/2020	BDNO5_BH25_0.2-0.3_220420	0.2-0.3	N			18	4.4	0.4	1.9	0.3	12	24	0.024	8.5	0.2	Non Saline	Non-sodic	
	4/22/2020	BDNO5_BH25_0.4-0.6_220420	0.4-0.6	N	74	16	19	7.5	0.3	6.4	1.2	9.5	29	0.029	8.5	0.2	Non Saline	Moderately sodic	350
	4/22/2020	BDNO5_BH25_1.4-1.6_220420	1.4-1.6	N	42	170	15	8.0	0.2	20	2.9	3.5	160	0.16	8.5	1.4	Non Saline	Highly sodic	63
BDNO5_PTP06	3/24/2020	BDNO5_PTP06_0.25-0.45_240320	0.25-0.45	N	220	370	13	6.9	0.2	22	2.8	3.2	440	0.44	8.5	3.7	Slightly Saline	Highly sodic	23
	3/24/2020	BDNO5_BH25_0.6-0.8_240320	0.6-0.8	N	94	290	15	7.9	0.1	37	5.4	1.2	310	0.31	8.5	2.6	Slightly Saline	Highly sodic	33
	3/24/2020	BDNO5_BH25_0.9-1.1_240320	0.9-1.1	N	110	300	16	8.9	0.2	38	6.2	1.1	280	0.28	8.5	2.4	Slightly Saline	Highly sodic	36
	3/24/2020	BDNO5_BH25_1.4-1.6_240320	1.4-1.6	N	96	230	16	8.8	0.2	41	6.5	0.5	280	0.28	9	2.5	Slightly Saline	Highly sodic	35
BDNO5_PTP08	3/23/2020	BDNO5_PTP08_0.3-0.5_230320	0.3-0.5	N	120	9.7	21	6.0	0.3	9.2	1.9	1.9	94	0.094	7	0.7	Non Saline	Moderately sodic	110
	3/23/2020	BDNO5_PTP08_0.9-1.1_230320	0.9-1.1	N	160	< 5	13	9.0	0.2	17	2.2	1.5	38	0.038	7	0.3	Non Saline	Highly sodic	260
	3/23/2020	BDNO5_PTP08_1.4-1.6_230320	1.4-1.6	N	140	< 5	12	7.7	0.3	26	3.2	1.0	30	0.03	7	0.2	Non Saline	Highly sodic	340
BDNO5_TP05	5/13/2020	BDNO5_TP05_0.0-0.2_130520	0-0.2	N	37	< 5	8.5	3.3	0.3	3.6	0.3	4.6	22	0.022	9	0.2	Non Saline	Non-sodic	470
	5/13/2020	BDNO5_TP05_0.2-0.4_130520	0.2-0.4	N			11	7.2	0.2	9.6	1.0	2.2	27	0.027	7	0.2	Non Saline	Moderately sodic	
	5/13/2020	BDNO5_TP05_0.4-0.6_130520	0.4-0.6	N	95	120	12	8.5	0.2	20	2.4	0.8	110	0.11	9	1.0	Non Saline	Highly sodic	89
	5/13/2020	BDNO5_TP05_1.4-1.6_130520	1.4-1.6	N	150	360	14	8.3	0.2	27	3.7	1.7	240	0.24	9	2.2	Slightly Saline	Highly sodic	42
BDNO5_TP06	5/13/2020	BDNO5_TP06_0.0-0.2_130520	0-0.2	N	< 30	5.9	5.3	1.8	0.4	4.5	0.2	2.9	37	0.037	9	0.3	Non Saline	Non-sodic	270
	5/13/2020	BDNO5_TP06_0.2-0.4_130520	0.2-0.4	N			3.8	1.4	0.2	5.2	0.2	2.0	13	0.013	9	0.1	Non Saline	Moderately sodic	
	5/13/2020	BDNO5_TP06_0.4-0.6_130520	0.4-0.6	N	150	5.1	6.8	4.5	0.1	10.0	0.7	1.5	18	0.018	8.5	0.2	Non Saline	Moderately sodic	550
	5/13/2020	BDNO5_TP06_1.4-1.6_130520	1.4-1.6	N	79	470	15	9.5	0.2	34	5.2	0.3	330	0.33	8.5	2.8	Slightly Saline	Highly sodic	30
BDNO5_TP07	5/20/2020	BDNO5_TP07_0.0-0.1_200520	0-0.1	N	< 30	< 5	13	5.9	0.4	4.5	0.6	6.0	17	0.017	8.5	0.1	Non Saline	Non-sodic	580
	5/20/2020	BDNO5_TP07_0.2-0.4_200520	0.2-0.4	N			15	8.9	0.3	9.2	1.3	4.0	24	0.024	8.5	0.2	Non Saline	Moderately sodic	410
	5/20/2020	BDNO5_TP07_0.4-0.6_200520	0.4-0.6	N	74	20	13	8.5	0.3	13	1.7	2.8	35	0.035	8.5	0.3	Non Saline	Highly sodic	280
	5/20/2020	BDNO5_TP07_0.9-1.1_200520	0.9-1.1	N	47	110	17	11	0.4	16	2.8	3.1	93	0.093	17	1.6	Non Saline	Highly sodic	110
	5/20/2020	BDNO5_TP07_1.4-1.6_200520	1.4-1.6	N	< 30	72	14	9.3	0.2	16	2.2	2.6	66	0.066	9	0.6	Non Saline	Highly sodic	150
BDNO5_TP08	5/20/2020	BDNO5_TP08_0.0-0.1_200520	0-0.1	N	76	6.6	21	6.3	0.3	3.8	0.8	13	27	0.027	8.5	0.2	Non Saline	Non-sodic	380
	5/20/2020	BDNO5_TP08_0.2-0.4_200520	0.2-0.4	N			16	8.4	0.2	7.3	1.2	6.6	27	0.027	8.5	0.2	Non Saline	Moderately sodic	
	5/20/2020	BDNO5_TP08_0.4-0.6_200520	0.4-0.6	N	210	30	29	11	0.3	10	3.1	16	77	0.077	8.5	0.7	Non Saline	Moderately sodic	130
	5/20/2020	BDNO5_TP08_0.9-1.1_200520	0.9-1.1	N	65	270	22	13	0.3	19	4.2	4.6	280	0.28	8.5	2.4	Slightly Saline	Highly sodic	35
	5/20/2020	BDNO5_TP08_1.4-1.7_200520	1.4-1.7	N	45	280	27	9.6	0.3	16	4.3	13	320	0.32	8.5	2.7	Slightly Saline	Highly sodic	32
BDNO5_TP10	3/13/2020	BDNO5_TP10_0.0-0.2_130320	0-0.2	N	36	17	21	1.8	0.5	1.0	0.2	19	76	0.076	9	0.7	Non Saline	Non-sodic	130
	3/13/2020	BDNO5_TP10_0.4-0.5_130320	0.4-0.5	N	430	85	8.0	2.8	0.1	8.9	0.7	4.4	93	0.093	8.5	0.8	Non Saline	Moderately sodic	110
	3/13/2020	BDNO5_TP10_0.9-1.0_130320	0.9-1	N	450	1000	12	7.3	0.1	13	1.6	3.2	870	0.87	8.5	7.4	Moderately Saline	Highly sodic	11
BP_BH18	3/12/2020	BP_BH18_0.0-0.1_120320	0-0.1	N	250	120	33	4.7	0.1	3.7	1.2	27	360	0.36	14	5.0	Moderately Saline	Non-sodic	28
	3/12/2020	BP_BH18_0.4-0.5_120320	0.4-0.5	N	540	200	23	10	0.2	12	2.9	9.6	470	0.47	14	6.6	Moderately Saline	Highly sodic	22
	3/12/2020	BP_BH18_1.3-1.4_120320	1.3-1.4	N	260	68	19	9.3	0.3	18	3.3	5.8	210	0.21	14	2.9	Slightly Saline	Highly sodic	48
BP_BH19	3/12/2020	BP_BH19_0.4-0.5_120320	0.4-0.5	N	330	370	13	8.8	0.2	20	2.6	1.2	490	0.49	9	4.4	Moderately Saline	Highly sodic	21
BP_BH20	3/12/2020	BP_BH19_1.1-1.2_120320	1.1-1.2	N	54	35	11	8.0	0.4	23	2.6	0.1	77	0.077	8	0.6	Non Saline	Highly sodic	130
	3/12/2020	BP_BH20_0.0-0.1_120320	0-0.1	N	140	14	8.2	3.3	0.1	7.7	0.6	4.2	40	0.04	14	0.6	Non Saline	Moderately sodic	250
	3/12/2020	BP_BH20_0.4-0.5_120320	0.4-0.5	N	160	43	16	8.9	0.2	14	2.3	4.4	130	0.13	7	0.9	Non Saline	Highly sodic	75
BP_TP09	5/22/2020	BP_TP09_0.2-0.3_220520	0.2-0.3	N	98	40	11	7.8	0.3	11	1.1	1.3	45	0.045	8.5	0.4	Non Saline	Highly sodic	220
	5/22/2020	BP_TP09_0.9-1.0_220520	0.9-1	N	140	220	14	9.8	0.4	23	3.1	0.3	210	0.21	8.5	1.8	Non Saline	Highly sodic	48
	5/22/2020	BP_TP09_1.4-1.5_220520	1.4-1.5	N	170	410	14	8.8	0.4	34	4.9	0.2	460	0.46	9	4.1	Slightly Saline	Highly sodic	22
Statistical Summary																			
Number of Results					83	83	99	99	99	198	198	99	99						84
Number of Detects					66	77	99	99	89	197	197	99	99						84
Number of non-Detects					17	6	0	0	10	1	1	0	0						0
Minimum Concentration					< 30	< 5	1.6	0.4	0.1	< 0.1	< 0.1	0.1	13						11
Minimum Detect					35	5.1	1.6	0.4	0.1	0.2	0.2	0.1	13						11
Maximum Concentration					670	1000	33	13	1.1	54	54	27	870						580
Maximum Detect					670	1000	33	13	1.1	54	54	27	870						580
Mean Concentration					118.843	162.786	14.248	6.363	0.285	8.641	8.641	5.652	196.192						138.167
Geometric Average					74.009	55.735	12.426	5.364	0.225	3.698	3.698	2.895	111.417						85.702
Standard Deviation					120.629	208.533	6.914	3.141	0.196	10.985	10.985	5.914	206.358						132.414
Median Average					84	72	13	6.4	0.3	3.35	3.35	3.2	98						91.5
Geometric Standard Deviation					2.818	5.51	1.764	1.945	2.079	4.161	4.161	3.815	3.021						2.812
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	0	0	0	0						0

Legend:
- Not analysed / not calculated
LOR – Limit of Recording
* LOR Exceeds Guideline Trigger Value
Sample Type: N - Primary, FD - Duplicate, FT - Triplicate
% = Percent
meq/100g = meq / 100g
mg/kg = milligrams per kilogram
ohm.m =
us/cm = Microsiemens per centimetre

Action Levels:
1. Non Saline (Salinity effects mostly negligible).
2. Slightly Saline (Yields of very sensitive crops may be affected).
3. Moderately Saline (Yield of many crops affected).
4. Very Saline (Only tolerant crops yield satisfactorily)
5. Highly Saline (Only a few very tolerant crops yield satisfactorily).

1. Non-sodic (Soil with an ESP of less than 5%)
2. Moderately sodic (Soil with an ESP between 5 and 10%)
3. Highly sodic (Soil with an ESP of more than 10%)

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Table 1c: Soil Analytical Results - Cations and Anions, sodic classification, salinity and Inorganics

Sample Date - 2020-02-25 - 2020-09-24
Site ID: Sydney Water - Upper South Creek Treated Water Pipelines

					Cations and Anions														Inorganics
					Sulphate as SO4 2-	Chloride	Cation Exchange Capacity	Exchangeable Magnesium	Exchangeable Potassium	Exchangeable Sodium Percentage (ESP)	Exchangeable Sodium	Exchangeable Calcium	Conductivity (1:5 aqueous extract at 25°C	Conductivity (1:5 aqueous extract at 25°C	Soil Texture Group Multiplication Factor (Light medium clay)	ECe	Salinity Classification (DLWC, 2002)**	Sodic Classification	Resistivity at 80°C
				LOR	30	5	0.05	0.1	0.1	0.1	0.1	0.1	10	0.001	-	-	-	-	0.5
				Units	mg/kg	mg/kg	meq/100g	meq/100g	meq/100g	%	meq/100g	meq/100g	us/cm	ds/m	-	ds/m	-	-	ohm.m
				Action Levels															
Sample Location	**Date Sampled**	**Sample ID**	**Depth Range (m)**	**Sample Type**															
EDNO1_BH01_PO1	4/16/2020	EDNO1_BH01_PO1_0.0-0.1_160420	0-0.1	N	< 30	**5.1**	**7.1**	**2.8**	**0.2**	**2.7**	**0.2**	**4.0**	**13**	**0.013**	**8.5**	**0.1**	**Non Saline**	**Non-sodic**	**760**
	4/16/2020	EDNO1_BH01_PO1_0.2-0.3_160420	0.2-0.3	N			**9.5**	**4.1**	**0.2**	**5.1**	**0.5**	**4.7**	**12**	**0.012**	**8.5**	**0.1**	**Non Saline**	**Moderately sodic**	
	4/16/2020	EDNO1_BH01_PO1_0.4-0.6_160420	0.4-0.6	N	**180**	**42**	**17**	**10**	**0.2**	**15**	**2.6**	**3.4**	**66**	**0.066**	**7**	**0.5**	**Non Saline**	**Highly sodic**	**150**
	4/16/2020	EDNO1_BH01_PO1_0.9-1.1_160420	0.9-1.1	N	**58**	**390**	**11**	**6.8**	**0.2**	**26**	**2.8**	**1.0**	**500**	**0.5**	**7**	**3.5**	**Slight Saline**	**Highly sodic**	**20**
	4/16/2020	EDNO1_BH01_PO1_1.4-1.6_160420	1.4-1.6	N			**8.3**	**5.6**	**0.1**	**27**	**2.2**	**0.4**	**980**	**0.98**	**7**	**6.9**	**Moderately Saline**	**Highly sodic**	
EDNO1_BH16	3/9/2020	EDNO1_BH16_0.1-0.2_090320	0.1-0.2	N	**30**	**19**	**5.3**	**2.2**	**0.3**	**8.0**	**0.4**	**2.4**	**31**	**0.031**	**14**	**0.4**	**Non Saline**	**Moderately sodic**	**320**
	3/9/2020	EDNO1_BH16_0.4-0.5_090320	0.4-0.5	N	< 30	**15**	**3.2**	**2.1**	**0.2**	**21**	**0.7**	**0.2**	**38**	**0.038**	**14**	**0.5**	**Non Saline**	**Highly sodic**	**270**
EDNO1_BH17	3/6/2020	EDNO1_BH17_0.1-0.2_060320	0.1-0.2	N	**45**	**19**	**8.0**	**2.0**	**0.8**	**1.3**	**0.1**	**5.1**	**41**	**0.041**	**14**	**0.6**	**Non Saline**	**Non-sodic**	**240**
	3/6/2020	EDNO1_BH17_0.4-0.5_060320	0.4-0.5	N	**52**	**6.8**	**6.5**	**1.8**	**0.4**	**1.6**	**0.1**	**4.2**	**22**	**0.022**	**14**	**0.3**	**Non Saline**	**Non-sodic**	**470**
EDNO1_BH18A	6/1/2020	EDNO1_BH18A_0.0-0.2_010620	0-0.2	N	**44**	**5.5**	**6.2**	**1.7**	**0.5**	**1.5**	< 0.1	**4.0**	**31**	**0.031**	**14**	**0.4**	**Non Saline**	**Non-sodic**	**330**
	6/1/2020	EDNO1_BH18A_0.4-0.5_010620	0.4-0.5	N	**40**	< 5	**4.1**	**1.7**	**0.2**	**3.2**	**0.1**	**2.1**	< 10	**0.01**	**9**	**0.1**	**Non Saline**	**Non-sodic**	**1000**
	6/1/2020	EDNO1_BH18A_0.9-1.0_010620	0.9-1	N	**39**	< 5	**4.4**	**1.7**	**0.2**	**2.8**	**0.1**	**2.3**	**15**	**0.015**	**9**	**0.1**	**Non Saline**	**Non-sodic**	**660**
	6/1/2020	EDNO1_BH18A_1.9-2.0_010620	1.9-2	N	< 30	< 5	**4.0**	**1.7**	**0.2**	**4.2**	**0.2**	**1.9**	< 10	**0.01**	**17**	**0.2**	**Non Saline**	**Non-sodic**	**1100**
	6/1/2020	EDNO1_BH18A_4.9-5.0_010620	4.9-5	N			**1.5**	**0.8**	< 0.1	**9.1**	< 0.1	**0.5**	**11**	**0.011**	**17**	**0.2**	**Non Saline**	**Moderately sodic**	
EDNO1_BH19a	4/15/2020	EDNO1_BH19A_0.4-0.5_150420	0.4-0.5	N	< 30	**6.6**	**4.1**	**2.2**	**0.3**	**6.5**	**0.3**	**1.4**	**15**	**0.015**	**10**	**0.2**	**Non Saline**	**Moderately sodic**	**690**
	4/15/2020	EDNO1_BH19A_0.9-1.0_150420	0.9-1	N	< 30	**17**	**6.3**	**3.8**	**0.1**	**6.0**	**0.4**	**2.0**	**14**	**0.014**	**9**	**0.1**	**Non Saline**	**Moderately sodic**	**740**
	4/15/2020	EDNO1_BH19A_1.9-2.0_150420	1.9-2	N			**5.1**	**3.1**	**0.1**	**6.1**	**0.3**	**1.5**	**12**	**0.012**	**9**	**0.1**	**Non Saline**	**Moderately sodic**	
	4/15/2020	EDNO1_BH19A_2.9-3.0_150420	2.9-3	N	< 30	**9.7**	**4.8**	**2.9**	**0.2**	**5.7**	**0.3**	**1.4**	**130**	**0.13**	**9**	**1.2**	**Non Saline**	**Moderately sodic**	**76**
Statistical Summary																			
Number of Results					14	14	18	18	18	36	36	18	18						14
Number of Detects					8	11	18	18	17	34	34	18	16						14
Number of non-Detects					6	3	0	0	1	2	2	0	2						0
Minimum Concentration					30	< 5	1.5	0.8	0.1	0.1	0.1	0.2	< 10						20
Minimum Detect					30	5.1	1.5	0.8	0.1	0.1	0.1	0.2	11						20
Maximum Concentration					180	390	17	10	0.8	27	27	5.1	980						1100
Maximum Detect					180	390	17	10	0.8	27	27	5.1	980						1100
Mean Concentration					41.286	38.8	6.467	3.167	0.247	4.561	4.561	2.361	107.833						487.571
Geometric Average					30.39	10.784	5.691	2.631	0.204	1.286	1.286	1.768	29.105						333.048
Standard Deviation					42.91	101.634	3.513	2.272	0.175	6.996	6.996	1.527	246.046						340.826
Median Average					34.5	8.25	5.75	2.2	0.2	1.9	1.9	2.05	18.5						400
Geometric Standard Deviation					2.115	3.844	1.701	1.824	1.893	6.378	6.378	2.463	4.15						3.028
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	0	0	0	0						0

Legend:
- Not analysed / not calculated
LOR – Limit of Recording
* LOR Exceeds Guideline Trigger Value
Sample Type: N - Primary, FD - Duplicate, FT - Triplicate
% = Percent
meq/100g = meq / 100g
mg/kg = milligrams per kilogram
ohm.m =
us/cm = Microsiemens per centimetre

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4. Very Saline (Only tolerant crops yield satisfactorily).
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3. Highly sodic (Soil with an ESP of more than 10%)

Table 2a: Soil Analytical Results - pH (Acids and Bases)
Sample Date - 2020-02-25 - 2020-09-24
Site ID: Sydney Water - Upper South Creek AWRC (Contamination)

Sample Locations	Sample ID	Depth (m)	pH	Classification
ENV_AWRC_TP15	ENV_AWRC_TP15_0.0-0.1_030720	0.0-0.1	6.1	Slightly Acidic
	ENV_AWRC_TP15_0.9-1.0_030720	0.9-1.0	5.1	Slightly Acidic
	ENV_AWRC_TP15_1.9-2.0_030720	1.9-2.0	4.8	Acidic
ENV_AWRC_TP29	ENV_AWRC_TP29_0.9-1.0_030720	0.9-1.0	5.8	Slightly Acidic
	ENV_AWRC_TP29_1.9-2.0_030720	1.9-2.0	5.7	Slightly Acidic
ENV_AWRC_TP41	ENV_AWRC_TP41_0.0-0.1_030720	0.0-0.1	7.2	Slightly Basic
	ENV_AWRC_TP41_0.9-1.0_030720	0.9-1.0	6	Slightly Acidic
	ENV_AWRC_TP41_1.9-2.0_030720	1.9-2.0	5.3	Slightly Acidic
ENV_AWRC_TP44	ENV_AWRC_TP44_0.0-0.1_030720	0.0-0.1	5.8	Slightly Acidic
	ENV_AWRC_TP44_0.9-1.0_020720	0.9-1.0	5.8	Slightly Acidic
	ENV_AWRC_TP44_1.9-2.0_020720	1.9-2.0	6	Slightly Acidic
ENV_AWRC_TP49	ENV_AWRC_TP49_0.4-0.5_020720	0.4-0.5	5.7	Slightly Acidic
	ENV_AWRC_TP49_0.9-1.0_020720	0.9-1.0	5.7	Slightly Acidic
	ENV_AWRC_TP49_2.9-3.0_020720	2.9-3.0	6.4	Slightly Acidic
ENV_AWRC_TP50	ENV_AWRC_TP50_0.0-0.1_020720	0.0-0.1	5.5	Slightly Acidic
	ENV_AWRC_TP50_0.9-1.0_020720	0.9-1.0	5.5	Slightly Acidic
	ENV_AWRC_TP50_1.9-2.0_020720	1.9-2.0	5.5	Slightly Acidic
ENV_AWRC_TP23	ENV_AWRC_TP23_1.9-2.0_010720	1.9-2.0	5.4	Slightly Acidic
ENV_AWRC_TP06	ENV_AWRC_TP06_0.0-0.1_290620	0.0-0.1	5.9	Slightly Acidic
	ENV_AWRC_TP06_0.9-1.0_290620	0.9-1.0	5.7	Slightly Acidic
	ENV_AWRC_TP06_1.9-2.0_290620	1.9-2.0	6	Slightly Acidic
ENV_AWRC_TP11	ENV_AWRC_TP11_0.0-0.1_290620	0.0-0.1	6.6	Slightly Acidic
	ENV_AWRC_TP11_0.9-1.0_290620	0.9-1.0	6.1	Slightly Acidic
	ENV_AWRC_TP11_1.9-2.0_290620	1.9-2.0	6	Slightly Acidic
ENV_AWRC_TP16	ENV_AWRC_TP16_0.4-0.5_300620	0.4-0.5	6.3	Slightly Acidic
	ENV_AWRC_TP16_0.9-1.0_300620	0.9-1.0	6.3	Slightly Acidic
	ENV_AWRC_TP16_2.9-3.0_300620	2.9-3.0	7.4	Slightly Basic
ENV_AWRC_TP21	ENV_AWRC_TP21_0.4-0.5_300620	0.4-0.5	5.8	Slightly Acidic
	ENV_AWRC_TP21_0.9-1.0_300620	0.9-1.0	5.6	Slightly Acidic
	ENV_AWRC_TP21_2.9-3.0_300620	2.9-3.0	5.3	Slightly Acidic
ENV_AWRC_TP22	ENV_AWRC_TP22_0.0-0.1_300620	0.0-0.1	6.6	Slightly Acidic
	ENV_AWRC_TP22_0.9-1.0_300620	0.9-1.0	5.5	Slightly Acidic
	ENV_AWRC_TP22_1.9-2.0_300620	1.9-2.0	5.6	Slightly Acidic
ENV_AWRC_TP23	ENV_AWRC_TP23_0.4-0.5_010720	0.4-0.5	7.6	Slightly Basic
	ENV_AWRC_TP23_0.9-1.0_010720	0.9-1.0	5.9	Slightly Acidic
	ENV_AWRC_TP23_2.9-3.0_010720	2.9-3.0	5.7	Slightly Acidic
ENV_AWRC_TP30	ENV_AWRC_TP30_0.4-0.5_010720	0.4-0.5	6.1	Slightly Acidic
	ENV_AWRC_TP30_0.9-1.0_010720	0.9-1.0	5.7	Slightly Acidic
	ENV_AWRC_TP30_2.9-3.0_010720	2.9-3.0	5.8	Slightly Acidic
ENV_AWRC_TP42	ENV_AWRC_TP42_0.4-0.5_010720	0.4-0.5	6.3	Slightly Acidic
	ENV_AWRC_TP42_0.9-1.0_010720	0.9-1.0	6.1	Slightly Acidic
	ENV_AWRC_TP42_2.9-3.0_010720	2.9-3.0	6.6	Slightly Acidic
ENV_AWRC_BH24	ENV_AWRC_BH24_0.0-0.2_020720	0.0-0.2	7.5	Slightly Basic
	ENV_AWRC_BH24_0.4-0.6_020720	0.4-0.6	7	Neutral
	ENV_AWRC_BH24_0.9-1.1_020720	0.9-1.1	7.5	Slightly Basic
	ENV_AWRC_BH24_3.6-3.8_020720	3.6-3.8	7.4	Slightly Basic
ENV_AWRC_BH25	ENV_AWRC_BH25_0.0-0.2_020720	0.0-0.2	7.6	Slightly Basic
	ENV_AWRC_BH25_0.4-0.6_020720	0.4-0.6	7.4	Slightly Basic
	ENV_AWRC_BH25_2.4-2.6_020720	2.4-2.6	7.3	Slightly Basic
	ENV_AWRC_BH25_4.0-4.2_020720	4.0-4.2	4.9	Acidic

Action Levels:	
Very Acidic	0 - 2
Acidic	2 - 5
Slightly Acidic	5 - 7
Neutral	7
Slightly Basic	7 - 9
Basic	9 - 12
Very Basic	12 - 14

Table 2b: Soil Analytical Results - pH (Acids and Bases)
Sample Date - 2020-02-25 - 2020-09-24
Site ID: Sydney Water - Upper South Creek AWRC (Geotechnical)

Sample Locations	Sample ID	Depth (m)	pH	Classification
GEO-AWRC-BH02	GEO-AWRC-BH02	0.5	6	Slightly Acidic
	GEO-AWRC-BH02	4.5	5.8	Slightly Acidic
	GEO-AWRC-BH02	8.5	6.3	Slightly Acidic
GEO-AWRC-BH09	GEO-AWRC-BH09	1.5	6.4	Slightly Acidic
GEO-AWRC-BH11	GEO-AWRC-BH11	2.5	6.5	Slightly Acidic
	GEO-AWRC-BH11	8.5	7.2	Slightly Basic
GEO-AWRC-BH15	GEO-AWRC-BH15	0.3	6.7	Slightly Acidic
GEO-AWRC-BH18	GEO-AWRC-BH18	1.5	6.5	Slightly Acidic
GEO-AWRC-MW05	GEO-AWRC-MW05	2	8	Slightly Basic
GEO-AWRC-MW07	GEO-AWRC-MW07	2.5	6.8	Slightly Acidic

Action Levels:

Very Acidic	0 - 2
Acidic	2 - 5
Slightly Acid	5 - 7
Neutral	7
Slightly Basi	7 - 9
Basic	9 - 12
Very Basic	12 - 14

Table 2c: Soil Analytical Results - pH (Acids and Bases)
Sample Date - 2020-02-25 - 2020-09-24
Site ID: Sydney Water - Upper South Creek Pipelines (Geotechnical)

Sample Locations	Sample ID	Depth (m)	pH	Classification
	BDNO5-BH01	2	6.4	Slightly Acidic
BDNO5-BH01	BDNO5-BH01	6	5.5	Slightly Acidic
BDNO5-BH02	BDNO5-BH02	2.95	5.5	Slightly Acidic
BDNO5-BH03B	BDNO5-BH03B	1	7.9	Slightly Basic
BDNO5-BH04B	BDNO5-BH04B	1.5	5.8	Slightly Acidic
BDNO5-BH06	BDNO5-BH06	1	6.1	Slightly Acidic
	BDNO5-BH07	1	6.2	Slightly Acidic
BDNO5-BH07	BDNO5-BH07	3	6.9	Slightly Acidic
BDNO5-BH10	BDNO5-BH10	2.5	7.7	Slightly Basic
	BDNO5-BH11A	2	8.1	Slightly Basic
BDNO5-BH11A	BDNO5-BH11A	5	8.7	Slightly Basic
BDNO5-BH12	BDNO5-BH12	2	7.3	Slightly Basic
BDNO5-BH13	BDNO5-BH13	1.5	7.2	Slightly Basic
BDNO5-BH14	BDNO5-BH14	0.95	6.1	Slightly Acidic
BDNO5-BH15	BDNO5-BH15	1	6.8	Slightly Acidic
	BDNO5-BH16	2	5.9	Slightly Acidic
BDNO5-BH16	BDNO5-BH16	3	5.7	Slightly Acidic
BDNO5-BH17	BDNO5-BH17	4.5	6.1	Slightly Acidic
BDNO5-BH18	BDNO5-BH18	1.5	5.5	Slightly Acidic
BDNO5-BH19	BDNO5-BH19	2.5	5.7	Slightly Acidic
BDNO5-BH20	BDNO5-BH20	2	8.8	Slightly Basic
	BDNO5-BH21	0.95	6.1	Slightly Acidic
BDNO5-BH21	BDNO5-BH21	4.95	5.9	Slightly Acidic
BDNO5-BH22	BDNO5-BH22	0.95	6.3	Slightly Acidic
	BDNO5-BH23	0.5	6.5	Slightly Acidic
BDNO5-BH23	BDNO5-BH23	5.5	6.4	Slightly Acidic
	BDNO5-BH24	2.5	6.9	Slightly Acidic
BDNO5-BH24	BDNO5-BH24	5.5	7.8	Slightly Basic
BDNO5-TP01	BDNO5-TP01	0.5	8.5	Slightly Basic
BDNO5-TP02	BDNO5-TP02	0.5	8.2	Slightly Basic
BDNO5-TP05	BDNO5-TP05	2	8.3	Slightly Basic
BDNO5-TP09	BDNO5-TP09	2	5.3	Slightly Acidic
BDNO5-TP10	BDNO5-TP10	2	5.4	Slightly Acidic
BDNO5-TP11	BDNO5-TP11	0.5	5.9	Slightly Acidic
EDNO1-BH15	EDNO1-BH15	0.5	5.8	Slightly Acidic
EDNO1-BH16	EDNO1-BH16	0.95	6.7	Slightly Acidic
	EDNO1-BH17	0.95	7.2	Slightly Basic
EDNO1-BH17	EDNO1-BH17	4.5	7.2	Slightly Basic
EDNO1-BH18A	EDNO1-BH18A	3.5	7.9	Slightly Basic
EDNO1-BH19A	EDNO1-BH19A	10.5	8.8	Slightly Basic
EDNO1-BH20	EDNO1-BH20	1	5.7	Slightly Acidic
EDNO1-BH22	EDNO1-BH22	0.5	6.3	Slightly Acidic
EDNO1-BH23	EDNO1-BH23	1.5	6.9	Slightly Acidic
EDNO1-BH25	EDNO1-BH25	0.5	6.5	Slightly Acidic
EDNO1-BH26	EDNO1-BH26	3	8.3	Slightly Basic
EDNO1-BH-P01	EDNO1-BH-P01	1.83	7.8	Slightly Basic
EDNO1-TP07	EDNO1-TP07	1	6.8	Slightly Acidic
EDNO1-TP08a	EDNO1-TP08a	0.95	6.7	Slightly Acidic
EDNO1-TP08a	EDNO1-TP08a	0	5.9	Slightly Acidic
EFO2-BH01A	EFO2-BH01A	1.5	7.5	Slightly Basic
EFO2-BH03	EFO2-BH03	0.5	6.9	Slightly Acidic
EFO2-BH03	EFO2-BH03	2	6.5	Slightly Acidic
EFO2-BH04	EFO2-BH04	0.85	6.4	Slightly Acidic

Action Levels:	
Very Acidic	0 - 2
Acidic	2 - 5
Slightly Acidic	5 - 7
Neutral	7
Slightly Basic	7 - 9
Basic	9 - 12
Very Basic	12 - 14

Table 3a: AWRC Soil Analytical Results - ASS - SPOCAS Suite, ASS - Field pH Test
Sydney Water Upper South Creek Pipelines and AWRC
Sample Date - 2020-02-25 - 2020-08-13
Site ID: Advanced Water Recycling Centre
Project Code: 20036007

					Acid Sulfate Soils - SPOCAS Suite																Acid Sulfate Soils - Field pH	
					pH (KCl)	Titratable Actual Acidity	HCl Extractable Sulfur	Net Acid soluble sulfur - acidity units	Sulfur - Peroxide Oxidisable Sulfur	Net Acid soluble sulfur	Net Acid soluble sulfur - equivalent S% pyrite	Acid Neutralising Capacity equivalent S% pyrite	ANC Fineness Factor	Net Acidity (sulfur units) - SPOCAS	Liming rate - SPOCAS	pH (1:5 Aqueous extract)	Chloride	Sulphate as SO4 2-	Resistivity at 80°C	pH-FOX (Field pH Peroxide test)*	Reaction Ratings*
				LOR	0.1	2	0.02	10	0.02	0.02	0.02	0.02		0.02	1	0.1	5	10	0.5	0.1	0
				Units	pH units	mol H+/t	% S	mol H+/t	% S	% S	% S	% S	factor	% S	kg CaCO3/t	pH units	mg/kg	mg/kg	ohm.m	pH units	-
				Action Levels																	
Sample Location	**Date Sampled**	**Sample ID**	**Depth Range (m)**	**Sample Type**																	
ENV_AWRC_BH14	3/07/2020	ENV_AWRC_BH14_0.0-0.2_030720	0-0.2	N													< 10	**28**	**570**		
	3/07/2020	ENV_AWRC_BH14_0.9-1.1_030720	0.9-1.1	N													**41**	**53**	**290**		
	3/07/2020	ENV_AWRC_BH14_1.9-2.1_030720	1.9-2.1	N													**79**	**31**	**170**		
	3/07/2020	ENV_AWRC_BH14_2.9-3.1_030720	2.9-3.1	N													**210**	**89**	**75**		
ENV_AWRC_BH15	3/07/2020	ENV_AWRC_BH15_0.4-0.6_030720	0.4-0.6	N													**360**	**240**	**59**		
	3/07/2020	ENV_AWRC_BH15_0.9-1.1_030720	0.9-1.1	N	**4.5**	**24**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.04**	**2**		**650**	**170**	**36**	**4.4**	**1**
	3/07/2020	ENV_AWRC_BH15_1.4-1.6_030720	1.4-1.6	N													**920**	**190**	**25**		
	3/07/2020	ENV_AWRC_BH15_2.4-2.6_030720	2.4-2.6	N													**780**	**140**	**32**		
ENV_AWRC_BH16	3/07/2020	ENV_AWRC_BH16_0.0-0.2_030720	0-0.2	N													**35**	**46**	**210**		
	3/07/2020	ENV_AWRC_BH16_0.9-1.1_030720	0.9-1.1	N													**610**	**270**	**29**		
	3/07/2020	ENV_AWRC_BH16_1.9-2.1_030720	1.9-2.1	N													**1300**	**180**	**19**		
	3/07/2020	ENV_AWRC_BH16_3.0-3.2_030720	3-3.2	N													**1300**	**170**	**16**		
ENV_AWRC_BH21	3/07/2020	ENV_AWRC_BH21_0.8-1.0_030720	0.8-1	N	**4.6**	**23**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.04**	**2**					**4.7**	**1**
ENV_AWRC_BH24	2/07/2020	ENV_AWRC_BH24_0.0-0.2_020720	0-0.2	N												**7.5**	**9.1**	**43**	**440**		
	2/07/2020	ENV_AWRC_BH24_0.4-0.6_020720	0.4-0.6	N												**7.0**	**66**	**110**	**140**		
	2/07/2020	ENV_AWRC_BH24_0.9-1.1_020720	0.9-1.1	N												**7.5**	**280**	**54**	**52**		
	2/07/2020	ENV_AWRC_BH24_3.6-3.8_020720	3.6-3.8	N												**7.4**	**890**	**120**	**23**		
ENV_AWRC_BH25	2/07/2020	ENV_AWRC_BH25_0.0-0.2_020720	0-0.2	N												**7.6**	< 5	**48**	**650**		
	2/07/2020	ENV_AWRC_BH25_0.4-0.6_020720	0.4-0.6	N												**7.4**	**180**	**170**	**69**		
	2/07/2020	ENV_AWRC_BH25_2.4-2.6_020720	2.4-2.6	N												**7.3**	**69**	**88**	**150**		
	2/07/2020	ENV_AWRC_BH25_4.0-4.2_020720	4-4.2	N												**4.9**	**800**	**65**	**21**		
ENV_AWRC_TP02	6/07/2020	ENV_AWRC_TP02_0.0-0.1_060720	0-0.1	N																**4**	**4**
	6/07/2020	ENV_AWRC_TP02_0.4-0.5_060720	0.4-0.5	N																**4.3**	**1**
	6/07/2020	QC141_060720	0-0.1	FD																**4.2**	**4**
ENV_AWRC_TP03	29/06/2020	ENV_AWRC_TP03_0.0-0.1_290620	0-0.1	N																**4.4**	**4**
	29/06/2020	ENV_AWRC_TP03_0.4-0.5_290620	0.4-0.5	N																**4.4**	**1**
ENV_AWRC_TP06	29/06/2020	ENV_AWRC_TP06_0.0-0.1_290620	0-0.1	N												**5.9**	**59**	**57**	**470**	**3.8**	**2**
	29/06/2020	ENV_AWRC_TP06_0.4-0.5_290620	0.4-0.5	N																**4.6**	**1**
	29/06/2020	ENV_AWRC_TP06_0.9-1.0_290620	0.9-1	N												**5.7**	**64**	**55**	**200**		
	29/06/2020	ENV_AWRC_TP06_1.9-2.0_290620	1.9-2	N												**6.0**	**27**	**20**	**380**		
ENV_AWRC_TP08	29/06/2020	ENV_AWRC_TP08_0.0-0.1_290620	0-0.1	N																**5**	**4**
	29/06/2020	ENV_AWRC_TP08_0.4-0.5_290620	0.4-0.5	N																**5.5**	**4**
	29/06/2020	QC129_290620	0-0.1	FD																**5.5**	**4**
ENV_AWRC_TP11	29/06/2020	ENV_AWRC_TP11_0.0-0.1_290620	0-0.1	N												**6.6**	**19**	**18**	**470**	**5.4**	**4**
	29/06/2020	ENV_AWRC_TP11_0.4-0.5_290620	0.4-0.5	N																**4.8**	**1**
	29/06/2020	ENV_AWRC_TP11_0.9-1.0_290620	0.9-1	N												**6.1**	**810**	**180**	**24**		
	29/06/2020	ENV_AWRC_TP11_1.9-2.0_290620	1.9-2	N												**6.0**	**1400**	**770**	**24**		
ENV_AWRC_TP12	29/06/2020	ENV_AWRC_TP12_0.0-0.1_290620	0-0.1	N																**5.6**	**4**
	29/06/2020	ENV_AWRC_TP12_0.4-0.5_290620	0.4-0.5	N																**5.1**	**4**
ENV_AWRC_TP15	3/07/2020	ENV_AWRC_TP15_0.0-0.1_030720	0-0.1	N												**6.1**	< 10	**24**	**400**	**5.1**	**2**
	3/07/2020	ENV_AWRC_TP15_0.4-0.5_030720	0.4-0.5	N																**4.7**	**2**
	3/07/2020	ENV_AWRC_TP15_0.9-1.0_030720	0.9-1	N												**5.1**	**850**	**230**	**22**		
	3/07/2020	ENV_AWRC_TP15_1.9-2.0_030720	1.9-2	N												**4.8**	**1600**	**210**	**14**		
ENV_AWRC_TP16	30/06/2020	ENV_AWRC_TP16_0.0-0.1_300620	0-0.1	N																**4.5**	**1**
	30/06/2020	ENV_AWRC_TP16_0.4-0.5_300620	0.4-0.5	N												**6.3**	**31**	**120**	**170**	**4.3**	**1**
	30/06/2020	ENV_AWRC_TP16_0.9-1.0_300620	0.9-1	N												**6.3**	**26**	**68**	**260**		
	30/06/2020	ENV_AWRC_TP16_2.9-3.0_300620	2.9-3	N												**7.4**	**39**	**31**	**200**		
ENV_AWRC_TP17	30/06/2020	ENV_AWRC_TP17_0.0-0.1_300620	0-0.1	N																**4.6**	**4**
	30/06/2020	ENV_AWRC_TP17_0.4-0.5_300620	0.4-0.5	N																**6.6**	**4**
ENV_AWRC_TP19	30/06/2020	ENV_AWRC_TP19_0.0-0.1_300620	0-0.1	N																**4.4**	**1**
	30/06/2020	ENV_AWRC_TP19_0.4-0.5_300620	0.4-0.5	N																**4**	**1**
ENV_AWRC_TP20	30/06/2020	ENV_AWRC_TP20_0.0-0.1_300620	0-0.1	N																**4.5**	**4**

					Acid Sulfate Soils - SPOCAS Suite																Acid Sulfate Soils - Field pH	
					pH (KCl)	Titratable Actual Acidity	HCl Extractable Sulfur	Net Acid soluble sulfur - acidity units	Sulfur - Peroxide Oxidisable Sulfur	Net Acid soluble sulfur	Net Acid soluble sulfur - equivalent S% pyrite	Acid Neutralising Capacity equivalent S% pyrite	ANC Fineness Factor	Net Acidity (sulfur units) - SPOCAS	Liming rate - SPOCAS	pH (1:5 Aqueous extract)	Chloride	Sulphate as SO4 2-	Resistivity at 80°C	pH-FOX (Field pH Peroxide test)*	Reaction Ratings*
				LOR	0.1	2	0.02	10	0.02	0.02	0.02	0.02		0.02	1	0.1	5	10	0.5	0.1	0
				Units	pH units	mol H+/t	% S	mol H+/t	% S	% S	% S	% S	factor	% S	kg CaCO3/t	pH units	mg/kg	mg/kg	ohm.m	pH units	-
				Action Levels																	
Sample Location	**Date Sampled**	**Sample ID**	**Depth Range (m)**	**Sample Type**																	
ENV_AWRC_TP20	30/06/2020	ENV_AWRC_TP20_0.4-0.5_300620	0.4-0.5	N																**4.7**	**1**
ENV_AWRC_TP21	30/06/2020	ENV_AWRC_TP21_0.0-0.1_300620	0-0.1	N																**4.8**	**1**
	30/06/2020	ENV_AWRC_TP21_0.4-0.5_300620	0.4-0.5	N												**5.8**	**76**	**92**	**140**	**4.5**	**1**
	30/06/2020	ENV_AWRC_TP21_0.9-1.0_300620	0.9-1	N												**5.6**	**160**	**85**	**92**		
	30/06/2020	ENV_AWRC_TP21_2.9-3.0_300620	2.9-3	N												**5.3**	**450**	**99**	**40**		
ENV_AWRC_TP22	30/06/2020	ENV_AWRC_TP22_0.0-0.1_300620	0-0.1	N												**6.6**	< 10	**40**	**330**	**4.4**	**4**
	30/06/2020	ENV_AWRC_TP22_0.4-0.5_300620	0.4-0.5	N																**4.6**	**1**
	30/06/2020	ENV_AWRC_TP22_0.9-1.0_300620	0.9-1	N												**5.5**	**340**	**140**	**47**		
	30/06/2020	ENV_AWRC_TP22_1.9-2.0_300620	1.9-2	N												**5.6**	**490**	**92**	**41**		
ENV_AWRC_TP23	1/07/2020	ENV_AWRC_TP23_0.0-0.1_010720	0-0.1	N																**4.4**	**4**
	1/07/2020	ENV_AWRC_TP23_0.4-0.5_010720	0.4-0.5	N												**7.6**	< 10	**56**	**190**	**4.4**	**4**
	1/07/2020	ENV_AWRC_TP23_0.9-1.0_010720	0.9-1	N												**5.9**	**22**	**100**	**220**		
	1/07/2020	ENV_AWRC_TP23_1.9-2.0_010720	1.9-2	N												**5.4**			**69**		
	1/07/2020	ENV_AWRC_TP23_2.9-3.0_010720	2.9-3	N												**5.7**	**300**	**120**	**55**		
ENV_AWRC_TP26	1/07/2020	ENV_AWRC_TP26_0.0-0.1_010720	0-0.1	N																**5**	**4**
	1/07/2020	ENV_AWRC_TP26_0.4-0.5_010720	0.4-0.5	N																**4.5**	**1**
ENV_AWRC_TP27	1/07/2020	ENV_AWRC_TP27_0.0-0.1_010720	0-0.1	N																**4.5**	**1**
	1/07/2020	ENV_AWRC_TP27_0.4-0.5_010720	0.4-0.5	N																**7.1**	**4**
ENV_AWRC_TP29	3/07/2020	ENV_AWRC_TP29_0.0-0.1_030720	0-0.1	N																**3.9**	**4**
	3/07/2020	ENV_AWRC_TP29_0.4-0.5_030720	0.4-0.5	N																**4.8**	**2**
	3/07/2020	ENV_AWRC_TP29_0.9-1.0_030720	0.9-1	N												**5.8**	**65**	**80**	**200**		
	3/07/2020	ENV_AWRC_TP29_1.9-2.0_030720	1.9-2	N												**5.7**	**300**	**82**	**72**		
ENV_AWRC_TP30	1/07/2020	ENV_AWRC_TP30_0.0-0.1_010720	0-0.1	N																**6**	**4**
	1/07/2020	ENV_AWRC_TP30_0.4-0.5_010720	0.4-0.5	N												**6.1**	**23**	**44**	**340**	**4.8**	**4**
	1/07/2020	ENV_AWRC_TP30_0.9-1.0_010720	0.9-1	N												**5.7**	**78**	**42**	**210**		
	1/07/2020	ENV_AWRC_TP30_2.9-3.0_010720	2.9-3	N												**5.8**	**31**	**35**	**230**		
ENV_AWRC_TP34	1/07/2020	ENV_AWRC_TP34_0.0-0.1_010720	0-0.1	N																**4.8**	**4**
	1/07/2020	ENV_AWRC_TP34_0.4-0.5_010720	0.4-0.5	N																**5.7**	**4**
ENV_AWRC_TP35	1/07/2020	ENV_AWRC_TP35_0.0-0.1_010720	0-0.1	N																**3.7**	**4**
	1/07/2020	ENV_AWRC_TP35_0.4-0.5_010720	0.4-0.5	N																**4.8**	**1**
ENV_AWRC_TP36	3/07/2020	ENV_AWRC_TP36_0.0-0.1_030720	0-0.1	N																**3.9**	**4**
	3/07/2020	ENV_AWRC_TP36_0.4-0.5_030720	0.4-0.5	N																**4.8**	**1**
ENV_AWRC_TP38	1/07/2020	ENV_AWRC_TP38_0.0-0.1_010720	0-0.1	N																**5.8**	**4**
	1/07/2020	ENV_AWRC_TP38_0.4-0.5_010720	0.4-0.5	N																**5.3**	**4**
ENV_AWRC_TP41	3/07/2020	ENV_AWRC_TP41_0.0-0.1_030720	0-0.1	N												**7.2**	**24**	**12**	**310**	**7.4**	**4**
	3/07/2020	ENV_AWRC_TP41_0.4-0.5_030720	0.4-0.5	N																**5.1**	**2**
	3/07/2020	ENV_AWRC_TP41_0.9-1.0_030720	0.9-1	N												**6**	**350**	**160**	**46**		
	3/07/2020	ENV_AWRC_TP41_1.9-2.0_030720	1.9-2	N												**5.3**	**660**	**100**	**34**		
ENV_AWRC_TP42	1/07/2020	ENV_AWRC_TP42_0.0-0.1_010720	0-0.1	N																**4.6**	**4**
	1/07/2020	ENV_AWRC_TP42_0.4-0.5_010720	0.4-0.5	N												**6.3**	**24**	**52**	**420**	**4.9**	**1**
	1/07/2020	ENV_AWRC_TP42_0.9-1.0_010720	0.9-1	N												**6.1**	**19**	**44**	**370**		
	1/07/2020	ENV_AWRC_TP42_2.9-3.0_010720	2.9-3	N												**6.6**	**110**	**31**	**130**		
ENV_AWRC_TP43	2/07/2020	ENV_AWRC_TP43_0.0-0.1_020720	0-0.1	N																**4.7**	**4**
	2/07/2020	ENV_AWRC_TP43_0.4-0.5_020720	0.4-0.5	N																**5.1**	**2**
ENV_AWRC_TP44	2/07/2020	ENV_AWRC_TP44_0.9-1.0_020720	0.9-1	N												**5.8**	**430**	**190**	**41**		
	2/07/2020	ENV_AWRC_TP44_1.9-2.0_020720	1.9-2	N												**6**	**640**	**86**	**39**		
	3/07/2020	ENV_AWRC_TP44_0.0-0.1_030720	0-0.1	N												**5.8**	**13**	**14**	**830**	**5.3**	**1**
	3/07/2020	ENV_AWRC_TP44_0.4-0.5_030720	0.4-0.5	N																**5.6**	**4**
ENV_AWRC_TP45	2/07/2020	ENV_AWRC_TP45_0.0-0.1_020720	0-0.1	N																**5.1**	**2**
	2/07/2020	ENV_AWRC_TP45_0.4-0.5_020720	0.4-0.5	N																**4.3**	**1**
ENV_AWRC_TP46	2/07/2020	ENV_AWRC_TP46_0.0-0.1_020720	0-0.1	N																**4.6**	**4**
	2/07/2020	ENV_AWRC_TP46_0.4-0.5_020720	0.4-0.5	N																**4.6**	**2**
ENV_AWRC_TP47	2/07/2020	ENV_AWRC_TP47_0.0-0.1_020720	0-0.1	N																**4.2**	**4**
	2/07/2020	ENV_AWRC_TP47_0.4-0.5_020720	0.4-0.5	N																**4.7**	**4**
ENV_AWRC_TP49	2/07/2020	ENV_AWRC_TP49_0.0-0.1_020720	0-0.1	N																**3.7**	**4**
	2/07/2020	ENV_AWRC_TP49_0.4-0.5_020720	0.4-0.5	N												**5.7**	**71**	**150**	**130**	**4.7**	**4**
	2/07/2020	ENV_AWRC_TP49_0.9-1.0_020720	0.9-1	N												**5.7**	**64**	**93**	**150**		

					Acid Sulfate Soils - SPOCAS Suite																Acid Sulfate Soils - Field pH	
					pH (KCl)	Titratable Actual Acidity	HCl Extractable Sulfur	Net Acid soluble sulfur - acidity units	Sulfur - Peroxide Oxidisable Sulfur	Net Acid soluble sulfur	Net Acid soluble sulfur - equivalent S% pyrite	Acid Neutralising Capacity equivalent S% pyrite	ANC Fineness Factor	Net Acidity (sulfur units) - SPOCAS	Liming rate - SPOCAS	pH (1:5 Aqueous extract)	Chloride	Sulphate as SO4 2-	Resistivity at 80°C	pH-FOX (Field pH Peroxide test)*	Reaction Ratings*
				LOR	0.1	2	0.02	10	0.02	0.02	0.02	0.02		0.02	1	0.1	5	10	0.5	0.1	0
				Units	pH units	mol H+/t	% S	mol H+/t	% S	% S	% S	% S	factor	% S	kg CaCO3/t	pH units	mg/kg	mg/kg	ohm.m	pH units	-
				Action Levels																	
Sample Location	**Date Sampled**	**Sample ID**	**Depth Range (m)**	**Sample Type**																	
ENV_AWRC_TP50	2/07/2020	ENV_AWRC_TP49_2.9-3.0_020720	2.9-3	N												**6.4**	**210**	**92**	**71**		
	2/07/2020	ENV_AWRC_TP50_0.0-0.1_020720	0-0.1	N												**5.5**	**12**	**32**	**610**	**8.6**	**4**
	2/07/2020	ENV_AWRC_TP50_0.4-0.5_020720	0.4-0.5	N																**4.8**	**4**
GEO_AWRC_ABH01	30/06/2020	GEO_AWRC_ABH01_0.0-0.2_300620	0-0.2	N	**6.3**	**4.0**	< 0.02	< 10	**0.02**	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**1.0**						
	30/06/2020	GEO_AWRC_ABH01_1.9-2.0_300620	1.9-2	N	**4.9**	**13**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**1.0**						
GEO_AWRC_ABH02	30/06/2020	GEO_AWRC_ABH02_0.0-0.2_300620	0-0.2	N	**5.3**	**14**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**2.0**						
	30/06/2020	GEO_AWRC_ABH02_1.9-2.0_300620	1.9-2	N	**4.8**	**17**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.04**	**2.0**						
GEO_AWRC_ABH03	30/06/2020	GEO_AWRC_ABH03_0.0-0.2_300620	0-0.2	N	**5.1**	**21**	< 0.02	< 10	**0.03**	< 0.02	< 0.02	< 0.02	**1.5**	**0.06**	**3.0**						
	30/06/2020	GEO_AWRC_ABH03_2.9-3.0_300620	2.9-3	N	**4.7**	**19**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**2.0**						
GEO_AWRC_BH02	17/06/2020	GEO_AWRC_BH02_0.0-0.5_170620	0-0.5	N	**4.8**	**22**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.04**	**2.0**						
GEO_AWRC_BH03	1/07/2020	GEO_AWRC_BH03_0.0-0.2_010720	0-0.2	N	**5.4**	**10**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.04**	**2**					**3.5**	**4**
GEO_AWRC_BH04	22/06/2020	GEO_AWRC_BH04_0.4-0.2_220620	0.4-0.2	N	**5.1**	**14**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.04**	**2**					**5.2**	**4**
	22/06/2020	GEO_AWRC_BH04_0.9-1.0_220620	0.9-1	N	**5.1**	**13**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.05**	**1.5**	**0.03**	**1**					**5.5**	**4**
GEO_AWRC_BH05	7/07/2020	GEO_AWRC_BH05_0.4-0.5_070720	0.4-0.5	N	**5.2**	**15**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**2**					**5.3**	**1**
GEO_AWRC_BH06	19/06/2020	GEO_AWRC_BH06_0.0-0.2_190620	0-0.2	N	**5.0**	**16**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.04**	**2.0**						
GEO_AWRC_BH07	6/07/2020	GEO_AWRC_BH07_0.4-0.5_060720	0.4-0.5	N	**4.6**	**42**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.08**	**4**					**5**	**1**
	6/07/2020	GEO_AWRC_BH07_2.9-3.0_060720	2.9-3	N	**6.1**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.06**	**1.5**	< 0.02	< 1					**8.6**	**4**
GEO_AWRC_BH08	23/06/2020	GEO_AWRC_BH08_0.0-0.2_230620	0-0.2	N	**5.2**	**12**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**2**					**4.4**	**4**
	23/06/2020	GEO_AWRC_BH08_2.4-2.5_230620	2.4-2.5	N	**4.8**	**18**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**2**					**4.8**	**4**
GEO_AWRC_BH09	7/07/2020	GEO_AWRC_BH09_0.0-0.2_070720	0-0.2	N	**5.3**	**13**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**1**					**5**	**1**
	7/07/2020	GEO_AWRC_BH09_1.8-2.0_070720	1.8-2	N	**5.1**	**8**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	< 0.02	**1**					**4.8**	**1**
GEO_AWRC_BH10	6/07/2020	GEO_AWRC_BH10_0.4-0.5_060720	0.4-0.5	N	**5.2**	**12**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**1**					**4.8**	**4**
	6/07/2020	GEO_AWRC_BH10_2.4-2.5_060720	2.4-2.5	N	**4.7**	**23**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.04**	**2**					**4.7**	**4**
GEO_AWRC_BH12	22/06/2020	GEO_AWRC_BH12_0.0-0.2_220620	0-0.2	N	**5.5**	**13**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.11**	**1.5**	**0.03**	**1.0**						
GEO_AWRC_BH13	30/06/2020	GEO_AWRC_BH13_0.0-0.2_300620	0-0.2	N	**7.7**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	< 0.02	**1.0**						
	30/06/2020	GEO_AWRC_BH13_0.9-1.0_300620	0.9-1	N	**4.5**	**34**	**0.05**	**14**	< 0.02	**0.03**	**0.02**	< 0.02	**1.5**	**0.08**	**4.0**						
GEO_AWRC_BH14	18/06/2020	GEO_AWRC_BH14_0.4-0.6_180620	0.4-0.6	N	**4.7**	**34**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.06**	**3.0**						
GEO_AWRC_BH17	24/06/2020	GEO_AWRC_BH17_0.0-0.2_240620	0-0.2	N	**5.4**	**15**	< 0.02	< 10	**0.04**	< 0.02	< 0.02	< 0.02	**1.5**	**0.06**	**3.0**						
GEO_AWRC_BH18	3/07/2020	GEO_AWRC_BH18_0.4-0.5_030720	0.4-0.5	N	**5.6**	**5**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	< 0.02	**1**					**5.2**	**4**
GEO_AWRC_BH19	2/07/2020	GEO_AWRC_BH19_0.4-0.5_020720	0.4-0.5	N	**5.3**	**12**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**2**					**5.8**	**4**
GEO_AWRC_BH20	30/06/2020	GEO_AWRC_BH20_0.0-0.2_300620	0-0.2	N	**6.1**	**3.0**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.02**	**1.0**						
	30/06/2020	GEO_AWRC_BH20_2.4-2.5_300620	2.4-2.5	N	**6.0**	**4.0**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.10**	**1.5**	< 0.02	< 1						
GEO_AWRC_BH21	2/07/2020	GEO_AWRC_BH21_0.4-0.5_020720	0.4-0.5	N	**5.5**	**5**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	< 0.02	< 1					**6.6**	**2**
GEO_AWRC_BH22	1/07/2020	GEO_AWRC_BH22_0.0-0.2_010720	0-0.2	N	**5.3**	**12**	< 0.02	< 10	**0.02**	< 0.02	< 0.02	< 0.02	**1.5**	**0.04**	**2**					**3.5**	**4**
	1/07/2020	GEO_AWRC_BH22_2.4-2.5_010720	2.4-2.5	N	**4.8**	**20**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.05**	**2**					**4.2**	**1**
GEO_AWRC_MW01	26/06/2020	GEO_AWRC_MW01_0.1-0.2_260620	0.1-0.2	N	**5.5**	**12**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.39**	**1.5**	< 0.02	**1.0**						
	26/06/2020	GEO_AWRC_MW01_2.4-2.5_260620	2.4-2.5	N	**4.9**	**12**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.02**	**1.0**						
GEO_AWRC_MW02	29/06/2020	GEO_AWRC_MW02_0.0-0.2_290620	0-0.2	N	**5.0**	**17**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.04**	**2.0**						
	29/06/2020	GEO_AWRC_MW02_2.4-2.5_290620	2.4-2.5	N	**5.3**	**6.0**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	< 0.02	**1.0**						
GEO_AWRC_MW03	26/06/2020	GEO_AWRC_MW03_0.0-0.2_260620	0-0.2	N	**5.1**	**13**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**1**					**4**	**4**
	26/06/2020	GEO_AWRC_MW03_0.9-1.0_260620	0.9-1	N	**4.5**	**36**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.07**	**3**					**4.9**	**2**
GEO_AWRC_MW04	26/06/2020	GEO_AWRC_MW04_0.4-0.5_260620	0.4-0.5	N	**4.8**	**21**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.04**	**2.0**						
	26/06/2020	GEO_AWRC_MW04_1.4-1.5_260620	1.4-1.5	N	**4.6**	**21**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.04**	**2.0**						
GEO_AWRC_MW05	26/06/2020	GEO_AWRC_MW05_0.0-0.2_260620	0-0.2	N	**5.3**	**12**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**1**					**6.2**	**4**
	26/06/2020	GEO_AWRC_MW05_0.9-1.0_260620	0.9-1	N	**5.7**	**8**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.09**	**1.5**	**0.02**	**1**					**6.8**	**4**
GEO_AWRC_TP01	7/07/2020	GEO_AWRC_TP01_0.4-0.5_070720	0.4-0.5	N	**5.8**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.08**	**1.5**	< 0.02	**1**					**5.6**	**4**
	7/07/2020	GEO_AWRC_TP01_0.9-1.0_070720	0.9-1	N	**5.7**	**2**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.05**	**1.5**	< 0.02	< 1					**7.4**	**4**
	7/07/2020	GEO_AWRC_TP01_2.9-3.0_070720	2.9-3	N	**6.1**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.05**	**1.5**	< 0.02	< 1					**8.4**	**4**
Statistical Summary																					
Number of Results					47	47	47	47	47	47	47	47	47	47	47	48	59	59	60	90	90
Number of Detects					47	43	1	1	4	1	1	9	47	36	42	48	54	59	60	90	90
Number of non-Detects					0	4	46	46	43	46	46	38	0	11	5	0	5	0	0	0	0
Minimum Concentration					4.5	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	1.5	< 0.02	1	4.8	< 5	12	14	3.5	1
Minimum Detect					4.5	2	0.05	14	0.02	0.03	0.02	0.05	1.5	0.02	1	4.8	9.1	12	14	3.5	1
Maximum Concentration					7.7	42	0.05	14	0.04	0.03	< 0.02	0.39	1.5	0.08	4	7.6	1600	770	830	8.6	4
Maximum Detect					7.7	42	0.05	14	0.04	0.03	0.02	0.39	1.5	0.08	4	7.6	1600	770	830	8.6	4
Mean Concentration					5.245	14.34	0.011	5.191	0.011	0.01	0.01	0.029	1.5	0.033	1.649	6.154	313.366	105.949	186.117	5.02	2.911

					Acid Sulfate Soils - SPOCAS Suite															Acid Sulfate Soils - Field pH	
					pH (KCl)	Titratable Actual Acidity	HCl Extractable Sulfur	Net Acid soluble sulfur - acidity units	Sulfur - Peroxide Oxidisable Sulfur	Net Acid soluble sulfur	Net Acid soluble sulfur - equivalent S% pyrite	Acid Neutralising Capacity equivalent S% pyrite	ANC Fineness Factor	Net Acidity (sulfur units) - SPOCAS	Liming rate - SPOCAS	pH (1:5 Aqueous extract)	Chloride	Sulphate as SO4 2-	Resistivity at 80°C	pH-FOX (Field pH Peroxide test)*	Reaction Ratings*
				LOR	0.1	2	0.02	10	0.02	0.02	0.02	0.02		0.02	1	0.1	5	10	0.5	0.1	0
				Units	pH units	mol H+/t	% S	mol H+/t	% S	% S	% S	% S	factor	% S	kg CaCO3/t	pH units	mg/kg	mg/kg	ohm.m	pH units	-
				Action Levels																	
Sample Location	**Date Sampled**	**Sample ID**	**Depth Range (m)**	**Sample Type**																	
Geometric Average					5.215	10.445	0.01	5.111	0.011	0.01	0.01	0.015	1.5	0.027	1.432	6.111	103.272	76.714	107.942	4.933	2.481
Standard Deviation					0.595	9.469	0.006	1.313	0.006	0.003	0.001	0.06	0	0.018	0.865	0.75	404.347	108.231	185.904	1.02	1.371
Median Average					5.2	13	0.01	5	0.01	0.01	0.01	0.01	1.5	0.03	2	6	78	86	135	4.8	4
Geometric Standard Deviation					1.112	2.613	1.265	1.162	1.332	1.174	1.106	2.443	1	1.891	1.741	1.127	5.652	2.24	3.07	1.2	1.86
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Legend:

- Not analysed / not calculated
LOR – Limit of Recording
* LOR Exceeds Guideline Trigger Value
Sample Type: N - Primary, FD - Duplicate, FT - Triplicate
- = NO UNIT
% S = % Sulfur
factor =
kg CaCO3/t = kg CaCO3 per tonne
mg/kg = milligrams per kilogram
mol H+/t = mol H+/t
ohm.m =
pH units = pH units

Action Levels:
NSW ASSMAC (1998 **0.03%S (18 mol H+/t)**

Table 3b: USC Pipelines Soil Analytical Results - ASS - SPOCAS Suite, ASS - Field pH Test
Sydney Water Upper South Creek Pipelines and AWRC
Sample Date - 2020-02-25 - 2020-08-13
Site ID: Pipelines
Project Code: 20036007

					Acid Sulfate Soils - SPOCAS Suite																Acid Sulfate Soils - Field pH	
					pH (KCl)	Titratable Actual Acidity	HCl Extractable Sulfur	Net Acid soluble sulfur - acidity units	Sulfur - Peroxide Oxidisable Sulfur	Net Acid soluble sulfur	Net Acid soluble sulfur - equivalent S% pyrite	Acid Neutralising Capacity equivalent S% pyrite	ANC Fineness Factor	Net Acidity (sulfur units) - SPOCAS	Liming rate - SPOCAS	Chloride	Sulphate as SO4 2-	Resistivity at 80°C	Final pH	Initial pH	pH after HCl addition	pH-FOX (Field pH Peroxide test)*	Reaction Ratings*
				LOR	0.1	2	0.02	10	0.02	0.02	0.02	0.02		0.02	1	5	30	0.5	0.1	0.1	0.1	0.1	0
				Units	pH units	mol H+/t	% S	mol H+/t	% S	% S	% S	% S	factor	% S	kg CaCO3/t	mg/kg	mg/kg	ohm.m	pH units	pH units	pH units	pH units	-
				Action Levels																			
Sample Location	**Date Sampled**	**Sample ID**	**Depth Range (m)**	**Sample Type**																			
BDN05_BH09	9/04/2020	BDN05_BH09_0.0-0.1_090420	0-0.1	N	**4.9**	**20**	< 0.02	< 10	**0.03**	< 0.02	< 0.02	< 0.02	**1.5**	**0.06**	**3.0**								
BDN05_BH10	8/04/2020	BDN05_BH10_0.0-0.1_080420	0-0.1	N	**7.0**	< 2	< 0.02	< 10	**0.05**	< 0.02	< 0.02	< 0.02	**1.5**	< 0.02	**1.0**								
BDN05_TP01	6/04/2020	BDN05_TP01_0.0-0.1_060420	0-0.1	N	**6.5**	< 2	< 0.02	< 10	**0.02**	< 0.02	< 0.02	< 0.02	**1.5**	< 0.02	< 1								
BDN05_TP02	6/04/2020	BDN05_TP02_0.0-0.1_060420	0-0.1	N	**5.9**	**8.0**	< 0.02	< 10	**0.05**	< 0.02	< 0.02	< 0.02	**1.5**	**0.06**	**3.0**								
BDN05_TP03	6/04/2020	BDN05_TP03_0.0-0.1_060420	0-0.1	N	**8.7**	< 2	< 0.02	< 10	**0.04**	< 0.02	< 0.02	**0.17**	**1.5**	< 0.02	< 1								
BDNO5_BH01	11/03/2020	BDNO5_BH01_0.9-1.0_110320	0.9-1	N	**6**	**4**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	< 0.02	**1**							**4.8**	**4**
BDNO5_BH02	11/03/2020	BDNO5_BH02_0.4-0.5_110320	0.4-0.5	N															**5.2**	**7.4**	**1.6**		
BDNO5_BH03B	21/05/2020	BDNO5_BH03B_0.0-0.2_210520	0-0.2	N												**14**	**43**	**240**					
	21/05/2020	BDNO5_BH03B_0.4-0.6_210520	0.4-0.6	N												**75**	**190**	**87**					
	21/05/2020	BDNO5_BH03B_0.9-1.1_210520	0.9-1.1	N												**330**	**120**	**28**					
	21/05/2020	BDNO5_BH03B_1.4-1.6_210520	1.4-1.6	N												**230**	**94**	**33**					
BDNO5_BH04	8/05/2020	BDNO5_BH04_0.0-0.1_080520	0-0.1	N	**5.7**	**11**	< 0.02	< 10	**0.03**	< 0.02	< 0.02	**0.20**	**1.5**	**0.05**	**2.0**								
	8/05/2020	BDNO5_BH04_0.9-1.1_080520	0.9-1.1	N												**82**	**35**	**94**					
	8/05/2020	BDNO5_BH04_1.4-1.6_080520	1.4-1.6	N												**210**	**36**	**74**					
	11/05/2020	BDNO5_BH04_0.0-0.2_110520	0-0.2	N												**6.1**	< 30	**270**					
	11/05/2020	BDNO5_BH04_0.4-0.6_110520	0.4-0.6	N												**15**	**89**	**180**					
BDNO5_BH06	12/05/2020	BDNO5_BH06_0.0-0.1_120520	0-0.1	N	**5.6**	**15**	< 0.02	< 10	**0.03**	< 0.02	< 0.02	< 0.02	**1.5**	**0.06**	**3.0**								
	12/05/2020	BDNO5_BH06_0.0-0.2_120520	0-0.2	N												**6.0**	**78**	**390**					
	12/05/2020	BDNO5_BH06_0.4-0.6_120520	0.4-0.6	N												**120**	**170**	**76**					
	12/05/2020	BDNO5_BH06_1.4-1.6_120520	1.4-1.6	N												**610**	< 30	**25**					
BDNO5_BH07	7/05/2020	BDNO5_BH07_0.0-0.1_070520	0-0.1	N	**5.4**	**13**	< 0.02	< 10	**0.02**	< 0.02	< 0.02	< 0.02	**1.5**	**0.04**	**2.0**	**18**	< 30	**250**					
	7/05/2020	BDNO5_BH07_0.4-0.6_070520	0.4-0.6	N												**9.3**	**230**	**410**					
	7/05/2020	BDNO5_BH07_1.4-1.6_070520	1.4-1.6	N												**390**	**150**	**35**					
BDNO5_BH08	18/05/2020	BDNO5_BH08_0.0-0.1_180520	0-0.1	N	**5.0**	**23**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.05**	**2.0**								
BDNO5_BH09	9/04/2020	BDNO5_BH09_0.0-0.1_090420	0-0.1	N	**4.9**	**20**	< 0.02	< 10	**0.03**	< 0.02	< 0.02	< 0.02	**1.5**	**0.06**	**3.0**								
BDNO5_BH10	8/04/2020	BDNO5_BH10_0.0-0.1_080420	0-0.1	N	**7.0**	< 2	< 0.02	< 10	**0.05**	< 0.02	< 0.02	< 0.02	**1.5**	< 0.02	**1.0**								
BDNO5_BH11	14/04/2020	BDNO5_BH11_0.0-0.1_140420	0-0.1	N	**5.3**	**14**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.04**	**2.0**								
BDNO5_BH12	9/04/2020	BDNO5_BH12_0.0-0.15_090420	0-0.15	N												**20**	**160**	**140**					
	9/04/2020	BDNO5_BH12_0.4-0.5_090420	0.4-0.5	N	**5.8**	**7**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**1**	**65**	**240**	**76**					
	9/04/2020	BDNO5_BH12_0.9-1.0_090420	0.9-1	N												**560**	**260**	**20**					
	9/04/2020	BDNO5_BH12_2.9-3.0_090420	2.9-3	N												**850**	**150**	**13**					
BDNO5_BH13	8/04/2020	BDNO5_BH13_0.0-0.2_080420	0-0.2	N												**44**	< 30	**55**					
	8/04/2020	BDNO5_BH13_0.4-0.5_080420	0.4-0.5	N												**93**	< 30	**110**					
	8/04/2020	BDNO5_BH13_0.9-1.0_080420	0.9-1	N												**380**	**120**	**28**					
	8/04/2020	BDNO5_BH13_2.9-3.0_080420	2.9-3	N	**5.7**	**4**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	< 0.02	**1**	**180**	< 30	**27**					
BDNO5_BH14	12/03/2020	BDNO5_BH14_0.1-0.2_120320	0.1-0.2	N	**7.6**	< 2	< 0.02	< 10	**0.06**	< 0.02	< 0.02	**0.37**	**1.5**	< 0.02	< 1				**5.6**	**9**	**1.6**		
	12/03/2020	BDNO5_BH14_0.4-0.5_120320	0.4-0.5	N															**5.2**	**6.1**	**1.6**		
BDNO5_BH15	27/03/2020	BDNO5_BH15_0.0-0.2_270320	0-0.2	N	**7.6**	< 2	< 0.02	< 10	**0.03**	< 0.02	< 0.02	**0.17**	**1.5**	< 0.02	< 1				**5.2**	**7.1**	**1.6**		
	27/03/2020	BDNO5_BH15_0.4-0.6_270320	0.4-0.6	N															**5.1**	**6.4**	**1.6**		
BDNO5_BH16	17/03/2020	BDNO5_BH16_0.0-0.2_170320	0-0.2	N	**8.4**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.17**	**1.5**	< 0.02	< 1	**11**	< 30	**88**					
	17/03/2020	BDNO5_BH16_0.4-0.5_170320	0.4-0.5	N												**19**	< 30	**75**					
	17/03/2020	BDNO5_BH16_0.7-0.8_170320	0.7-0.8	N												**190**	**200**	**23**					
	17/03/2020	BDNO5_BH16_2.4-2.5_170320	2.4-2.5	N												**530**	**200**	**18**					
	17/03/2020	BDNO5_BH16_3.4-3.5_170320	3.4-3.5	N	**6.1**	**3.0**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.03**	**1.5**	< 0.02	**1.0**								
BDNO5_BH17	16/03/2020	BDNO5_BH17_0.0-0.2_160320	0-0.2	N												**39**	**53**	**140**					
	16/03/2020	BDNO5_BH17_0.4-0.5_160320	0.4-0.5	N												**64**	**69**	**100**					
	16/03/2020	BDNO5_BH17_0.9-1.0_160320	0.9-1	N												**220**	**290**	**39**					
	16/03/2020	BDNO5_BH17_1.9-2.0_160320	1.9-2	N	**6.9**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.08**	**1.5**	< 0.02	< 1	**600**	**670**	**15**					
BDNO5_BH18	12/03/2020	BDNO5_BH18_0.0-0.2_120320	0-0.2	N	**8.6**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.18**	**1.5**	< 0.02	< 1	**80**	**71**	**62**				**6.9**	**4**
	12/03/2020	BDNO5_BH18_0.4-0.5_120320	0.4-0.5	N												**140**	**56**	**69**					
	12/03/2020	BDNO5_BH18_0.9-1.0_120320	0.9-1	N												**540**	< 30	**21**					
	12/03/2020	BDNO5_BH18_3.4-3.5_120320	3.4-3.5	N												**570**	**61**	**15**					
	13/03/2020	BDNO5_BH19_0.0-0.2_130320	0-0.2	N												**33**	**53**	**160**					

					Acid Sulfate Soils - SPOCAS Suite																	Acid Sulfate Soils - Field pH	
					pH (KCl)	Titratable Actual Acidity	HCl Extractable Sulfur	Net Acid soluble sulfur - acidity units	Sulfur - Peroxide Oxidisable Sulfur	Net Acid soluble sulfur	Net Acid soluble sulfur - equivalent S% pyrite	Acid Neutralising Capacity equivalent S% pyrite	ANC Fineness Factor	Net Acidity (sulfur units) - SPOCAS	Liming rate - SPOCAS	Chloride	Sulphate as SO4 2-	Resistivity at 80°C	Final pH	Initial pH	pH after HCl addition	pH-FOX (Field pH Peroxide test)*	Reaction Ratings*
				LOR	0.1	2	0.02	10	0.02	0.02	0.02	0.02		0.02	1	5	30	0.5	0.1	0.1	0.1	0.1	0
				Units	pH units	mol H+/t	% S	mol H+/t	% S	% S	% S	% S	factor	% S	kg CaCO3/t	mg/kg	mg/kg	ohm.m	pH units	pH units	pH units	pH units	-
				Action Levels																			
Sample Location	**Date Sampled**	**Sample ID**	**Depth Range (m)**	**Sample Type**																			
BDNO5_BH19	13/03/2020	BDNO5_BH19_0.4-0.5_130320	0.4-0.5	N	**7.4**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.15**	**1.5**	< 0.02	< 1	**10**	**41**	**180**				**5.9**	**4**
	13/03/2020	BDNO5_BH19_0.9-1.0_130320	0.9-1	N												**100**	< 30	**280**					
	13/03/2020	BDNO5_BH19_1.9-2.0_130320	1.9-2	N	**4.4**	**35**	**0.09**	**24**	< 0.02	**0.05**	**0.04**	< 0.02	**1.5**	**0.11**	**5**							**4.2**	**2**
BDNO5_BH20	16/03/2020	BDNO5_BH20_0.1-0.2_160320	0.1-0.2	N	**5.6**	**10**	< 0.02	< 10	**0.03**	< 0.02	< 0.02	< 0.02	**1.5**	**0.04**	**2**								
BDNO5_BH21	13/03/2020	BDNO5_BH21_0.1-0.2_130320	0.1-0.2	N												**10**	< 30	**100**	**5.5**	**8.6**	**1.5**		
	13/03/2020	BDNO5_BH21_0.4-0.5_130320	0.4-0.5	N												< 5	< 30	**120**	**5.5**	**8.5**	**1.5**		
	13/03/2020	BDNO5_BH21_0.9-1.0_130320	0.9-1	N															**5.2**	**7.1**	**1.6**		
BDNO5_BH23C	22/04/2020	BDNO5_BH23C_0.1-0.2_220420	0.1-0.2	N												**9.1**	**170**	**200**					
	22/04/2020	BDNO5_BH23C_0.9-1.0_220420	0.9-1	N												**11**	**94**	**190**					
	22/04/2020	BDNO5_BH23C_1.8-1.9_220420	1.8-1.9	N												**13**	**60**	**170**					
	22/04/2020	BDNO5_BH23C_2.8-2.9_220420	2.8-2.9	N	**5**	**12**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**1**	**200**	**95**	**57**				**3.4**	**4**
BDNO5_BH24	21/04/2020	BDNO5_BH24_0.0-0.1_210420	0-0.1	N	**5.5**	< 2	< 0.02	< 10	**0.02**	< 0.02	< 0.02	**0.14**	**1.5**	**0.02**	**1.0**	< 5	< 30	**200**					
	21/04/2020	BDNO5_BH24_0.4-0.6_210420	0.4-0.6	N												**7.6**	**35**	**350**					
	21/04/2020	BDNO5_BH24_1.9-2.1_210420	1.9-2.1	N												**28**	**84**	**110**					
BDNO5_BH25	22/04/2020	BDNO5_BH25_0.0-0.1_220420	0-0.1	N	**5.2**	< 2	< 0.02	< 10	**0.03**	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**1.0**	**6.8**	< 30	**240**					
	22/04/2020	BDNO5_BH25_0.4-0.6_220420	0.4-0.6	N												**16**	**74**	**350**					
	22/04/2020	BDNO5_BH25_1.4-1.6_220420	1.4-1.6	N												**170**	**42**	**63**					
BDNO5_PTP02	26/03/2020	BDNO5_PTP02_0.5-0.7_260320	0.5-0.7	N	**7.1**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.06**	**1.5**	< 0.02	< 1								
BDNO5_PTP03	26/03/2020	BDNO5_PTP03_0.25-0.45_260320	0.25-0.45	N	**8.7**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.09**	**1.5**	< 0.02	< 1								
BDNO5_PTP04	26/03/2020	BDNO5_PTP04_0.9-1.1_260320	0.9-1.1	N															**5**	**7.3**	**1.6**		
BDNO5_PTP06	24/03/2020	BDNO5_PTP06_0.25-0.45_240320	0.25-0.45	N												**370**	**220**	**23**					
	24/03/2020	BDNO5_PTP06_0.6-0.8_240320	0.6-0.8	N												**290**	**94**	**33**					
	24/03/2020	BDNO5_PTP06_0.9-1.1_240320	0.9-1.1	N												**300**	**110**	**36**					
	24/03/2020	BDNO5_PTP06_1.4-1.6_240320	1.4-1.6	N												**230**	**96**	**35**					
BDNO5_PTP07	24/03/2020	BDNO5_PTP07_0.3-0.5_240320	0.3-0.5	N	**7.8**	< 2	< 0.02	< 10	**0.07**	< 0.02	< 0.02	< 0.02	**1.5**	**0.02**	**1.0**								
BDNO5_PTP08	23/03/2020	BDNO5_PTP08_0.3-0.5_230320	0.3-0.5	N												**9.7**	**120**	**110**					
	23/03/2020	BDNO5_PTP08_0.9-1.1_230320	0.9-1.1	N												< 5	**160**	**260**					
	23/03/2020	BDNO5_PTP08_1.4-1.6_230320	1.4-1.6	N												< 5	**140**	**340**					
BDNO5_PTP09	20/03/2020	BDNO5_PTP09_0.5-0.6_200320	0.5-0.6	N	**7.9**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.18**	**1.5**	< 0.02	< 1								
BDNO5_PTP13	20/03/2020	BDNO5_PTP13_0.3-0.5_200320	0.3-0.4	N	**9.6**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.59**	**1.5**	< 0.02	< 1								
	20/03/2020	BDNO5_PTP13_2.0-2.5_200320	2-2.5	N	**5.7**	**2.0**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	< 0.02	< 1								
BDNO5_TP01	6/04/2020	BDNO5_TP01_0.0-0.1_060420	0-0.1	N	**6.5**	< 2	< 0.02	< 10	**0.02**	< 0.02	< 0.02	< 0.02	**1.5**	< 0.02	< 1								
BDNO5_TP03	6/04/2020	BDNO5_TP02_0.0-0.1_060420	0-0.1	N	**5.9**	**8.0**	< 0.02	< 10	**0.05**	< 0.02	< 0.02	< 0.02	**1.5**	**0.06**	**3.0**								
	6/04/2020	BDNO5_TP03_0.0-0.1_060420	0-0.1	N	**8.7**	< 2	< 0.02	< 10	**0.04**	< 0.02	< 0.02	**0.17**	**1.5**	< 0.02	< 1								
BDNO5_TP05	13/05/2020	BDNO5_TP05_0.0-0.1_130520	0-0.1	N	**4.9**	**27**	< 0.02	< 10	**0.03**	< 0.02	< 0.02	< 0.02	**1.5**	**0.07**	**3.0**								
	13/05/2020	BDNO5_TP05_0.0-0.2_130520	0-0.2	N												< 5	**37**	**470**					
	13/05/2020	BDNO5_TP05_0.4-0.6_130520	0.4-0.6	N												**120**	**95**	**89**					
	13/05/2020	BDNO5_TP05_1.4-1.6_130520	1.4-1.6	N												**360**	**150**	**42**					
BDNO5_TP06	13/05/2020	BDNO5_TP06_0.0-0.1_130520	0-0.1	N	**5.1**	**18**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.05**	**2.0**								
	13/05/2020	BDNO5_TP06_0.0-0.2_130520	0-0.2	N												**5.9**	< 30	**270**					
	13/05/2020	BDNO5_TP06_0.4-0.6_130520	0.4-0.6	N												**5.1**	**150**	**550**					
	13/05/2020	BDNO5_TP06_1.4-1.6_130520	1.4-1.6	N												**470**	**79**	**30**					
BDNO5_TP07	20/05/2020	BDNO5_TP07_0.0-0.1_200520	0-0.1	N	**5.3**	**22**	< 0.02	< 10	**0.03**	< 0.02	< 0.02	< 0.02	**1.5**	**0.07**	**3.0**	< 5	< 30	**580**					
	20/05/2020	BDNO5_TP07_0.2-0.4_200520	0.2-0.4	N														**410**					
	20/05/2020	BDNO5_TP07_0.4-0.6_200520	0.4-0.6	N												**20**	**74**	**280**					
	20/05/2020	BDNO5_TP07_0.9-1.1_200520	0.9-1.1	N												**110**	**47**	**110**					
	20/05/2020	BDNO5_TP07_1.4-1.6_200520	1.4-1.6	N												**72**	< 30	**150**					
BDNO5_TP08	20/05/2020	BDNO5_TP08_0.0-0.1_200520	0-0.1	N	**5.9**	**8.0**	< 0.02	< 10	**0.02**	< 0.02	< 0.02	**0.29**	**1.5**	**0.04**	**2.0**	**6.6**	**76**	**380**					
	20/05/2020	BDNO5_TP08_0.4-0.6_200520	0.4-0.6	N												**30**	**210**	**130**					
	20/05/2020	BDNO5_TP08_0.9-1.1_200520	0.9-1.1	N												**270**	**65**	**35**					
	20/05/2020	BDNO5_TP08_1.4-1.7_200520	1.4-1.7	N												**280**	**45**	**32**					
BDNO5_TP08S	20/05/2020	BDNO5_TP08S_0.0-0.1_200520	0-0.1	N	**5.2**	**19**	< 0.02	< 10	**0.02**	< 0.02	< 0.02	< 0.02	**1.5**	**0.05**	**3.0**								
BDNO5_TP09	12/03/2020	BDNO5_TP09_0.1-0.2_120320	0.1-0.2	N	**8.4**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.47**	**1.5**	< 0.02	< 1				**5.4**	**8.2**	**1.6**		
	12/03/2020	BDNO5_TP09_0.4-0.5_120320	0.4-0.5	N															**5.2**	**8.1**	**1.6**		
BDNO5_TP10	13/03/2020	BDNO5_TP10_0.0-0.2_130320	0-0.2	N												**17**	**36**	**130**	**5.3**	**8.4**	**1.6**		
	13/03/2020	BDNO5_TP10_0.4-0.5_130320	0.4-0.5	N												**85**	**430**	**110**					
	13/03/2020	BDNO5_TP10_0.9-1.0_130320	0.9-1	N												**1000**	**450**	**11**					
	13/03/2020	BDNO5_TP10_1.9-2.0_130320	1.9-2	N	**5.2**	**12**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**1**							**4.5**	**2**

					Acid Sulfate Soils - SPOCAS Suite																Acid Sulfate Soils - Field pH	
					pH (KCl)	Titratable Actual Acidity	HCl Extractable Sulfur	Net Acid soluble sulfur - acidity units	Sulfur - Peroxide Oxidisable Sulfur	Net Acid soluble sulfur	Net Acid soluble sulfur - equivalent S% pyrite	Acid Neutralising Capacity equivalent S% pyrite	ANC Fineness Factor	Net Acidity (sulfur units) - SPOCAS	Liming rate - SPOCAS	Chloride	Sulphate as SO4 2-	Resistivity at 80°C	Final pH	Initial pH	pH after HCl addition	pH-FOX (Field pH Peroxide test)*	Reaction Ratings*
				LOR	0.1	2	0.02	10	0.02	0.02	0.02	0.02		0.02	1	5	30	0.5	0.1	0.1	0.1	0.1	0
				Units	pH units	mol H+/t	% S	mol H+/t	% S	% S	% S	% S	factor	% S	kg CaCO3/t	mg/kg	mg/kg	ohm.m	pH units	pH units	pH units	pH units	-
				Action Levels																			
Sample Location	**Date Sampled**	**Sample ID**	**Depth Range (m)**	**Sample Type**																			
BDNO5_TP11	18/03/2020	BDNO5_TP11_0.1-0.2_180320	0.1-0.2	N	**9.0**	< 2	< 0.02	< 10	**0.08**	< 0.02	< 0.02	**5.7**	**1.5**	< 0.02	< 1								
	18/03/2020	BDNO5_TP11_0.9-1.0_180320	0.9-1	N	**8.6**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.41**	**1.5**	< 0.02	< 1								
BP_BH06	17/04/2020	BP_BH06_3.1-3.2_170420	3.1-3.2	N	**7.0**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.13**	**1.5**	< 0.02	< 1								
BP_BH12	8/04/2020	BP_BH12_3.9-4.0_080420	3.9-4	N															**5**	**7.3**	**1.6**		
BP_BH15A	25/05/2020	BP_BH15A_2.5-2.6_250520	2.5-2.6	N	**9.0**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.30**	**1.5**	< 0.02	< 1								
BP_BH18	12/03/2020	BP_BH18_0.0-0.1_120320	0-0.1	N												**120**	**250**	**28**	**5.2**	**4.6**	**1.6**		
	12/03/2020	BP_BH18_0.4-0.5_120320	0.4-0.5	N												**200**	**540**	**22**					
	12/03/2020	BP_BH18_1.3-1.4_120320	1.3-1.4	N												**68**	**260**	**48**					
BP_BH19	12/03/2020	BP_BH19_0.4-0.5_120320	0.4-0.5	N												**370**	**330**	**21**					
	12/03/2020	BP_BH19_1.1-1.2_120320	1.1-1.2	N												**35**	**54**	**130**					
BP_BH20	12/03/2020	BP_BH20_0.0-0.1_120320	0-0.1	N												**14**	**140**	**250**					
	12/03/2020	BP_BH20_0.4-0.5_120320	0.4-0.5	N												**43**	**160**	**75**					
	12/03/2020	BP_BH20_0.9-1.0_120320	0.9-1	N															**5.1**	**8.3**	**1.6**		
BP_BH22	16/04/2020	BP_BH22_3.0-3.1_160420	3-3.1	N	**6.3**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.09**	**1.5**	< 0.02	< 1				**5.2**	**9.4**	**1.6**		
BP_BH26	10/03/2020	BP_BH26_0.0-0.1_100320	0-0.1	N															**5.2**	**6.3**	**1.6**		
BP_BH29	14/04/2020	BP_BH29_0.2-0.3_140420	0.2-0.3	N															**5.4**	**6.1**	**1.6**		
	14/04/2020	BP_BH29_1.0-1.2_140420	1-1.2	N															**5.2**	**8**	**1.5**		
BP_BH33	9/04/2020	BP_BH33_2.5-2.6_090420	2.5-2.6	N															**5.1**	**7**	**1.6**		
BP_TP09	22/05/2020	BP_TP09_0.2-0.3_220520	0.2-0.3	N												**40**	**98**	**220**					
	22/05/2020	BP_TP09_0.9-1.0_220520	0.9-1	N												**220**	**140**	**48**					
	22/05/2020	BP_TP09_1.4-1.5_220520	1.4-1.5	N												**410**	**170**	**22**					
EDNO1_BH01	31/07/2020	EDNO1_BH01_2.4-2.5_310720	2.4-2.5	N	**5.2**	**9**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.06**	**1.5**	< 0.02	**1**							**6.8**	**4**
EDNO1_BH01_PO1	16/04/2020	EDNO1_BH01_PO1_0.0-0.1_160420	0-0.1	N	**5.2**	**20**	< 0.02	< 10	**0.02**	< 0.02	< 0.02	< 0.02	**1.5**	**0.05**	**3.0**	**5.1**	< 30	**760**					
	16/04/2020	EDNO1_BH01_PO1_0.4-0.6_160420	0.4-0.6	N												**42**	**180**	**150**					
	16/04/2020	EDNO1_BH01_PO1_0.9-1.1_160420	0.9-1.1	N												**390**	**58**	**20**					
EDNO1_BH08	15/04/2020	EDNO1_BH08_0.0-0.1_150420	0-0.1	N	**5.5**	**11**	< 0.02	< 10	**0.03**	< 0.02	< 0.02	**2.7**	**1.5**	**0.04**	**2.0**								
EDNO1_BH09	18/09/2020	EDNO1_BH09_2.9-3.0_180920	2.9-3	N	**8.9**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.11**	**1.5**	< 0.02	< 1							**8.8**	**4**
EDNO1_BH12	31/07/2020	EDNO1_BH12_0.9-1.0_310720	0.9-1	N	**8.6**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**3.2**	**1.5**	< 0.02	< 1							**8.3**	**4**
EDNO1_BH16	9/03/2020	EDNO1_BH16_0.1-0.2_090320	0.1-0.2	N												**19**	**30**	**320**					
	9/03/2020	EDNO1_BH16_0.4-0.5_090320	0.4-0.5	N												**15**	< 30	**270**					
EDNO1_BH17	6/03/2020	EDNO1_BH17_0.1-0.2_060320	0.1-0.2	N												**19**	**45**	**240**					
	6/03/2020	EDNO1_BH17_0.4-0.5_060320	0.4-0.5	N												**6.8**	**52**	**470**	**5.2**	**7.7**	**1.7**		
EDNO1_BH18A	1/06/2020	EDNO1_BH18A_0.0-0.2_010620	0-0.2	N												**5.5**	**44**	**330**					
	1/06/2020	EDNO1_BH18A_0.4-0.5_010620	0.4-0.5	N												< 5	**40**	**1000**					
	1/06/2020	EDNO1_BH18A_0.9-1.0_010620	0.9-1	N												< 5	**39**	**660**					
	1/06/2020	EDNO1_BH18A_1.9-2.0_010620	1.9-2	N	**5.0**	**12**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**1.0**	< 5	< 30	**1100**					
EDNO1_BH19a	15/04/2020	EDNO1_BH19A_0.0-0.1_150420	0-0.1	N															**5.2**	**8.6**	**1.6**		
	15/04/2020	EDNO1_BH19A_0.4-0.5_150420	0.4-0.5	N	**5.0**	**15**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.04**	**2.0**	**6.6**	< 30	**690**					
	15/04/2020	EDNO1_BH19A_0.9-1.0_150420	0.9-1	N												**17**	< 30	**740**					
	15/04/2020	EDNO1_BH19A_2.9-3.0_150420	2.9-3	N												**9.7**	< 30	**76**					
EDNO1_BH20	10/03/2020	EDNO1_BH20_0.0-0.2_100320	0-0.2	N															**5.2**	**7.9**	**1.5**		
	10/03/2020	EDNO1_BH20_0.4-0.5_100320	0.4-0.5	N															**5**	**6.4**	**1.6**		
EDNO1_BH22	3/03/2020	EDNO1_BH22_0.2-0.5_030320	0.2-0.5	N															**5.2**	**8.6**	**1.5**		
EDNO1_BH25	27/04/2020	EDNO1_BH25_0.0-0.1_270420	0-0.1	N	**5.7**	**13**	< 0.02	< 10	**0.03**	< 0.02	< 0.02	< 0.02	**1.5**	**0.05**	**2.0**								
EDNO1_BH26	28/04/2020	EDNO1_BH26_0.0-0.2_280420	0-0.2	N	**5.1**	**16**	< 0.02	< 10	**0.03**	< 0.02	< 0.02	< 0.02	**1.5**	**0.05**	**2.0**								
EDNO1_TP03	3/08/2020	EDNO1_TP03_3.2-3.3_030820	3.2-3.3	N	**6.2**	**3**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	**0.07**	**1.5**	< 0.02	< 1							**7.9**	**4**
EDNO1_TP06	10/03/2020	EDNO1_TP08_0.1-0.2_100320	0.1-0.2	N															**5.1**	**7.4**	**1.6**		
	10/03/2020	EDNO1_TP08_0.9-1.1_100320	0.9-1	N															**5.2**	**7.2**	**1.6**		
EDNO1_TP07	10/03/2020	EDNO1_TP07_0.4-0.5_100320	0.4-0.5	N	**5.2**	**15**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**2**								
	10/03/2020	EDNO1_TP07_1.4-1.5_100320	1.4-1.5	N	**5.3**	**8**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	< 0.02	**1**								
EDNO1_TP08	10/03/2020	EDNO1_TP06_0.1-0.2_100320	0.1-0.2	N	**6.2**	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	< 0.02	< 1				**5.2**	**6.5**	**1.6**		
EED_TP04	21/05/2020	EED_TP04_1.7-1.8_210520	1.7-1.8	N	**4.6**	**22**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.04**	**2.0**								
EF_BH01	18/03/2020	EF_BH01_0.9-1.0_180320	0.9-1	N	**4.9**	**17**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.03**	**1.0**								
EF_BH03	18/03/2020	EF_BH03_1.4-1.5_180320	1.4-1.5	N	**4.3**	**59**	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	**1.5**	**0.11**	**5.0**								
EFO2_BH04	3/03/2020	EFO2_BH04_0.2-0.3_030320	0.2-0.3	N															**5.1**	**6.4**	**1.7**		
ENDO1_BH07	15/04/2020	EDNO1_BH07_0.0-0.1_150420	0-0.1	N	**5.1**	**26**	< 0.02	< 10	**0.04**	< 0.02	< 0.02	< 0.02	**1.5**	**0.08**	**4.0**								
	15/04/2020	ENDO1_BH07_0.0-0.1_150420	0-0.1	N	**5.1**	**26**	< 0.02	< 10	**0.04**	< 0.02	< 0.02	< 0.02	**1.5**	**0.08**	**4.0**								

Statistical Summary

					Acid Sulfate Soils - SPOCAS Suite																Acid Sulfate Soils - Field pH	
					pH (KCl)	Titratable Actual Acidity	HCl Extractable Sulfur	Net Acid soluble sulfur - acidity units	Sulfur - Peroxide Oxidisable Sulfur	Net Acid soluble sulfur	Net Acid soluble sulfur - equivalent S% pyrite	Acid Neutralising Capacity equivalent S% pyrite	ANC Fineness Factor	Net Acidity (sulfur units) - SPOCAS	Liming rate - SPOCAS	Chloride	Sulphate as SO4 2-	Resistivity at 80°C	Final pH	Initial pH	pH after HCl addition	pH-FOX (Field pH Peroxide test)*	Reaction Ratings*
				LOR	0.1	2	0.02	10	0.02	0.02	0.02	0.02		0.02	1	5	30	0.5	0.1	0.1	0.1	0.1	0
				Units	pH units	mol H+/t	% S	mol H+/t	% S	% S	% S	% S	factor	% S	kg CaCO3/t	mg/kg	mg/kg	ohm.m	pH units	pH units	pH units	pH units	-
				Action Levels																		
Sample Location	**Date Sampled**	**Sample ID**	**Depth Range (m)**	**Sample Type**																		
Number of Results					66	66	66	66	66	66	66	66	66	66	66	97	97	98	29	29	29	10	10
Number of Detects					66	38	1	1	30	1	1	27	66	34	41	88	74	98	29	29	29	10	10
Number of non-Detects					0	28	65	65	36	65	65	39	0	32	25	9	23	0	0	0	0	0	0
Minimum Concentration					4.3	< 2	< 0.02	< 10	< 0.02	< 0.02	< 0.02	< 0.02	1.5	< 0.02	< 1	< 5	< 30	11	5	4.6	1.5	3.4	2
Minimum Detect					4.3	2	0.09	24	0.02	0.05	0.04	0.03	1.5	0.02	1	5.1	30	11	5	4.6	1.5	3.4	2
Maximum Concentration					9.6	59	0.09	24	0.08	0.05	0.04	5.7	1.5	0.11	5	1000	670	1100	5.6	9.4	1.7	8.8	4
Maximum Detect					9.6	59	0.09	24	0.08	0.05	0.04	5.7	1.5	0.11	5	1000	670	1100	5.6	9.4	1.7	8.8	4
Mean Concentration					6.312	9.318	0.011	5.288	0.022	0.011	0.01	0.253	1.5	0.031	1.492	144.891	107.649	188.082	5.214	7.445	1.59	6.15	3.6
Geometric Average					6.165	4.267	0.01	5.12	0.017	0.01	0.01	0.035	1.5	0.022	1.121	43.972	65.087	104.042	5.212	7.365	1.589	5.878	3.482
Standard Deviation					1.429	10.695	0.01	2.339	0.016	0.005	0.004	0.852	0	0.025	1.172	201.15	115.885	213.715	0.146	1.074	0.049	1.876	0.843
Median Average					5.75	5.5	0.01	5	0.01	0.01	0.01	0.01	1.5	0.02	1	42	71	110	5.2	7.4	1.6	6.35	4
Geometric Standard Deviation					1.241	3.916	1.311	1.213	1.922	1.219	1.186	5.549	1	2.277	2.133	5.767	2.843	3.137	1.028	1.165	1.031	1.382	1.339
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Legend:
- Not analysed / not calculated
LOR – Limit of Recording
* LOR Exceeds Guideline Trigger Value
Sample Type: N - Primary, FD - Duplicate, FT - Triplicate
- = NO UNIT
% S = % Sulfur
factor =
kg CaCO3/t = kg CaCO3 per tonne
mg/kg = milligrams per kilogram
mol H+/t = mol H+/t
ohm.m =
pH units = pH units

Action Levels:
NSW ASSMAC (1998) **0.03%S (18 mol H+/t)**

Appendix C – Previous Investigation summaries

Environmental Assessment Reports

Relevant to AWRC site

JBS&G Australia Pty Ltd, 2018, University of Sydney Preliminary Site Investigation Badgerys Creek, NSW

JBS&G Australia Pty Ltd (JBS&G) was engaged by Pells Sullivan and Meynink (PSM) on behalf of the University of Sydney (UoS) to conduct a preliminary site investigation for the proposed Western Sydney Lands, located off Elizabeth Drive, Badgerys Creek. The area investigated includes the proposed AWRC and lots to the west.

A review of the site history indicated that most properties within the site appeared to be utilised for light agricultural purposes, and scientific purposes (CSIRO). Based on the findings of the desktop study as well as detailed site inspections, the potential sources of onsite contamination, both historical and current, are likely to be from surficial sources, and likely to be associated with the following:

- Pesticides/herbicides use in former agricultural areas
- Potential biological impacts from dairy farming
- Historical use of HBM (asbestos, lead-based paints, polychlorinated biphenyls (PCBs) in former and current site structures resulting in impacts to soils and in proximity to the location of former and current site structures
- ACMs utilised as irrigation lines (asbestos) conduits
- Potential hydrocarbon, polyaromatic hydrocarbons (PAH), organochlorine pesticide (OCP) contamination from the storage of materials and consumables at various locations across the site area (former and current sheds)

A review of potential offsite sources noted a potential for migration of potentially impacted surface water, surface soils, groundwater and landfill gas to the site from the SUEZ landfill facility located to the south-west. JBS&G also noted an airfield (along the eastern border of the AWRC) which may constitute a potential source of PFAS contamination given the potential for historical use of fire-fighting chemicals at the air field and the ubiquity of PFAS with such chemicals and uses. Aurecon Arup considers this to be unlikely due to historical use of the air field in the Second World War being much earlier than the introduction of AFFF containing PFAS in the late 1960s, and its use for larger airport and training usage.

JBS&G undertook 12 soil sampling locations within the proposed AWRC facility.

Fill materials were observed at four locations to a maximum depth of 0.15 mbgs (not limited to the AWRC). Fill material at a location within the AWRC was comprised of loose well graded gravelly silt with inclusions of angular igneous gravels and surrounding built structures.

Reworked natural materials (used as filling) were observed at 8 locations (not limited to the AWRC), surrounding existing and or/ historical structures (surrounding the buildings and the footprint of the radio telescope array). Reworked natural soils were identified as red-brown natural clays with inclusions of surficial anthropogenic materials including brick, concrete, metal wire / metal building materials and fragments of ACM sheet board. These materials were encountered to a maximum depth of 0.1 mbgs. Several of the structures present on site were noted to contain ACM in various building materials.

Laboratory analysis of soil samples showed some heavy metal exceedances of EILs and minor TRH exceedances of public open space land use management and/or ESLs. Concentrations of heavy metals, TRH and all other assessed contaminants were below the adopted human health criteria. Three zinc and copper exceedances were found within the AWRC impact assessment area. It was noted that elevated concentrations of heavy metal were generally found close to the former radio-telescope. No PFAS was reported in any soil samples analysed near to the runway to the east of the AWRC.

Fragments of ACM were identified on the ground surface and in surficial soils (0 – 0.2 mbgs) in reworked natural soils at two borehole locations in proximity to former building structures on the AWRC. In addition to the two soil sampling locations within the AWRC, fragments of ACM (in varying condition – including non-friable and friable) were observed across the ground surface and in surficial soils (0 – 0.1 mbgs) in proximity to and within footprints of a majority of historical site structures within the AWRC, and within the footprint of the former CSIRO Radio Telescope.

Asbestos in the form of ACM, AF) and/or FA exceeded HSLs in surface soils (0-0.2 mbgs) at some locations. JBS&G concluded that, with the exception of asbestos in soils generally in proximity to historical site structures, there does not appear to be widespread chemical contamination to soils from historical activities at the site.

Kemps Creek

AAJV, 2019a, WSAGA Reticulation Amplifications Options Assessment and Detailed Design, Preliminary Site Investigation (Contamination)

AECOM Aurecon Joint Venture (AAJV) was engaged by Sydney Water to undertake a PSI on sections of Elizabeth Dr and Devonshire Rd. The Elizabeth Dr section (ED WM1) correspond to the central section of the treated water pipeline.

A review of the site history indicated that most of the lots within project area have been used for agriculture. Based on the findings of the desktop study, the potential sources of onsite contamination, both historical and current are as follows:

- PFAS from the nearby Kemps Creek Rural Fire Service
- Nearby landfills and associated contaminants
- Western Sydney Airport construction and associated contaminants, including: Ammonia, nutrients, heavy metals
- Petrol stations and associated contaminants, including TRH, BEX, PAH, phenols and lead
- Rural/primary production land use and associated contaminants, including OCPs, OPPs, herbicides, heavy metals and nutrients

AAJV also undertook a site inspection and identified illegally dumped domestic and C&D waste along sections of Elizabeth Drive. Illegal dumping of domestic and construction wastes, including suspected ACM and asbestos cement sheeting were observed along Elizabeth Drive.

AAJV, 2019b, WSAGA Reticulation Amplifications Options Assessment and Detailed Design, Contamination Site Investigation Report

AAJV was engaged by Sydney Water to undertake a targeted contamination assessment of sections of Elizabeth Dr and Devonshire Rd. The Elizabeth Dr section (ED WM1) correspond to the central section of the treated water pipeline.

AAJV undertook a site inspection and identified illegally dumped domestic and C&D waste, including identified asbestos cement sheeting and suspected ACM in waste piles along Elizabeth Dr to the east of Badgerys Creek and to south of the Hi-Quality Kemps Creeks Quarry. Boreholes and test pits were also undertaken along the roads which identified that fill material was encountered along sections of Elizabeth Dr from the surface to depths of 1.5 m bgl. Fill material consisted mainly of clay with gravel, sand and some organic fragments such as timber and rootlets. Brown to red, low to high plasticity silty clay were present beneath the fill layer.

Soil samples were also tested, with no samples having any COPC concentrations above the adopted ASC NEPM health and ecological investigation/screening levels for commercial/industrial land use. TCLP testing also indicated that the soils met the preliminary classification of General Solid Waste (non-putrescible) under the NSW EPA *Waste Classification Guidelines* (2014).

AAJV concluded that there was a low risk of contamination impacting human health or the environment as part of construction works for the drinking water mains, with the exception of asbestos in soil and observed surface wastes.

ACM and suspected ACM was observed in various waste piles. AAJV recommended that care be taken during construction to avoid working near ACM to avoid and minimise the generation of airborne asbestos fibres for workers and the public. Work health and safety (WHS) and environmental protection measures were also recommended, as well as an unexpected finds protocol (UFP) to be prepared as part of the CEMP to ensure any identified contamination such as any additional ACMs in fill or illegal dumping is managed appropriately during earthworks and construction.

Aurecon Arup, 2019b, Resilience Planning: Prospect South to Macarthur Distribution System, Detailed Site Investigation

Aurecon Arup was engaged by Sydney Water to undertake to undertake a DSI on proposed water infrastructure from Prospect South to Macarthur. Part of the proposed alignment extends from Western Rd, Kemps Creek to 1.2 km east of the Brandown Quarries / Landfill, which corresponds to the central-western section of the brine pipeline.

Aurecon Arup undertook soil sampling through six test pits and six boreholes along the relevant alignment. One groundwater monitoring well was installed adjacent to the Brandown Quarries / Landfill. Both were screened against a Tier 1 criterion for human health and ecological toxicity for open land use and commercial/industrial land use. Out of the 12 soil sampling locations, none exceeded adopted criterions for human health. The following exceeded the criterion for ecological health for urban, residential and open space:

- W2-BH23: 200 mg/kg (Zinc)
- W2-TP04: 88 mg/kg, 152 mg/kg (Zinc)
- W2-TP06: 744 mg/kg (Zinc)
- W2-TP07: 190 mg/kg (Zinc), 66 mg/kg (Nickel)
- W2-MW01: 2 ug/L (Copper), 34 ug/L, 35 ug/L (Zinc)

It was concluded that the nickel and zinc concentrations in soil and groundwater were within naturally occurring levels, while the exceedance of TRH was likely due to roadside gravel and asphalt fragments, fill and/or historic illegal waste dumping. The PP noted that the exceedances are all at locations within the public road corridor and have little to no contact with sensitive ecological receptors.

Aurecon Arup also noted that fill was present along the alignment, consisting predominantly of silt. Some foreign materials such as asphalt road base, plastic, geofabric, glass and metal were present in.

RMS, 2019, M12 Motorway Environmental Impact Statement – Appendix O Soils and contamination assessment report

Roads and Maritime Services (RMS) prepared a soils and contamination assessment report to support the EIS for the M12 Motorway project (RMS, 2019). The project is a 16 km long alignment between the M7 Motorway at Cecil Hills and The Northern Road at Luddenham and would provide direct access between the Western Sydney Airport at Badgerys Creek and Sydney's motorway network. The motorway would run approximately parallel to a section of the treated water pipeline about 2 km to the north and cross the pipelines near the intersection of Mamre Road and Elizabeth Drive. The motorway would run across the southern edge of the AWRC impact assessment area and across the access road. The motorway would also be within the brine pipeline impact assessment area long Range Rd and the M7.

The report identified the key potential impacts to soils involved soil erosion associated with the disturbance of soils on existing slopes during construction, salinity risks within creeks, drainage channels and floodplains, soil contamination, asbestos and HBM, groundwater in areas of potential contamination, soil gas ingress.

A review of previous PSIs and intrusive soil investigations for the project identified several locations of moderate to high environmental concern within or directly adjacent to the treated water and AWRC impact assessment areas. A summary of these areas is presented below.

Potential areas of environmental interest

Site	Site Address	Potential contaminants of concern	Risk rating and analytical results
Former Kari & Ghossayn Pty Ltd (Solid Waste Landfill)	Lot 17 Clifton Avenue, Kemps Creek	TRH, BTEX, ammonia, PAH, heavy metals, Organophosphate Pesticides (OPP), Organochlorine Pesticides (OCP), Polychlorinated Biphenyls (PCB), nutrients, asbestos	Risk: Moderate Results from soil sampling near the site found concentrations below the guidelines. However, no samples were done within the site. Possible contamination within the site.
SUEZ Kemps Creek Resource Recovery Park	1725 Elizabeth Drive, Kemps Creek (next to project)	TRH, BTEX, ammonia, PAH, heavy metals, OCP, OPP, PCB, nutrients, asbestos	Risk: Moderate Groundwater containing copper, zinc, ammonia, nitrogen and nickel levels, and gas containing methane and carbon dioxide above the adopted guidelines were found adjacent to the site.
Stockpiles within Hi-quality Quarry Group Head Office	Corner Elizabeth Drive and Mamre Road, Kemps Creek	Heavy metals, TRH, BTEX, acids, sulphate, cyanide	Risk: Moderate Zinc and PAH levels in soil exceed adopted guidelines.

Site	Site Address	Potential contaminants of concern	Risk rating and analytical results
Area of significant illegally dumped material	Corner of Elizabeth Drive and Range Road, Kemps Creek	Heavy metals, BTEX, asbestos, PAH, OCP, OPP, PCB, TRH	Risk: High Asbestos fragments were found within the area.
Potential areas of existing fill	Generic areas of environmental impact along the project	Heavy metals, BTEX, asbestos, PAH, OCP, OPP, PCB, TRH	Risk: High Groundwater from below and next to several areas had nickel, zinc and copper levels exceeding guidelines.
Historical uncontrolled earthworks containing asbestos and buildings/ structures containing asbestos previously demolished/ degraded	Generic areas of environmental impact along the project	Asbestos	Risk: High Asbestos has been identified next to the construction footprint of the project.

The following exceedances were within or close to the impact assessment area for this proposal:

- BH217. ANZECC 2000 freshwater 95% guideline exceeded by copper (3.6 times), zinc (2.3 times) and nitrogen (4.3 times). Located on the eastern bank of South Creek, on the south-western border of the AWRC.
- TP312. Located in Range Rd, directly north of brine pipeline. Asbestos was present in the soil.

Warragamba Wastewater Treatment Plant

Parsons Brinckerhoff Australia Pty Limited, 2008, Combined Phase 1 & 2 ESA, Warragamba STP, Warragamba NSW 2752

Parsons Brinckerhoff Australia Pty Limited (Parsons Brinckerhoff) was engaged by Sydney Water to undertake a Phase 1 and 2 Environmental Site Assessment on the disused Warragamba Sewage Treatment Plant. The plant lies off Weir Rd, to the north of environmental flows pipeline.

Parsons Brinckerhoff undertook a site inspection of the site, and noted that small, fragmented fibrous cement was observed in fill on site. ACM (Fibrous cement sheeting) was also noted on the south-east and northern areas of the site.

Parsons Brinckerhoff also undertook soil sampling at 19 locations ranging from 20 m to 100 m away from the alignment and analysed for common COPCs. The samples returned levels below the adopted site assessment criteria at the time of writing (NEHF E, NSW EPA 2006) for TPG, BTEX, Phenols, PAH, PCBs, OCP/OPPs, e coli and asbestos.

One sample (BH6_0.1) located near the centre of the site returned concentrations of copper (2,100 mg/kg) and lead (680 mg/kg) above the adopted site assessment human health criteria at the time of writing. However, Parsons Brinckerhoff concluded that the sample was at an isolated hotspot due to being located next to access roads and was not representative of the site in whole.

Furthermore, the following heavy metals were found to exceed the NSW EPA (2006) Phytotoxicity Investigation levels which was applicable at the time of reporting in a variety of samples:

- Cadmium: 4.1 mg/kg
- Copper: 100 mg/kg, 2,100 mg/kg
- Lead: 680 mg/kg
- Zinc: 240 mg/kg, 420 mg/kg, 490 mg/kg, 530 mg/kg, 620 mg/kg, 690 mg/kg, 850 mg/kg, 11,000 mg/kg
- Mercury: 1.6 mg/kg, 2 mg/kg, 2.5 mg/kg, 2.6 mg/kg, 3.2 mg/kg, 8.6 mg/kg, 6.3 mg/kg, 11 mg/kg

Three samples located next to bushland were noted to have faecal coliform levels exceeding Grade A (NSW EPA 2000) criteria (130 MPN/gram, 350 MPN/gram, >1600 MPN/gram), but were assumed to be due to animal faeces.

Core Park Rd, Warragamba

Integrated Environmental Pty Ltd, 2016, Risk Assessment and Removal Plan, Warragamba Dam, Eighteenth St, Warragamba NSW 2752

Integrated Environmental Pty Ltd (IE) was engaged by WaterNSW to undertake a risk assessment and removal plan of asbestos at and around the Warragamba Dam Viewing Platform, Eighteenth St, and the Core Park Rd Dump Zone. The Core Park Rd Dump Zone corresponds to area to the south of the environmental flows pipeline.

IE undertook a visual site inspection and noted the following:

- Approximately 30 non-friable asbestos cement sheeting debris and a friable asbestos wiring was identified at Core Park Rd. It is estimated that the asbestos contaminate area is 400 m^2.
- Approximately 20 empty steel drums, a fluorescent light fitting and general dumped materials was noted at Core Park Rd. The estimated are of the Dump Zone is 10,000 m^2.

CH2M HILL Australia Pty Ltd, 2017a, Detailed Site Inspection, Sampling and Analysis Quality Plan - Eighteenth Street, Core Pare Road and Warragamba STP, Warragamba

CH2M HILL Australia Pty Ltd (CH2M) was engaged by Sydney Water to undertake a site inspection for a DSI Sampling and Analysis Quality Plan on three areas in Warragamba. Area 2 corresponds to the area 150 m south of the environmental flows pipeline in between Core Park Rd and Weir Rd. Area 3 corresponds to the Warragamba Sewage Treatment Plant, to the north of the environmental flows pipelines. Area 1 is not relevant to this project.

Some fragments of surface PACM and stockpiles of anthropogenic material are located in Area 2. A fragment of PACM and evidence of illegal dumping were noted along the edges of Area 3.

CH2M concluded that soil sampling at 114 test pits in Areas 1 and 2, placed in equal intervals, are required to access the extent of ACM contamination, potential risks, and whether further investigations and/or remediation works are required.

The DSI undertaken is detailed below.

CH2M HILL Australia Pty Ltd, 2017b, Detailed Site Investigation, Eighteenth Street and Core Park Road, Warragamba

CH2M was engaged by Sydney Water to undertake a DSI on two areas in Warragamba. Area 1 corresponds to an area roughly 500 m south of the environmental flows pipeline along Eighteenth Street. Area 2 corresponds to the area 150 m south of the environmental flows pipeline in between Core Park Rd and Weir Rd.

CH2M undertook soil sampling at 14 locations at Area 2 which were screened against a Tier 1 criterion for human health and ecological toxicity for an open space land use.

Area 2 was observed to have continuous fill layer comprised of silty sand overlaying a natural profile. Anthropogenic material, including ACM, bricks, concrete and glass were seen in the fill layer. Additionally, anthropogenic material such as potential ACM (PACM), bricks and terracotta tiles were observed on the surface.

Field asbestos quantification was undertaken in fill materials at each location where PACM was observed. In Area 2, 9 out of 15 samples exceeded the adopted asbestos criterion. It was noted that friable asbestos was present in a number of the exceeded samples. Asbestos was found at both the surface and generally up to depths of 0.2 m bgl.

All of the COPCs in the Area 2 samples were below the selected screening levels.

CH2M concluded that Area 2 posed an unacceptable risk to human health due to the concentration of asbestos observed. CH2M recommended the removal of ACM in Area 2, and to develop an asbestos management plan.

CH2M HILL Australia Pty Ltd, 2017c, Validation Report, Core Park Road, Warragamba

CH2M was engaged by Sydney Water to undertake a validation report on the area 150 m south of the environmental flows pipeline in between Cork Park Rd and Weir Rd.

Enviropacific Services Pty Ltd was engaged by Sydney Water in 2017 to remediate the northern half of the site which was identified to have ACM above screening levels adopted in the CH2M 2017 DSI. Surface ACM was removed, and asbestos impacted fill on the western side of the site was excavated and removed from site. Soil samples were obtained from the base and walls of the excavation and tested for fibrous and friable asbestos. Laboratory results indicated that samples did not contain any for fibrous or friable asbestos. No visible PACM was observed.

The excavation was backfilled using imported VENM.

Megarritys Creek, Warragamba

WSP- Parsons Brinckerhoff, 2015, Asbestos Remediation Clearance Certificate

WSP was engaged by Sydney Water to undertake a site inspection and assessment for asbestos remediation on the bushlands to the west Farnsworth Ave, Warragamba. This corresponds to the bushland area and the edge of the residential area off Farnsworth Ave to the south of the environmental flows pipeline.

WSP noted that RMA Contracting Pty Ltd removed ACM in the area in April and May 2015. WSP determined the area was clear of ACM on the surface layer only. As the area was believed to be a

historical site for illegal dumping, long term weathering or soil disturbance could cause buried material to be exposed. Airborne fibre concentrations were found to be satisfactory.

ADE Consulting Group Pty Ltd, 2017, Site Assessment Report – Farnsworth Avenue, Warragamba NSW

ADE Consulting Group Pty Ltd (ADE) was engaged by Sydney Water to undertake a site inspection and assessment on the bushlands to the west Farnsworth Ave, Warragamba. This corresponds to the bushland area and the edge of the residential area off Farnsworth Ave to the south of the environmental flows pipeline. A total of 6 subject areas were inspected

A stockpile of C&D waste containing suspected ACM as well as surface ACM was noted at SA4. An erosional pit where hydrocarbon staining was previously noted by Sydney Water was filed with water during the ADE inspection, and as such, a surface water sample was obtained for the pit. SA6 was noted to contain non-friable presumed asbestos containing fibre cement and sheeting fragments.

No asbestos was detected in any of the validation soil samples collected, while asbestos was identified in 1 fibre cement sample collected from SA4. COPC concentrations in surface water sample collected did not exceed the 99% trigger value for freshwater environments (ANZECC 2000).

ADE concluded that SA4 was not safe in regard to asbestos risk and recommended asbestos removal works to be conducted.

ADE Consulting Group Pty Ltd, 2019a, Asbestos Clearance Inspection Report, Farnsworth Avenue, Warragamba NSW

ADE was engaged by Sydney Water to undertake a site inspection and provide an Asbestos Clearance Inspection Report on Lot 6 DP 209076.This corresponds to the bushland area to the west of Farnsworth Ave to the south of the environmental flows pipeline.

ADE undertook a visual site inspection and noted that asbestos cement fragments were scattered around the haul road on the western side of the bushland, adjacent to the residential housing. Asbestos cement fragments were also noted on the grassy area to the north of the haul road on Lot 310 DP 4903871. The rest of the lot was noted to be visually free of non-friable asbestos. However, ADE noted that ACM is suspected to be present under the soil surface, heavy leaf litter of vegetation.

ADE Consulting Group Pty Ltd, 2019b, Asbestos Inspection Report – Part Lot 310 DP 210651 and Lot 6 DP 209076, Farnsworth Avenue, Warragamba NSW

ADE was engaged by Sydney Water to undertake an Asbestos Inspection of Lot 6 DP 209076 and Lot 310 DP 210651.This corresponds to the bushland area to the west of Farnsworth Ave to the south of the environmental flows pipeline.

ADE undertook a visual site inspection and noted that crushed asbestos cement fragments were present on the surface of Lot 6 and Lot 310. Soil samples were taken from 10 test pits on Lot 6, with non-friable asbestos cement fragments identified in two of the samples.

Warragamba Dam Viewing Platform and Eighteenth Street

Airsafe OHC Pty Ltd, 2016a, Clearance Certification

Airsafe OHC Pty Ltd (Airsafe) was engaged by Sydney Water to undertake a site inspection on the western side of Eighteenth Street for asbestos clearance on the 13th January 2016. This corresponds to the area to the south of the environmental flows pipeline.

No visible asbestos was seen on site or in immediate areas. ACM (asbestos cement sheet fragments), encapsulated with a PVA spray, embedded within concrete slabs of a house footprint remained on site. However, they noted that potential ACM may remain under the surface.

CH2M Hill Australia Pty Ltd, 2017b, Detailed Site Investigation, Eighteenth Street and Core Park Road, Warragamba

CH2M was engaged by Sydney Water to undertake a DSI on two areas in Warragamba. Area 1 corresponds to an area roughly 500 m south of the environmental flows pipeline along Eighteenth Street. Area 2 corresponds to the area 150 m south of the environmental flows pipeline in between Core Park Rd and Weir Rd.

CH2M undertook soil sampling at 100 locations at Area 1 which were screened against a Tier 1 criterion for human health and ecological toxicity for an open space land use.

Area 1 was observed to have continuous fill layer comprised of silty sand overlaying a natural profile. Anthropogenic material, including ACM, bricks, concrete and glass were seen in the fill layer. Additionally, anthropogenic material such as ACM, bitumen gravels, concrete and terracotta tiles were observed on the surface.

Field asbestos quantification was undertaken in fill materials at each location where PACM was observed. In Area 1, 43 out of 102 samples exceeded the adopted asbestos criterion. It was noted that friable asbestos was present in a number of the exceeded samples. Asbestos was found at the surface of 28 locations and within the upper soil profile, generally up to depths of 0.2 m bgl.

Four samples within the fill layer at Area 1 exceeded the adopted screening levels for benzo(a)pyrene, TRH and naphthalene.

CH2M concluded that Area 1 posed an unacceptable risk to human health due to the concentration of asbestos observed. CH2M recommended the restriction of public access to Area 1, to notify the NSW EPA of the findings, and to develop and asbestos management plan.

Integrated Environmental Pty Ltd, 2016, Risk Assessment and Removal Plan, Warragamba Dam, Eighteenth St, Warragamba NSW 2752

IE was engaged by WaterNSW to undertake a risk assessment and removal plan of asbestos at and around the Warragamba Dam Viewing Platform, Eighteenth St, and the Core Park Rd Dump Zone. The dump zone is directly to the south of the environmental flows pipeline while the dam is further to the south.

IE undertook a visual site inspection and noted the following:

- One fragment of friable material and roughly 500 non-friable fragments were found around the viewing platform. The estimated asbestos contaminated area surrounding the platform is 3,500 m^2.

- Over 1,000 ACM fragments (friable and non-friable) was identified to the north of the viewing platform in the burn zone. It is estimated that the asbestos contaminate area is 7,000 m^2.

IE noted that due to hazard reduction burns in the area, the fire can cause asbestos cement sheets to explode, causing airborne fibres and fine ACM to be scattered across the site.

WSP- Parsons Brinckerhoff, 2016, Stage 1 Preliminary Site Investigation and Sampling, Analysis and Quality Plan, Sydney Water Warragamba Dam Viewing Platform, Warragamba NSW

WSP - Parsons Brinckerhoff (WSP) was engaged by Sydney Water to undertake a PSI on the Warragamba Dam Viewing Platform and Eighteenth St. This corresponds to the area to the south of the environmental flows pipeline.

In addition to a desktop study, WSP undertook a site visit and noted fragments of ACM were identified to the north of the viewing platform during hazard reduction burns and were thought to be sourced from historical residential building on the site. ACM fragments were also identified across the site surface in the vicinity of the viewing platform.

WSP concluded that potential for soil contamination was high due to the visual evidence of asbestos across the site.

The project work corridor should be visually assessed by a licensed asbestos assessor (LAA) prior to construction works to inform risk within this area as well as for preliminary waste classification of spoil.

Airsafe OHC Pty Ltd, 2016b, Clearance Certification

Airsafe OHC Pty Ltd (Airsafe) was engaged by Sydney Water to undertake a site inspection on the Warragamba Dam Viewing Platform and Eighteenth St for asbestos clearance on the 17th December 2016. This corresponds to the area to the south of the environmental flows pipeline.

No visible asbestos was seen on site or in immediate areas. However, they noted that potential ACM may remain under leaf litter or shrubbery.

WSP- Parsons Brinckerhoff, 2017, Detailed Site Investigation, Sydney Water Warragamba Dam Viewing Platform, Warragamba NSW

WSP was engaged by Sydney Water to undertake a DSI on the Warragamba Dam Viewing Platform and Eighteenth St. This corresponds to the area to the south of the environmental flows pipeline.

WSP undertook soil sampling at 55 boreholes and selected samples were screened against a Tier 1 criterion for human health and ecological toxicity for an open space land use. One sample to the west of the viewing platform car park had lead concentrations (410 mg/kg) exceeding the adopted HIL C criteria which WSP believed represented a hotspot. Eight soil samples exceeded the adopted EIL for zinc, but no signs of distressed vegetation were observed. Zinc concentrations were below adopted HIL levels.

WSP also noted that highly degraded ACM fragments, including “Super 6” ACM roof sheeting, was found across the site, with asbestos detected in several soil samples. Asbestos concentrations in soil samples exceeded the NEPM (2013) health screening level (HSL) C for recreational/open space land use in 21 of the sampling locations.

WSP concluded that the site did not meet the the adopted screening/investigation levels for the current land use (public open space land use).

CH2M Hill Australia Pty Ltd, 2017d, Limited Site Investigations – Eighteenth Street, Warragamba

CH2M was engaged by Sydney Water to undertake a limited site investigation on the eastern side of the central section of Eighteenth St. This corresponds to the area to the south of the environmental flows pipeline.

CH2M undertook soil sampling at 33 locations and asbestos quantification at 22 locations with samples screened against a Tier 1 criterion for human health and ecological toxicity for a residential (low and high density) and a recreational/open space land use.

ACM was observed on the surface and within samples at nine locations which exceeded adopted criteria. Concentrations of zinc were above the adopted criteria at one location (99 mg/kg, 164 mg/kg), benzo(a)pyrene at two (1.5 mg/kg, 1.1 mg/kg) and nickel at one (164 mg/kg).

CH2M concluded that the site was not suitable for open space and/or residential land use due to the presence of asbestos.

Hibbs & Associates Pty Ltd, 2017a, Assessment of Asbestos Contamination Surrounding Warragamba Dam Viewing Platform, Eighteenth Street, Warragamba

Hibbs & Associates Pty Ltd (Hibbs) was engaged by Sydney Water to undertake an asbestos assessment of the Warragamba Dam Viewing Platform. This corresponds to the area to the south of the environmental flows pipeline.

Hibbs undertook a desktop study and site inspection of the site, during which “a significant amount” of non-friable ACM debris was observed on either side of Eighteenth St, outside the fences area.

Hibbs recommended concluded that a management plan should be implemented for the site and that non-accessible areas do not require remediation.

CH2M Hill Australia Pty Ltd, 2017e, Limited Site Investigations – Warragamba Eighteenth Street Viewing Platform and Roadway

CH2M was engaged by Sydney Water to undertake a limited site investigation (LSI) of the Warragamba Dam Viewing Platform and Eighteenth St. This corresponds to the area to the south of the environmental flows pipelines.

CH2M undertook soil sampling and asbestos sieving at 15 locations and assessed for asbestos against a Tier 1 criterion for human health for a recreational/open space land use. ACM was observed on the surface and within samples at 11 locations which exceeded adopted criteria. ACM was also observed on the surface of the roadway. However, it was noted that exceedances of the adopted criteria only occurred in the samples taken from the viewing platform.

CH2M concluded that the site is unsuitable for recreational/open space use.

Hibbs & Associates Pty Ltd, 2017b, Qualitative Risk Assessment – Asbestos Cement Debris, Warragamba Dam Viewing Platform

Hibbs was engaged by Sydney Water to undertake a risk assessment of the ACM present on Eighteenth Street and the Warragamba Dam Viewing Platform. This corresponds to the area to the south of the environmental flows pipeline.

Hibbs noted that the ACM present on site were non-friable, with the quantity describes as “not sufficient” enough to pose an increased asbestos related health risk via airborne fibres. These were supported by air monitoring samples on the site by Safe Environments (2017) and Airsafe Pty Ltd (2016, 2017) where asbestos airborne fibres were reported to be below detection limit. Based on this, Hibbs concluded that the ACM on site does not pose an increased asbestos related health risk if left in situ.

CH2M Hill Australia Pty Ltd, 2017f, Remedial Strategy – Warragamba Viewing Platform and Surrounding Land

CH2M was engaged by Sydney Water to develop a remedial strategy for the Warragamba Dam Viewing Platform. This corresponds to the area to the south of the environmental flows pipeline.

CH2M noted that based on previous investigations, the site was known to have wide-spread ACM, generally limited to the top 0.2 m of soil.

The following approach was suggested:

- Surface pick of asbestos within the fenced area of the viewing platform.
- Use of geotextile layer in all areas except pavements, rock outcrops and access tracks.
- Spreading of topsoil over the geotextile layer, followed by planting of vegetation on the soil.
- Ongoing maintenance of the vegetation.
- Install erosion control in the bushlands.
- Restore damaged fences and gates, review potential for installation of additional fencing, install notification signs.

Post-remediation management of the site is to be governed by a Contaminated Land Management Plan (CLMP). The CLMP is to also include an Asbestos Management Plan.

Safe Environments Pty Ltd, 2017, Asbestos Clearance Inspection, Viewing Platform, Eighteenth Street, Warragamba NSW 2752

Safe Environments Pty Ltd (Safe Environments) was engaged by Sydney Water to undertake a site inspection and assessment for asbestos remediation on Eighteenth Street and the Warragamba Dam Viewing Platform. This corresponds to the area to the south of the environmental flows pipeline.

Safe Environments noted that emu picking of ACM was undertaken in December 2017. No visible ACM was visible on the site or in immediate surrounding areas. However, as the inspection was limited to the surface, further ACM may be exposed due to erosion and soil movement. Airborne fibre concentrations were found to be satisfactory.

Hibbs & Associates Pty Ltd, 2017c, Asbestos Management Plan (Soil Impacts) – Warragamba Dam Viewing Platform

Hibbs was engaged by Sydney Water to develop an asbestos management plan for Eighteenth Street and the Warragamba Dam Viewing Platform. This corresponds to the area to the south of the environmental flows pipeline.

Hibbs recommended the following:

- Asbestos awareness training for all employees and contractors working at the site.
- Remove all visible and accessible ACM by a licenced asbestos removal contractor.

- As part of the site establishment, install vegetation, geofabric and capping layer, provide erosion control and install fencing.
- Maintenance and ongoing monitoring of the remediated area.

The plan also outlines the UFP and control measures for accessing the site following a fire.

CH2M Hill Australia Pty Ltd, 2018a, Contaminated Land Management Plan– Warragamba Viewing Platform and Surrounding Land

CH2M was engaged by Sydney Water to develop a CLMP for Eighteenth Street and the Warragamba Dam Viewing Platform. This corresponds to the area to the south of the environmental flows pipeline.

The following controls were put in place following the remediation of the site, with details of the remediation present in the following report:

- Remove all visible asbestos when present.
- A safe work method statement (SWMS) is to be prepared for all general maintenance.
- Where soil disturbance or excavation is to take place, these are to be coordinated with SW and/or WaterNSW. Materials are to be appropriately stored and disposed of. Appropriate dust control measures are to be put in place during excavations. If ACM (other than non-friable ACM) is encountered during excavations, all work is to cease, and the risk is to be assessed.
- Appropriate PPE is to be worn for all works which disturb the soil.
- Site inspections and rectifications measures should be taken routinely.

CH2M Hill Australia Pty Ltd, 2018b, Validation Report, Warragamba Dam Viewing Platform and Eighteenth St

CH2M was engaged by Sydney Water to undertake a validation report on Eighteenth Street and the Warragamba Dam Viewing Platform. This corresponds to the area to the south of the environmental flows pipeline.

CH2M noted that emu pick for surface asbestos was conducted in 2016 and January 2017, resulting in 13 tonnes of surface asbestos being removed from the site. However, the DSI and LSI by CH2M in 2017 noted that a “substantial amount” of ACM, including fibrous ACM was observed on the surface on site. The qualitative risk assessment by Hibbs in October 2016 determined that ACM, if left in situ, posed a negligible asbestos health related risk.

As part of the remediation works an emu pick was completed in December 2017 by Enviropacific Services at publicly accessible areas on and adjacent to the Site to remove visible asbestos. The land immediately around the viewing platform was capped with a geotextile fabric and 200mm – 250mm of Virgin Excavated Natural Material (VENM) topsoil. Along Eighteenth St sandstone was installed along the fence line for erosion control and notification signage was installed. CH2M undertook a visual assessment of the site and determined that there was a low and acceptable risk from the soils present to human health and ecological receptors.

CH2M considered the remediation works to have been successfully completed. However, due to residual ACM present on the site and in adjacent areas, a CLMP was prepared by CH2M in 2018 for ongoing management of the site.

CH2M Hill Australia Pty Ltd, 2018c, Suggested Site Inspection Checklist – Warragamba Viewing Platform and Eighteenth Street

CH2M undertook an annual site inspection Warragamba Dam Viewing Platform and Eighteenth St following remediation of the area. This corresponds to the area to the south of the environmental flows pipeline.

It was noted that four fragments of ACM were seen on the driveway, with PACM fragments noted on the rock shelf to the north of the viewing platform.

NSW Environment Protection Authority, 2018, Warragamba Dam Viewing Platform, Eighteenth Street, Warragamba, NSW

The NSW EPA sent an email to Sydney Water regarding an assessment of the Warragamba Dam Viewing Platform and Eighteenth St following remediation of the area. This corresponds to the area to the south of the environmental flows pipeline.

The EPA determined that based on the assessment, regulation of residual asbestos impact at the site under the CLM Act is not required, as the site has been remediated and measures have been put in place to prevent potential exposure.

CH2M Hill Australia Pty Ltd, 2019, Suggested Site Inspection Checklist – Warragamba Viewing Platform and Eighteenth Street

CH2M undertook an annual site inspection Warragamba Dam Viewing Platform and Eighteenth St following remediation of the area. This corresponds to the area to the south of the environmental flows pipeline.

A piece of ACM was observed on Eighteenth St while several fragments were seen under and to the north of the viewing platform.

Geotechnical Assessment Reports

AWRC

Pells Sullivan and Meynink, 2018, Badgerys Creek Development – Elizabeth Drive Geotechnical Investigation

A single geotechnical investigation report completed by Pells Sullivan and Meynink (PSM) on behalf of the UoS was reviewed. PSM undertook six site investigation locations within the AWRC. A summary of the subsurface ground profile recorded within the boreholes is presented below. Groundwater was observed in one test pit at 3.6 m, and wet soil at 3.0-3.7 m at two other test pits.

Subsurface ground profile summary (PSM, 2018)

From (m)	To (m)	Description
0.0	0.3	TOPSOIL: SILT, Clayey SAND or CLAY with sand. Pale brown and moist, with roots and rootlets present. All sand present are fine grained. Generally firm to still consistency. Any clay present have low plasticity.

From (m)	To (m)	Description
0.3	2.0-4.0	Variable alluvium layer. SAND to Clayey Gravelly SAND and CLAY to Gravelly Sandy CLAY. Often moist, stiff to very stiff. LATERITE fragments were noted at 0.8 -2.7 m in two boreholes.
2.0-4.0	Termination depth	BEDROCK: sandstone encountered in two test pits and laterite in two other test pits. Generally, highly weathered with very low strength.

Aurecon Arup, 2020b, Upper South Creek Advanced Water Recycling Centre Reference Design, Geotechnical Desk Study – Advanced Water Recycling Centre

Sydney Water engaged Aurecon Arup to undertake a Geotechnical Desk Study of the proposed AWRC that this EIS is for. An overview of the geotechnical characteristics of soils and recommendations is outlined below.

Site Visit

A site visit was conducted as part of the desk study on 30 April 2020, where the following were noted:

- The site is currently owned and operated by the University of Sydney as an active cattle farm. Some derelict buildings and scientific equipment are present on site however there is no evidence of major historical earthworks performed on the site.
- Toward the north western portion of the site, there is a farm dam likely formed from a billabong.
- The site is generally flat with slopes less than 5% grade.

The following were also concluded from the desk study:

Groundwater

Groundwater boreholes have been constructed as part of the M12 Motorway Concept Design and EIS. Based on information gathered from boreholes nearby the south creek area, the typical groundwater depth is expected to be between 34 and 36 mAHD in the area.

It is noted that the site is situated in an alluvial floodplain and the site layout has been located outside of likely extents of a 1 in 100 years annual exceedance probability (AEP) flooding event. This event is expected to result in a flood water level of approximately RL 38.5 m AHD. Further hydrogeological modelling is recommended to confirm the commensurate 1 in 100 years AEP groundwater level response to flooding or other inputs.

The design of below ground structures must consider the uplift effect on an empty structure. The SW specifications state that "…Buoyancy forces shall be resisted by the provision of either sufficient dead load to resist the floatation forces in accordance AS 1170.0, or the provision of an adequately designed pumped subsoil drainage system."

Alternatively, passive anchor piles could be considered to provide uplift resistance should groundwater and uplift conditions be more onerous than can be addressed with the above mentioned alternatives. Further site-specific geotechnical investigations are required to confirm the design conditions that are applicable to design for uplift of below ground structures.

Salinity

Moderate salinity potential is mapped across the AWRC site, which is considered within acceptable levels. However, scattered higher salinity areas potential are recorded in the creek beds and associated floodplain in areas surrounding the site, and some small areas which have not been identified may also exist.

Other properties

Australian Standard *AS1170.4-2007* indicates an earthquake hazard factor (Z) of 0.08 on the site.

According to the Mine Subsidence Board (MSB) the subject area is not in a mine subsidence district.

From available aggressivity testing on soil samples of alluvium as part from previous geotechnical investigations in the area, the soil has been assessed to have low aggressivity. The available tests have pH > 7, low EC, and a SO_4 sulfate content ≤ 270 ppm.

Shrink and Swell Movement

The site in its unimproved condition is deemed a Class H1 (highly reactive) site assuming the site is underlain by moisture reactive clayey soils of stiff to very stiff consistency. Development of the site will include significant bulk earthworks to lift the site to final design levels using inert structural fill. The redevelopment works are expected to result in at least 0.8 m of fill over natural soils which results in a potential re-classification to a M class site or better.

Shallow foundations should be designed with consideration of characteristic surface movements of between 20 mm and 40 mm.

For settlement sensitive structures that can tolerate less than 20 mm differential movements, the foundation treatment will need to consider removal of any plastic, cohesive soils and replacement with non-reactive select sand fill to a depth of at least 1.8 m below finished surface.

Pavement

CBR tests were carried out as part of the M12 Motorway Concept Design and Environmental Impact Statement (AAJV, 2019).

Based on the proposed placement of fill across most of the main site, pavements will be founded on select fill. Site specific pavement design is required in areas where select fill is expected to be less than 1 m thickness over natural ground.

Pavements in areas underlain by natural alluvial or residual soils will need to consider one or a combination of the following to ensure adequate long-term pavement performance:

- Treatment to improve the strength of subgrade soils e.g. lime amendment.
- Treatment to improve the shrink swell behaviour of subgrade soils.
- Placement of sufficient thickness of pavement layers to minimize shrink swell movements.
- Subgrade replacement.

Earthworks

In accordance with Sydney Water Specification Civil clause C2.4.3, at least 500 mm of topsoil and underlying expansive soils is expected to be stripped for construction.

Excavation work should be conducted in accordance with the Safe Work Australia, Excavation Work Code of Practice. It is recommended that an experienced geotechnical engineer assess unsupported trench excavations > 1.2 m depth. Excavations deeper than 1.5 m should be benched, or adequately battered, or shored if cut vertically. Any additional surcharge loading (cut stockpiling, equipment storage, etc) or heavy machinery near edge of the excavation (i.e. in a distance equal to depth of trench) should be avoided.

For excavations deeper than 1.5 m, unsupported excavations in dry materials should be constructed with a nominal maximum batter slope of 2H:1V. The stability of temporary excavations may be affected by the presence of weak layers, groundwater, ground stratigraphy and other factors. Where groundwater is present, temporary slopes should be reduced to no greater than 4H:1V. Any other unfavourable conditions should be referred to a Geotechnical Engineer for assessment.

Pipelines

Roads & Maritime Services, 2018, MR535 Elizabeth Drive Upgrade – The Northern Rd to M7, Strategic Geotechnical Factual Report

RMS undertook a geotechnical investigation along Elizabeth Dr between The Northern Rd and M7. This corresponds to the central section of the treated water pipeline and the western section of the brine pipeline which crosses Elizabeth Drive.

A geotechnical investigation of the area was undertaken in July 2018, consisting of two geotechnical boreholes, four test pits, and 37 pavement cores that ranged in depth from 1.4 to 14.6 m below ground level. Nineteen pavement cores and two test pits were undertaken within the treated water desktop assessment area up to depths of 2 m, and no groundwater was encountered. Solid flight augers and coring drilling methods were used. An overview of the characteristics of soils is outlined below.

Subsurface ground profile summary (RMS, 2018)

From (m)	To (m)	Description
0.0	0.05 - 0.4	ASPHALT: road surface present within all pavement cores
0.15	0.4	CONCRETE: present underneath asphalt in a few pavement cores
0.05-0.4	0.4-Termination depth (2 m)	FILL: present beneath asphalt layers. Absent from one pavement core. Generally SANDY GRAVEL, SILTY GRAVELLY SAND or SILTY SANDY GRAVEL. A variety of soil types comprising of a mixture of silt, sand, gravel and clay were present. Glass was present in one test pit and timber fragments in a pavement core.
0.5 - 1.3	Termination depth (2 m)	CLAY/ SANDY CLAY/ SILTY CLAY: present beneath fill layers. Generally low to medium plasticity.

Trace amounts of anthropogenic waste such as plastic, terracotta and glass were observed in some test pits beyond 500 m away from the treated water pipelines.

AAJV, 2019c, WSAGA Reticulation Amplifications Detailed Design – Geotechnical Investigation Report

Sydney Water engaged AAJV to undertake a detailed design of interim drinking water amplifications located on sections of Elizabeth Dr and Devonshire Rd. The Elizabeth Dr section (ED WM1) correspond to the central section of the treated water pipeline.

A geotechnical investigation of the desktop assessment area was undertaken in March 2019, consisting of seven boreholes and 15 test pits that ranged in depth from 0.9 to 20.60 m below ground level. Solid flight augers and coring drilling methods were used. The investigation also encountered groundwater at depths of 6.43 and 6.2 m below ground at two boreholes. An overview of the geotechnical characteristics of soils is outlined below.

Geotechnical characteristics

Moisture content testing on nine samples indicated that the moisture content of soils in the area is within 11.6% to 24.9%. The in-situ moisture content remain within 7% of the plastic index, with most samples measuring slightly lower than the associated plastic limit, which contribute to the firm to very stiff consistencies within the samples.

The Atterberg Limits and Linear Shrinkage testing undertaken on nine samples indicate that the soils were medium to high plasticity clays. Soils closer to waterways were medium plasticity.

The residual soils tested indicate that the site soils on site have significant shrink-swell properties in the residual soils tested. It was noted that soils taken from the boreholes close to Badgerys Creek showed lower linear shrinkages, likely due to the South Creek Alluvial landscape.

Soil samples collected from across the site were also tested for pH, conductivity, sulfate and chloride. The results of this testing are provided below:

- Results suggested that the site soils ranged from non-aggressive to moderate aggressivity towards concrete and steel. Samples taken from within the treated water desktop assessment area were generally classified as non-aggressive to mild. Special precautions may be needed with regard to the use of these materials.
- pH within the treated water desktop assessment area ranged from 3.6-8.9.
- Chloride and sulfate concentrations within the treated water desktop assessment area ranged from 130-2100 mg/kg and 17-360 mg/kg respectively.

The following additional geotechnical constraints and recommendations were made:

- No Emerson Crumb testing was undertaken. However, in general, the soils along the banks of the waterlines are likely to be moderate to highly dispersive. Slopes near water courses may be prone to progressive erosion and instability if not managed properly.
- Bringelly Shale, which is identified as underlaying the site, is known to slake and break down upon exposure. The derived soils are also dispersive in nature, which could affect surface water quality and may cause environmental contamination for nearby water bodies.
- Dispersive soils could also contribute to soil erosion where there is a heavy release of surface water run-off.
- Significant groundwater seepage could possibly trigger piping and the creation of voids within fill constructed from dispersive soil and shale derived materials.

A summary of the subsurface ground profile recorded within the boreholes is presented in Table 6-4.

Subsurface ground profile summary (AAJV, 2019)

From (m)	To (m)	Description
0.0	0.8-1.5	FILL/Topsoil: Silty CLAY, Sandy CLAY, Gravelly CLAY. Firm to very stiff consistency, medium density. Trace root fibres, gravels and concrete.
0.0-1.5	2.5-4.0	Silty CLAY, Clayey SILT: low to medium plasticity, firm to hard consistency. Traces of sand and gravel.
0.2 – 4.0	3.2 – 6.8	Silty CLAY: medium to high plasticity, with traces of gravel. Stiff to hard consistency.
2.5 – 6.8	9.0 – 20.6	BEDROCK: Interbedded-laminated shale and sandstone. Extremely weathered transitioning to fresh at lower depths.

Aurecon Arup, 2020c, Upper South Creek Advanced Water Recycling Centre Reference Design, Geotechnical Desk Study - Treated Water, Environmental Flows and Brine Pipelines

Sydney Water engaged Aurecon Arup to undertake a Geotechnical Desk Study of the proposed Upper South Creek pipelines that this EIS is for. An overview of the geotechnical characteristics of soils and recommendations is outlined below.

Site Visit

A site visit was conducted as part of the desk study on various days from November 2019 to June 2020 for each pipeline alignment. The following were noted for each type of pipeline.

Treated water pipeline:

- Groundwater likely to be encountered at shallow depths around the Nepean River.
- Areas of the proposed alignment include steep sided valley walls of Hawkesbury sandstone.
- Small areas of landfill material (contaminated land) within the Warragamba area.

Environmental flows pipeline:

- Megarritys Creek valley is steep, wide and deep.
- The valley floor release site area and the access roads around the Warragamba River are either formed on fill or cut into the Sandstone bedrock. This material is considered to be highly variable (in composition, strength and stiffness) and is noted to contain asbestos (warning signs in place).
- In one area near the proposed release site a small slope failure in the fill was observed to have occurred.
- Fill was observed on the channel bank, below the proposed release point. This fill is anticipated to overlie the natural rock and be of variable thickness. At the time of the visit the material was soft in some parts and is expected to require some management in order to establish a viable work site. It is also possible the fill material is prone to scour.
- In some places the valley wall has been excavated by drill and blast methods.

Brine Pipeline:

- Small areas of landfill material (contaminated land) within the Cecil Park area.

- Two potential landslips are present in Cecil Park. The alignment is likely below the toe of one of the landslips.
- There are land instability features to the east and west of the Westlink M7 crossing. The area to the west was visited, but there were no visible signs of land instability. Areas of small erosion and scarps are present around the site. Historical slides and movements were present to the east of the site.
- Tracks and cleared area present to the east of Henry Lawson Dr have imported fill and/or reworked material – siltstone, sandstone, bricks, old clay pipes. The fill was more than about 300 mm thick on the tracks where it was visible in gullies. No immediate signs of slope instability.
- Fill along roadside of Henry Lawson Dr – sandstone and siltstone gravel/cobbles visible through the grass.
- No salinity features were observed.

Groundwater

Shallow groundwater in the desktop assessment area range from 1.3 m bgl to 6.82 m below ground level. Due to the comparatively shallow depth of trenching excavation (anticipated depths up to 2 to 3 m) trenching works are at low risk of intercepting the aquifer although perched groundwater tables may be encountered. Trenchless crossings of creeks / rivers and infrastructure required within the Wianamatta Group basement rocks and alluvial materials will likely encounter groundwater.

Design for excavations should consider the potential for groundwater to impact on both side wall and base stability. Allowance should be made for drainage, dewatering or design of batters and shoring to accommodate groundwater pressures. This may include standpipe/ piezometer installation at key locations and possibly dataloggers or other methods to collect more accurate data for design.

The design groundwater levels shall be documented and shall take into account the short term and long-term groundwater levels as well as any perched levels in the vicinity of the proposed excavations.

The risk of water entering the excavation is considered more likely in the lower lying areas such as in the vicinity of creeks or rivers where groundwater levels are expected to be shallowest, and in areas where granular soil deposits are encountered. The majority of the infrastructure works are to be constructed within Blacktown and Luddenham landscapes in which generally fine-grained soils are prevalent. As such significant groundwater management of open excavations is not anticipated, beyond the use of sump pump dewatering. In areas where groundwater lowering and disposal may be required, consideration could be given to installing the pipework using trenchless technologies or watertight shoring for trenched excavation.

Risks associated with groundwater ingress are likely to increase during or for a period after prolonged or heavy rainfall. Optimal solutions (gravity drainage controls, cut-off walls, active dewatering) will depend on the nature and duration of groundwater control required. Equipment such as sump pumps should be made available during construction to manage potential groundwater ingress and similarly provision should be made for additional shoring that may be required due to potential groundwater induced instability.

Groundwater abstracted from dewatering works may require treatment prior to disposal should it contain contaminant levels above (NSW EPA, 2020) or excessively high pH.

Slope Instability

Localised areas of instability were identified during the site visits. However, these areas were outside the footprint of the proposed pipeline alignments. The colluvium at the toe of the escarpment along Bents Basin Road may have small areas of localised instability. The Warragamba and Nepean Valleys are steeply incised into Hawkesbury Sandstone and any works in these areas would be exposed to potential for rock falls. Localised slope failures in the fills that were placed to support the Warragamba Dam access roads were also observed on site visits.

East of the Nepean River, slope instability including soil creep and more rapid landslides can occur on even relatively shallow slopes in the region. Weathered residual soil derived from Bringelly Shale may creep downslope or form shallow landslides. Clearing of natural vegetation, disturbance from earthworks and urban developments and soil moisture content from rainfall are, among the factors that can contribute to slope instability.

A review of available aerial photographs identified land instability features including two within Cecil Hills and two in Cecil Park, one each side of the Westlink M7 crossing.

In general, after the completion of any cut and fill earthworks, bare slopes should be re-vegetated or other erosion control measures put in place as soon as practicable to mitigate soil erosion.

General Stability

Australian Standard *AS1170.4-2007* indicates an earthquake hazard factor (Z) of 0.08 for the area.

The reactivity of the ground from moisture changes for the majority of the area is expected to be Class H1 to H2 (highly reactive), in accordance with Australian Standard *AS 2870-1996, Residential Slabs and Footings*, where intermediate to highly plastic cohesive soils are present to depths of 1.8 m or greater. Class S or M (slightly to moderately reactive) could also be considered at some location where the soil properties are deemed to be slightly to moderately reactive, generally in areas of low to intermediate plasticity soils. Class A can be assumed on the western end of the alignment, where the geology becomes Hawkesbury Sandstone, where rock is encountered and little or no ground movement from moisture changes is expected.

In areas of alluvium, typically found across creek beds, there is potential for soils to soften and potentially collapse into excavations where groundwater is encountered. Similarly, bands and seams of granular material recorded across the site can also hold water and lead to instability.

According to the Mine Subsidence Board (MSB) the subject area is not in a proclaimed mine subsidence district.

Geotechnical Constraints

At least three known dykes would be expected to be encountered. Whilst the design depth is over 100 m in places and therefore the associated weathering that causes zones of poor rock mass with high permeability or hydrogeological boundaries with may not be present; this cannot be said with certainty.

Depth of weathering in the rock mass at each end of the tunnel is not well known. At the western end the Hawkesbury Sandstone in the Warragamba valley has formed steep cliffs and the zone of weathering would be expected to be limited and closely associated with defects. At the eastern end near Bents Basin Road the rock is covered by a colluvium slope and the weathering depth could therefore be greater below this. This would have associated issues in establishing the work sites and controlling initial tunnelling distances.

Groundwater levels are likely to be at the surface in the vicinity of where the proposed environmental flows pipeline passes beneath the existing Megarritys Creek. This creek would likely be in a zone of weaker, more fractured (and hence more permeable) ground. This could be an area of concern for some construction methods.

Soil shrink and swell

Bringelly Shale material present across the desktop assessment area is known to deteriorate in the presence of water and is prone to swelling. As such, there may be swelling movements across the site during construction. Where construction options lie across recorded areas of Bringelly Shale the following geotechnical issues exist:

- Re-use of Bringelly Shale material as a structural fill source is not recommended as it is known to deteriorate in the presence of water and is prone to swelling.
- The reactive swelling clays contained in Bringelly Shale and the residual soils derived from it can lead to swelling movements that need to be considered during design.
- Removal of residual soils to found on underlying rock will not entirely eliminate ground movements as the less weathered Bringelly Shale also has the potential to swell if water interacts with it and confining stress levels are low.
- High strength and stiffness can be derived (in part) from pore water suction, so changing seasonal conditions may affect the design bearing capacity and settlement behaviour of foundations and should be considered.
- Shallow foundations and thrust blocks within approximately 2 m of ground surface can experience heave and shrinkage related surface movements that may be in excess of 20 mm.

Alluvium

Where proposed pipelines are sited on the alluvium, there is potential for variable soil support over short distances and shallow groundwater may also be present.

Where groundwater is encountered there is the potential for soils to soften and potentially collapse into excavations. Thin bands and or seams of granular material are recorded and can hold perched groundwater as well, these can lead to excavation instability if not correctly managed.

Excavation stability during the construction phase will therefore need to be considered in planning and design. In addition, as the dimensions of alluvial soil paleochannels are closely associated with existing creek lines, these will need to be understood and defined if trenchless crossings are required.

It should be noted that boundaries of mapped geological units may not be exact. Alluvium should also be anticipated around any creeks and rivers. These areas will require additional investigation.

Disturbed Terrain

Where proposed pipelines are sited on disturbed Terrain (fill), additional investigation will be required to classify and assess the material encountered. Fill can be highly variable in its engineering characteristics so understanding the characteristic properties, extent and distribution near affected works will assist in identification of treatment requirements and design requirements for future works.

Depending on the elevation of the material, shallow groundwater may be encountered within the filled area and excavations may require temporary batters or shoring and other groundwater control measures such as dewatering.

Contamination assessment may be required, and measures may need to be implemented to protect workers health and safety should asbestos or other contaminants be present.

Erosion

Soil erosion may be an issue during both the construction and post-construction phase. Erosion control fencing, control of surface drainage and other measures may be required during wet season construction periods to prevent the uncontrolled release of sediments to waterways and the areas outside the work sites. Compaction may reduce the risk of erosion for cases where in-situ soils are used as backfill. Where necessary, erosion and sediment control measures will need to be used including: geofabrics, vegetation cover and drainage systems should be employed to protect fill batters from surface water run-off.

Earthworks

During earthworks, the following general measures should be followed:

- Compaction of fill shall be undertaking in accordance with Sydney Water Technical Specification – Civil (2019, Version 8). Field density tests shall be carried out at locations and to satisfy the required testing frequency.
- Select appropriate materials for re-use. In situ residual clay may be suitable for use as general fill, however, if possible, untreated, high plasticity clays should be avoided for use as structural fill due to their potential for shrink-swell movements. Unsuitable excavated materials shall be disposed offsite properly.
- The monitoring of the earthworks should be completed under a Level 1 Inspection and Testing commission.
- Excavation shall avoid exposure of Bringelly shale materials to rainfall, runoff or other sources of water by avoiding works in the wet season.
- Temporary batters flatter than 1.5H:1V are likely to be required in dry, firm (or better) clayey soils. Temporary slopes in dry, non-plastic sandy soils should be limited to 2H:1V. The above apply to excavations less than 2 m depth and above the groundwater table.
- In organic, uncontrolled fill, soft, loose or water charged ground significantly flatter batters are likely to be required. Shoring will be required where there is insufficient space to form temporary batters. Where the above-mentioned conditions are encountered or excavations are deeper than 2 m, a site-specific assessment of safe batter slopes and stabilisation works is recommended.
- Surcharge loading from traffic loading, construction materials, existing structures and stockpiled materials close to an excavation may reduce excavation stability. This risk will depend on the location of the trench relative to the potential surcharge loads.
- Backfilling and compaction of material should be carried out in accordance with Clause C2.7 (Backfill or Fill Material) and C2.8 (Compaction) of Sydney Water Technical Specification Civil (2019, Version 8). Backfill is required to be free of organic matter, tree roots, grass, vegetation, material greater than 75 mm in diameter and hazardous substances. Soil materials with a plastic index higher than 30%, or classified as Emerson class number 1, or with a free swell index higher than 3% are not considered suitable for use as backfilling.
- In general, any topsoil, soft alluvium, wet plastic clayey soils or fill material containing significant amounts of deleterious material will not be suitable for backfill. Residual soils and alluvial soils of low and intermediate plasticity may be used as general backfill material.
- For pipelines within the roadway corridor, granular backfill in trench excavations should be used, with the backfill placed and compacted in a similar manner to the existing pavement material.

Aurecon Arup, 2020d, Upper South Creek Advanced Water Recycling Centre Reference Design, Geotechnical Interpretive Note – Brine Pipeline

Sydney Water engaged Aurecon Arup to undertake intrusive geotechnical investigations along the AWRC pipelines that this EIS is for. This report focuses on the findings along the brine pipeline. An overview of the geotechnical characteristics of soils and recommendations is outlined below.

California Bearing Ratio

A total of five California Bearing Ratio (CBR) tests were undertaken for the project. Based on the available CBR test data, the subgrade strength classification is considered as weak for Residual soil and as medium for Alluvium. A moderate swell potential is noted for Residual soil, and a low swell potential is noted in Alluvium.

The results suggest that subgrade improvement or replacement with better materials may be required, depending on the design traffic and life of the pavements. Further investigations may be required to fully characterise materials once pavement alignments and locations are finalised.

Land Instability

Two areas of potential slope instability are present within the desktop assessment area; to the west and east of the M7, and the area between Prospect Creek and Henry Lawson Drive.

The brine pipeline is proposed to be constructed with directional drilling in the hilly area between Prospect Creek and Lawson drive, and the entry and exit points lie within flat areas. Therefore, instability is not considered a risk for the pipeline in the area of Prospect Creek and Lawson drive.

For the instable area to the east of the M7, the toe of the unstable area was mapped approximately 10 m to the north of the brine pipeline alignment. Possible historical flow lobes were noted downslope to the south of the brine pipeline alignment. Three test pits were undertaken in this area, where thin layers of colluvium soil were observed. The presence of the colluvium layers can be attributed to a landslide or to creep. The findings indicate that unstable ground conditions may extend in depth through the soil units to the top of the rock, that was encountered to a depth varying from 1.2 m to 2.5 m.

Aurecon Arup recommended that pipelines be installed fully in the bedrock within this area. The placement of granular fill was also recommended to ensure sufficient surface drainage of the unstable area to minimise the risk of soil creep or remobilising the historical landslip.

The area to the west of the M7 was known to have historical landslides, at a distance of over 1 km to the brine pipeline alignment. Three boreholes were undertaken within this area; however, no indication of historical land instability was noted. Top of rock within the area was noted to range from depths of 3.2 m to 9 m.

Erosion

Dispersion tests undertaken on samples indicated that the Emerson class numbers varied between 2, 5 and 6 within the residual and alluvium soil layers. There is therefore potential for soil erosion during construction and post-construction, in particular for the trenched sections of the brine pipeline. Erosion control fencing, control of surface drainage and other measures may be required during wet season construction periods to prevent the uncontrolled release of sediments to waterways and the areas outside the work sites.

Soil Salinity

The resistivity of the samples ranged between 12 and 300 Ωhm and the conductivity ranged between 33 and 833 µS/cm.

Soil Reactivity

The typically medium and high plasticity alluvial and residual clays that were encountered in the brine pipeline ground investigation are susceptible to swelling and shrinkage movements with changes in soil moisture content. The site can be classified based on AS 2870 – 2011 as slightly reactive, that is the site may experience only slight ground movement from moisture changes.

The shrink swell effect may cause differential displacements to the trenched and trenchless sections of the brine pipeline with a depth to invert level less than 1.8 m. It is recommended therefore that the pipeline is installed at a depth below 1.8 m where possible.

Groundwater

Groundwater was encountered during excavations at multiple areas across the pipeline. Furthermore, the following areas may also involve high groundwater inflow rates and require groundwater management of the trenched excavations:

- Areas near creeks.
- Areas where the excavation extends through the soil rock interface where more permeable / fractured rock can be anticipated.
- Areas where the trenched excavations intersect granular fill material such as around existing services, or land-drains and road subgrades.

As such, groundwater management may be required for the construction phase, particularly during the excavation of open trenches.

Allowance should be made for dewatering and excavation support. Temporary realignment / diversion of local creek flows may be required, depending on the time that the construction works are staged, and assuming that the creek has a seasonal flow pattern. It should be noted that groundwater extraction rates exceeding the equivalent of 3 ML/year during dewatering operations will require permits for water extraction, which can cause delay during construction if not obtained in advance.

It is noted that the main geotechnical hazard identified in another study in the area is the inferred presence of two fault zones at Kemps Creek. At fault zones, highly fractured / extremely weathered rock may be encountered. High permeability zones within the rock may also be encountered which are possibly water-charged. Rapid groundwater inflows are expected if the fault zones are encountered during excavation. Appropriate groundwater management will be required. Several other areas of extremely weathered and/or fractured rock zones where high permeability zones may be present were also noted along the pipeline.

Soil Durability

Soil samples were tested soil aggressivity, with the test results present below:

- The pH of the samples ranged from 5.3 to 8.8 (two samples with pH <5.5).
- The chlorides ranged from 5.7 to 173.6 ppm.
- The sulfates ranged from 5.8 to 28.4 ppm.
- The resistivity for most samples ranged between 2,000 and 5,000 ohm.cm, while there were samples with resistivity values higher than 5,000 ohm.cm.

Excavation Stability

Excavations more than 1.5 m deep shall require an excavation support system. Support measures may comprise battering, benching or vertical shoring excavations. Temporary batters flatter than 1.5H:1V are likely to be required in firm (or better) clayey soils above the groundwater table. Vertical shoring will be required where there is insufficient space to form batters or benches, and where excavations are adjacent to existing structures and infrastructure.

Overall, the side walls of test pits in the ground investigation in residual soil and shallow rock were stable.

Areas that may require support due to potential excavation instability, are summarised below:

- Areas near creeks, where high groundwater may be encountered in the excavation, such as at Kemps creek, Hinchinbrook creek and Clear Paddock Creek.
- Area east of M7, where colluvium was encountered in the test pits.
- Areas with gravelly layers (e.g. BDNO5-BH13), or loose fill, or soft clay (e.g. BDNO5-BH17).

Additionally, Bringelly Shale is prone to slaking when excavated and exposed to water. A support liner may be also required during construction of the shafts in Bringelly Shale to avoid slaking of Bringelly Shale and ensure stability of the unsupported excavation.

Material Reuse

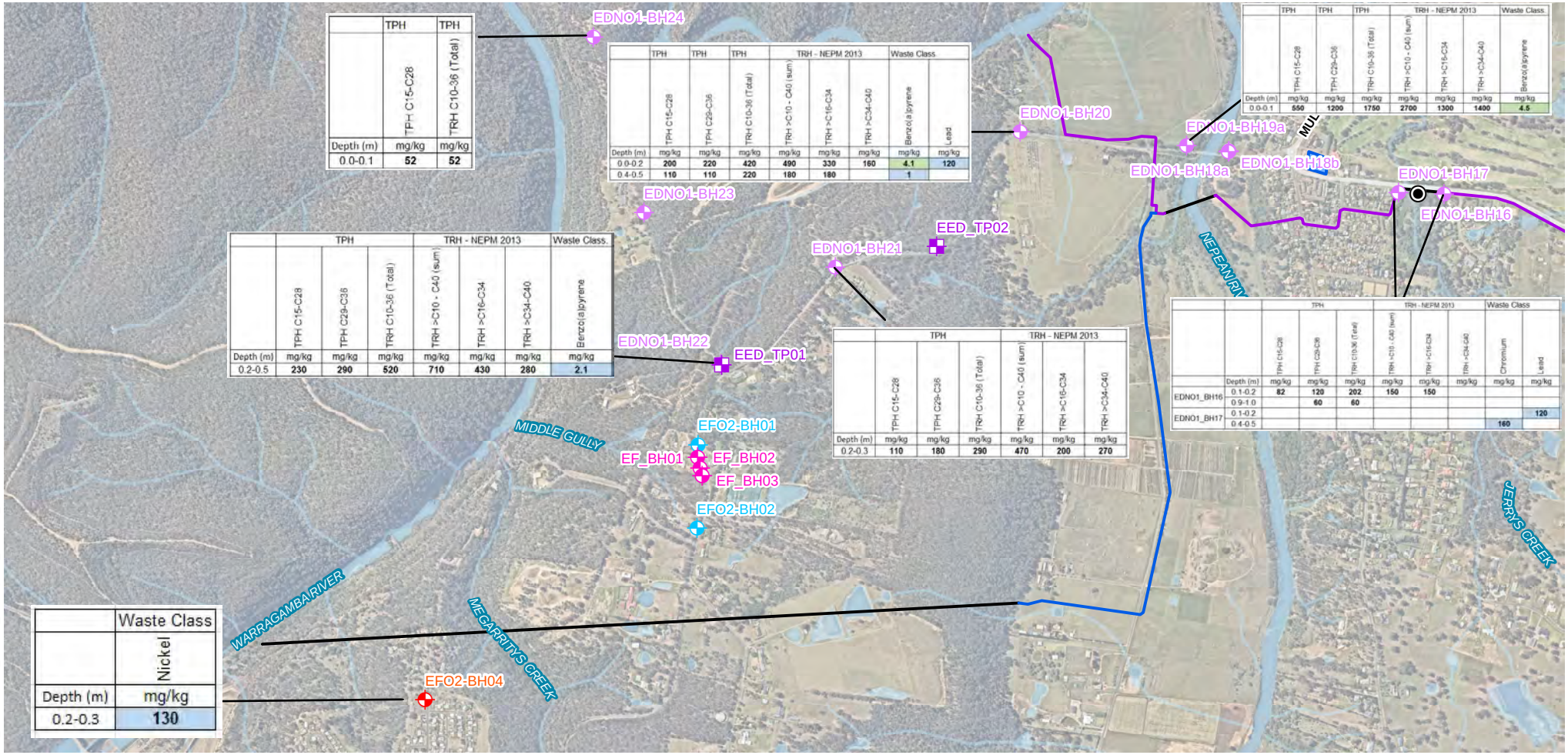
Material derived from Bringelly Shale is not considered appropriate for re-use as select fill as Bringelly Shale, and its residual soil, is prone to shrink/ swell movements and degradation due to changes of water content. The requirements for fill property have been set out by Sydney Water, and will be adhered to during the construction process.

Alluvium and material derived from Bringelly Shale may be used for general trench fill materials in non-settlement sensitive areas, subject to compliance with the Water Supply Code of Australia. Lime stabilisation could be considered for cohesive, plastic fills to reduce shrink -swell movements and to improve strength and stiffness. A filter geotextile separation layer should be placed between pipe embedment materials and any dispersive soil encountered in the pipe trench or in the trench fill.

Materials which are considered unsuitable for trench fill include:

- Topsoil and other highly organic material.
- Expansive soils with weighted plasticity index > 2,200 (if ground movements above the pipe trench are unacceptable).
- Rock or hard clay greater than 75 mm.
- Soil with a free swell index higher than 3%.
- Material that can be subjected to degradation over time.
- Highly dispersive soils that are classified as Emerson Class number 1.

Appendix D – Former Site Investigation Locations and Contamination AECs



	TPH	TPH
	TPH C15-C28	TRH C10-36 (Total)
Depth (m)	mg/kg	mg/kg
0.0-0.1	52	52

	TPH	TPH	TPH	TRH - NEPM 2013			Waste Class	
	TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C16-C34	TRH >C34-C40	Benzo(a)pyrene	Lead
Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
0.0-0.2	200	220	420	490	330	160	4.1	120
0.4-0.5	110	110	220	180	180		1	

	TPH			TRH - NEPM 2013			Waste Class
	TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C16-C34	TRH >C34-C40	Benzo(a)pyrene
Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
0.2-0.5	230	290	520	710	430	280	2.1

	TPH			TRH - NEPM 2013					Waste Class	
	TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C16-C34	TRH >C34-C40	Benzo(a)pyrene	Benzo(a)anthracene	Chromium	Lead
Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EDNO1_BH16 0.1-0.2	82	120	202	150	150					
0.9-1.0		60	60							
EDNO1_BH17 0.1-0.2										120
0.4-0.5									160	

	TPH			TRH - NEPM 2013			Waste Class
	TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C16-C34	TRH >C34-C40	Benzo(a)pyrene
Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
0.0-0.1	550	1200	1750	2700	1300	1400	4.5

	Waste Class
	Nickel
Depth (m)	mg/kg
0.2-0.3	130

- Environmental Flows Pipeline
- Treated Water Pipeline
- Underbore
- Site Compounds

Contamination Test Locations

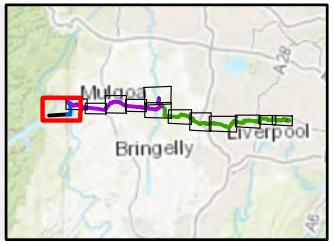
- Boreholes
- Test Pits

Geotechnical Investigations

- Borehole (Effluent Discharge - Option 1)
- Borehole (Effluent Discharge E-Flows - Option 2 or 2.1)
- Borehole (Effluent Discharge E-Flows - Option 3)
- Hand Auger

NSW EPA Waste Classification Guidelines (2014) Contaminant Thresholds for General Solid Waste without Leachate (CT1)

NSW EPA Waste Classification Guidelines (2014) Contaminant Thresholds for Restricted Solid Waste without Leachate (CT2)



Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Date: 3/09/2020

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Projection: GDA2020 MGA Zone 56

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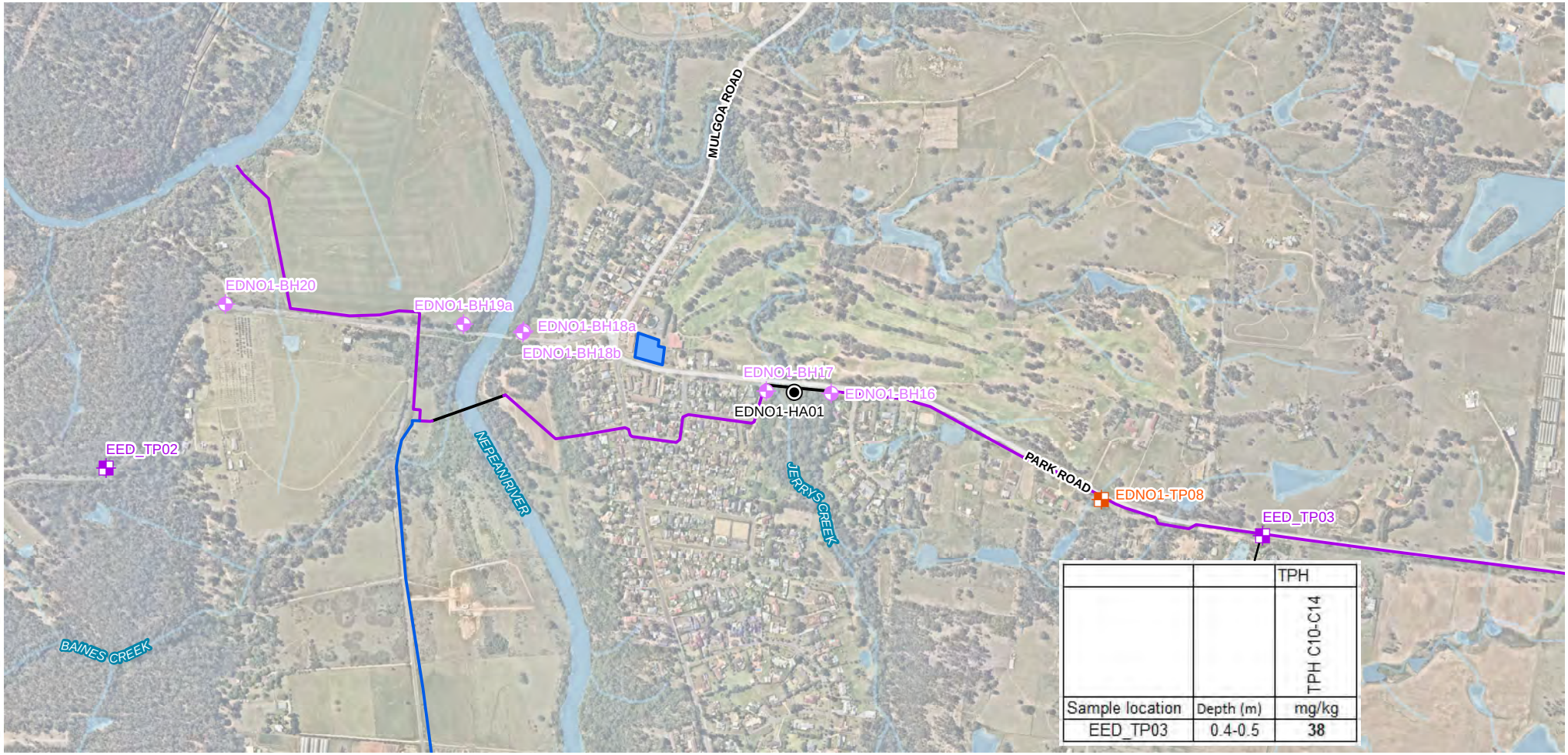
Upper South Creek Advanced Water Recycling Centre **DSI**

Figure 2a: Investigation locations and exceedances



		TPH
		TPH C10-C14
Sample location	Depth (m)	mg/kg
EED_TP03	0.4-0.5	38

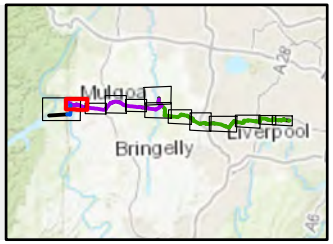
Environmental Flows Pipeline
Treated Water Pipeline
Underbore
Site Compounds

Contamination Test Locations

Test Pits

Geotechnical Investigations

Borehole (Effluent Discharge - Option 1)
Test Pit (Effluent Discharge - Option 1)
Hand Auger



Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Date: 28/08/2020

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Projection: GDA2020 MGA Zone 56

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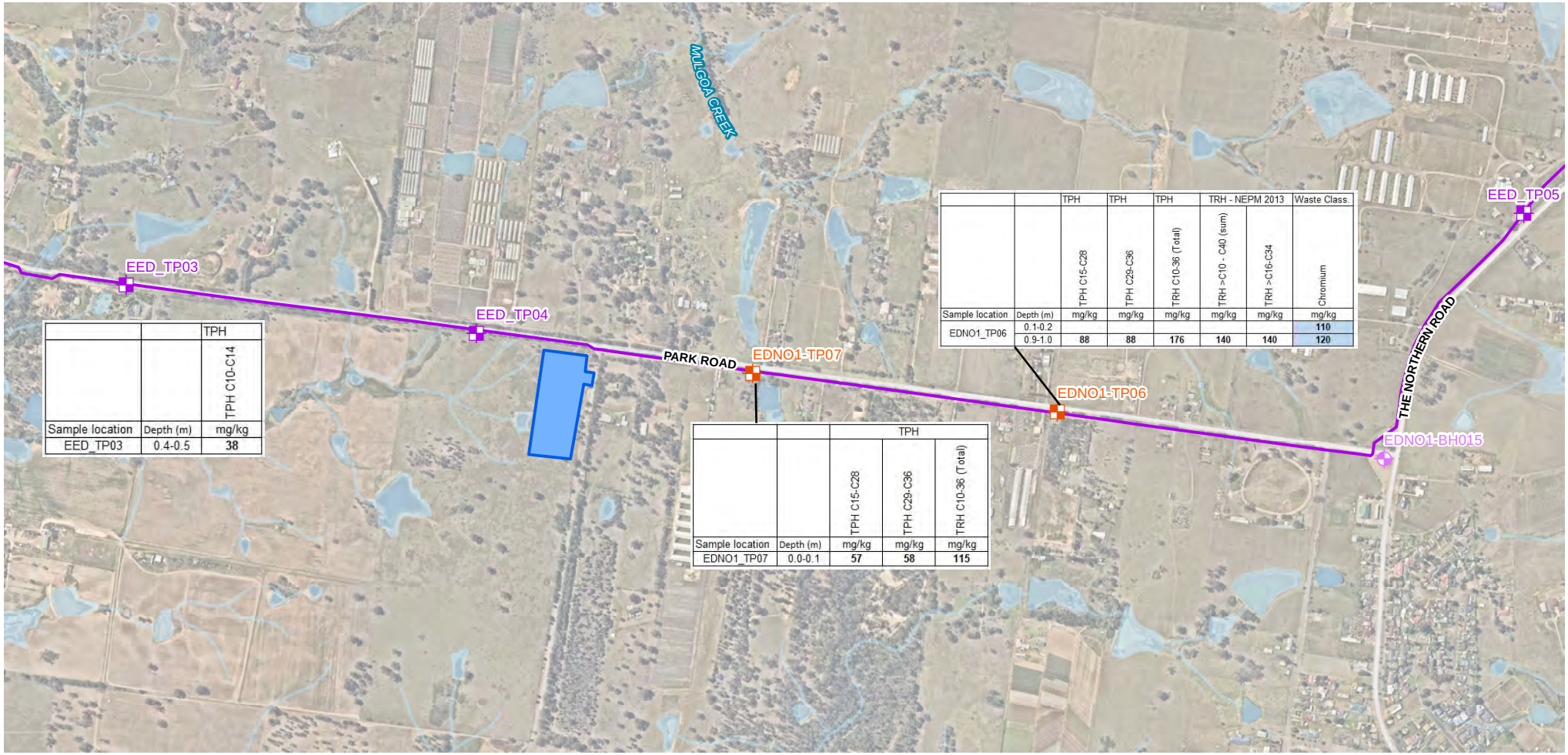
Upper South Creek Advanced Water Recycling Centre **DSI**

Figure 2b: Investigation locations and exceedances



Treated Water Pipeline

Site Compounds

Contamination Test Locations

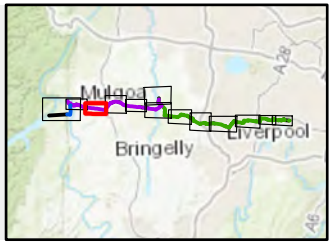
Test Pits

Geotechnical Investigations

Borehole (Effluent Discharge - Option 1)

Test Pit (Effluent Discharge - Option 1)

NSW EPA Waste Classification Guidelines (2014) Contaminant Thresholds for General Solid Waste without Leachate (CT1)



Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI

Date: 28/08/2020

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Projection: GDA2020 MGA Zone 56

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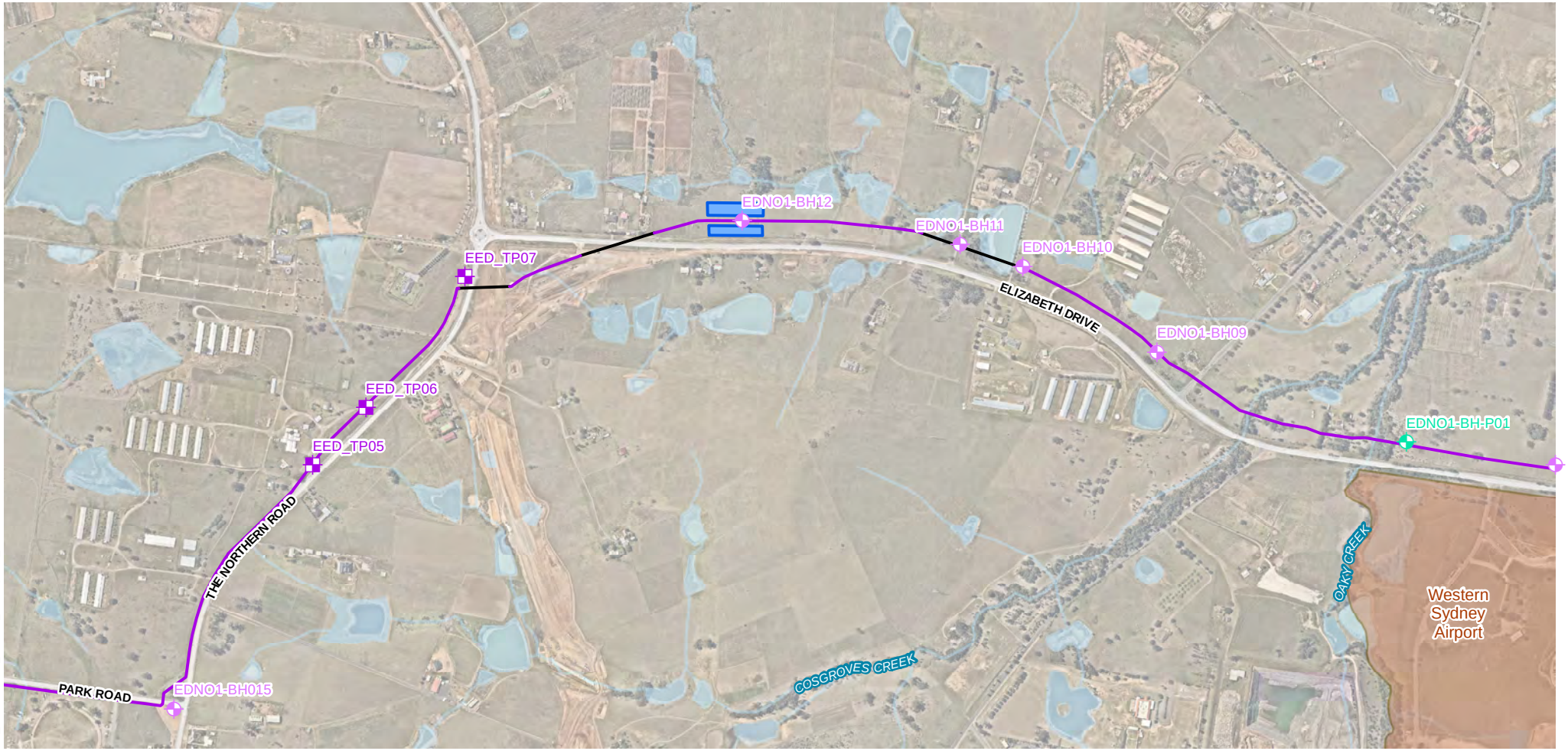
Upper South Creek Advanced Water Recycling Centre **DSI**

Figure 2c: Investigation locations and exceedances



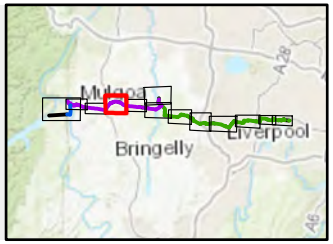
Treated Water Pipeline
Underbore
Site Compounds

Contamination Test Locations

Test Pits

Geotechnical Investigations

Borehole (Effluent Discharge - Option 1)
Provisional (Effluent Discharge - Option 1)
Western Sydney Airport



Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Date: 28/08/2020

1:14,000
0 250 500m

Projection: GDA2020 MGA Zone 56

Upper South Creek Advanced Water Recycling Centre **DSI**

Figure 2d: Investigation locations and exceedances

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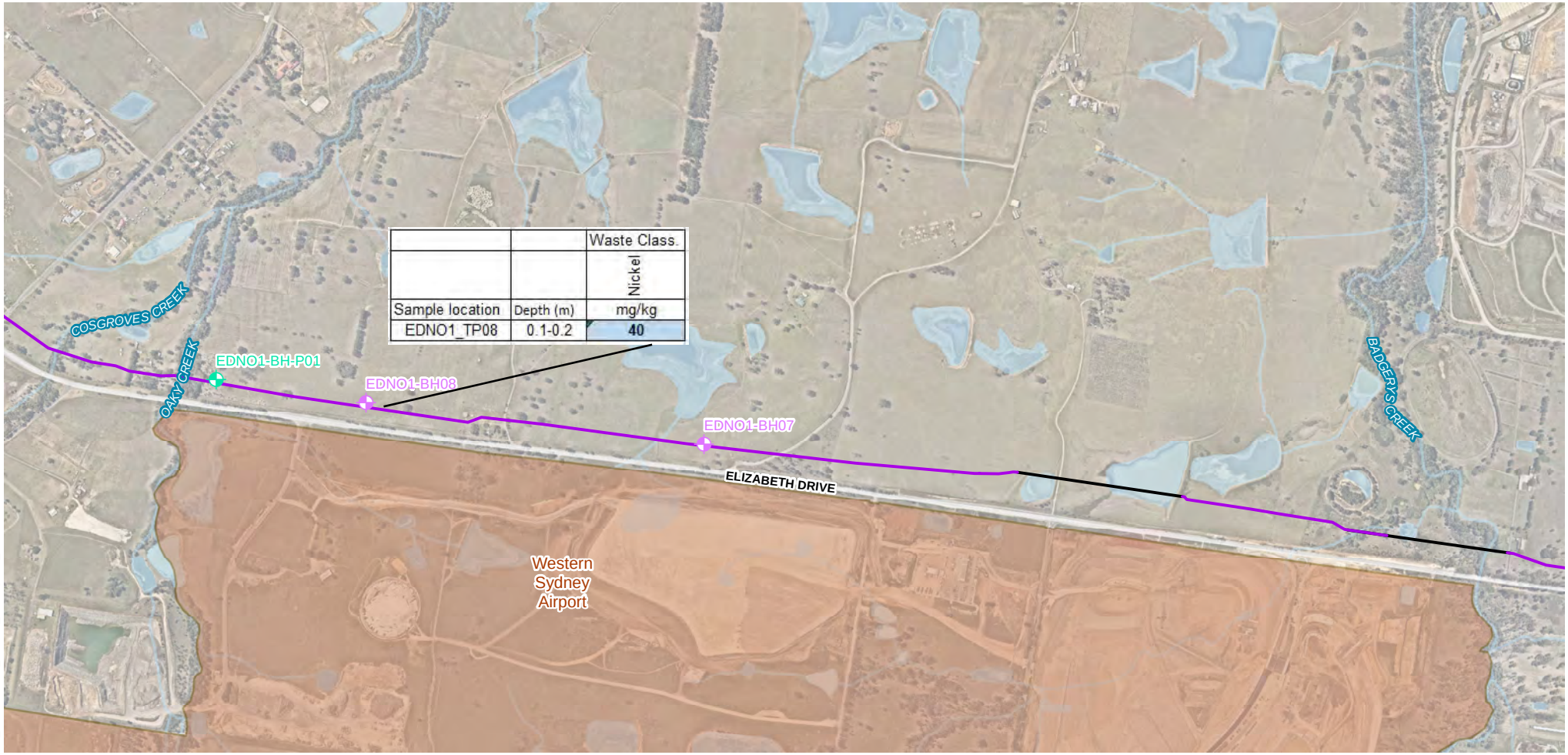


Treated Water Pipeline

Underbore

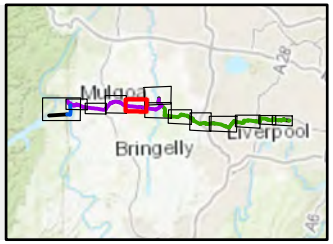
Geotechnical Investigations

Borehole (Effluent Discharge - Option 1)

Provisional (Effluent Discharge - Option 1)

Western Sydney Airport

NSW EPA Waste Classification Guidelines (2014) Contaminant Thresholds for General Solid Waste without Leachate (CT1)



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Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI

Date: 28/08/2020

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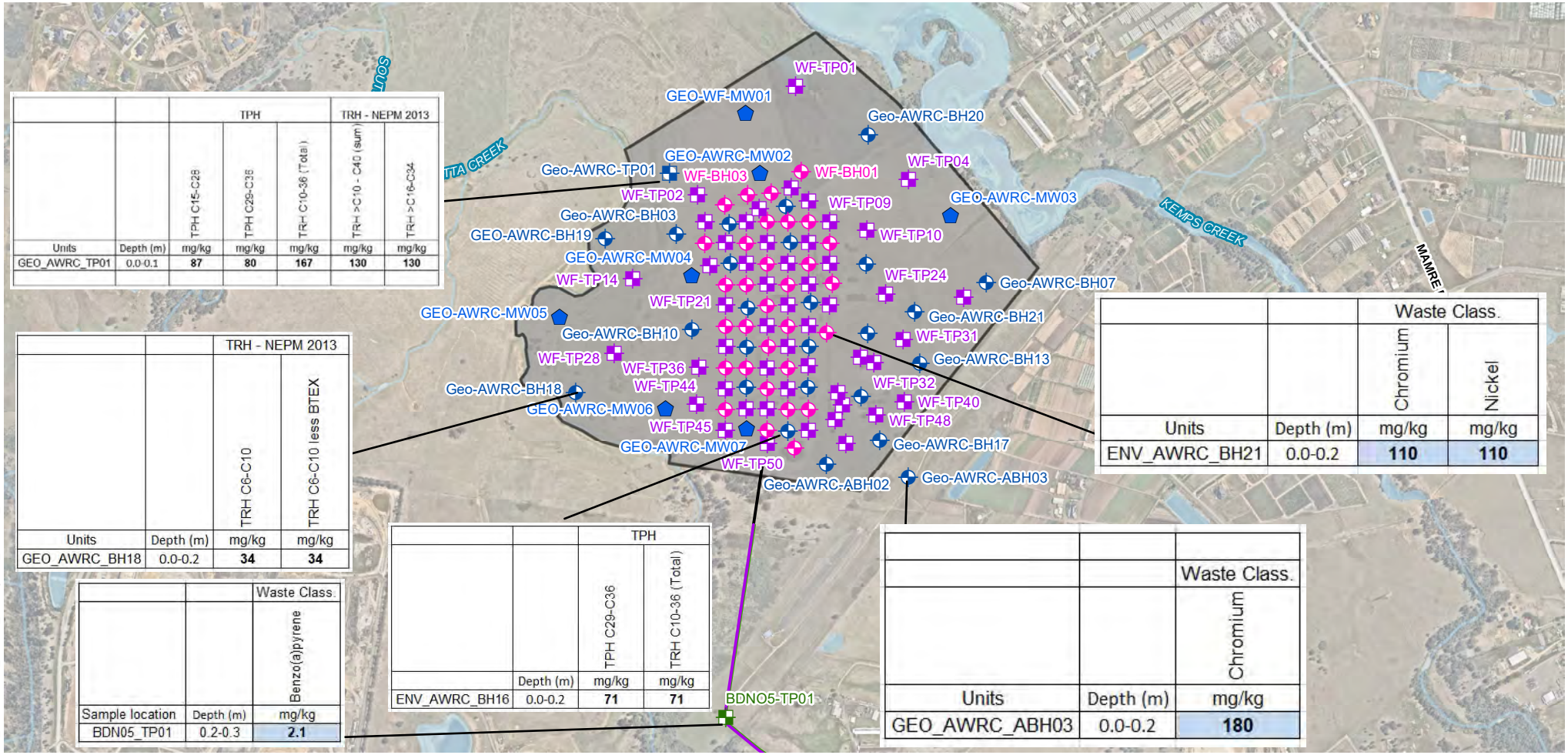
0 250 500m

Projection: GDA2020 MGA Zone 56

Upper South Creek Advanced Water Recycling Centre **DSI**

Figure 2e: Investigation locations and exceedances



		TPH			TRH - NEPM 2013	
		TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C16-C34
Units	Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
GEO_AWRC_TP01	0.0-0.1	**87**	**80**	**167**	**130**	**130**

		TRH - NEPM 2013	
		TRH C6-C10	TRH C6-C10 less BTEX
Units	Depth (m)	mg/kg	mg/kg
GEO_AWRC_BH18	0.0-0.2	**34**	**34**

		Waste Class.
		Benzo(a)pyrene
Sample location	Depth (m)	mg/kg
BDN05_TP01	0.2-0.3	**2.1**

		TPH	
		TPH C29-C36	TRH C10-36 (Total)
	Depth (m)	mg/kg	mg/kg
ENV_AWRC_BH16	0.0-0.2	**71**	**71**

		Waste Class.	
		Chromium	Nickel
Units	Depth (m)	mg/kg	mg/kg
ENV_AWRC_BH21	0.0-0.2	**110**	**110**

		Waste Class.
		Chromium
Units	Depth (m)	mg/kg
GEO_AWRC_ABH03	0.0-0.2	**180**

- Treated Water Pipeline
- Brine Pipeline
- Underbore
- Advanced Water Recycling Centre site

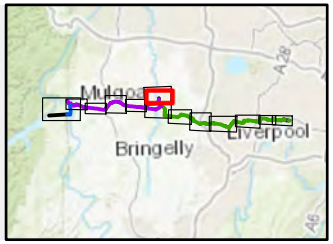
Contamination Test Locations

- Boreholes
- Test Pits

Geotechnical Investigations

- GW Wells (Advanced Water Recycling Centre)
- Borehole (Advanced Water Recycling Centre)
- Test Pit (Advanced Water Recycling Centre)
- Test Pit (Brine Discharge – NRGS - Option 5)

NSW EPA Waste Classification Guidelines (2014) Contaminant Thresholds for General Solid Waste without Leachate (CT1)



Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Date: 3/09/2020

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0 250 500m

Projection: GDA2020 MGA Zone 56

Upper South Creek Advanced Water Recycling Centre DSI

Figure 2f: Investigation locations and exceedances

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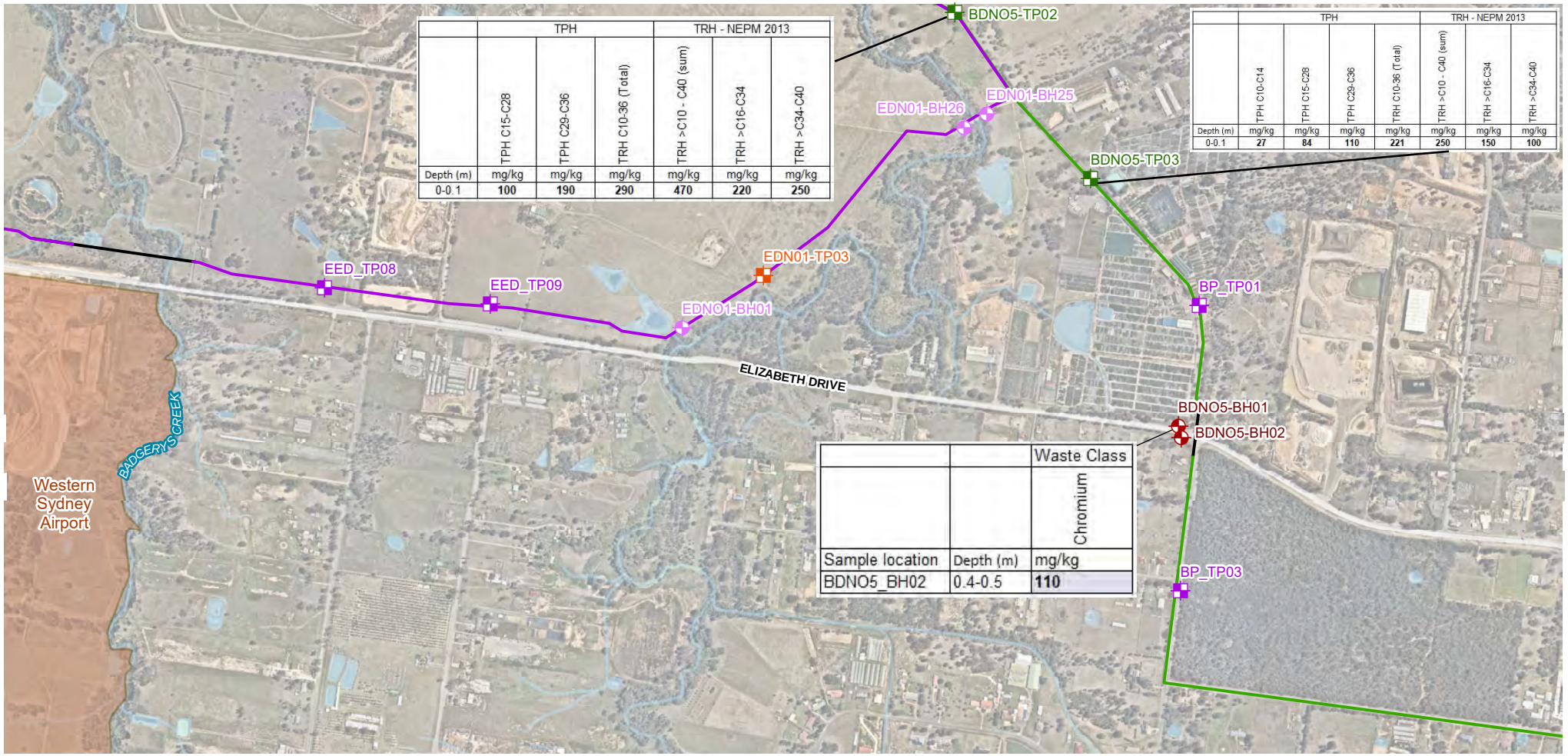


	TPH			TRH - NEPM 2013		
	TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C16-C34	TRH >C34-C40
Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
0-0.1	**100**	**190**	**290**	**470**	**220**	**250**

	TPH				TRH - NEPM 2013		
	TPH C10-C14	TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C16-C34	TRH >C34-C40
Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
0-0.1	**27**	**84**	**110**	**221**	**250**	**150**	**100**

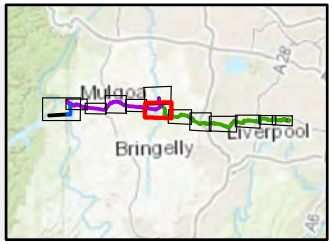
		Waste Class
		Chromium
Sample location	Depth (m)	mg/kg
BDNO5_BH02	0.4-0.5	**110**

Treated Water Pipeline
Brine Pipeline
Underbore

Contamination Test Locations
Test Pits

Geotechnical Investigations
Borehole (Effluent Discharge - Option 1)
Test Pit (Effluent Discharge - Option 1)
Borehole (Brine Discharge – NRGS - Option 5)
Test Pit (Brine Discharge – NRGS - Option 5)
Western Sydney Airport

NSW EPA Waste Classification Guidelines (2014) Contaminant Thresholds for General Solid Waste without Leachate (CT1)



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Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Date: 28/08/2020

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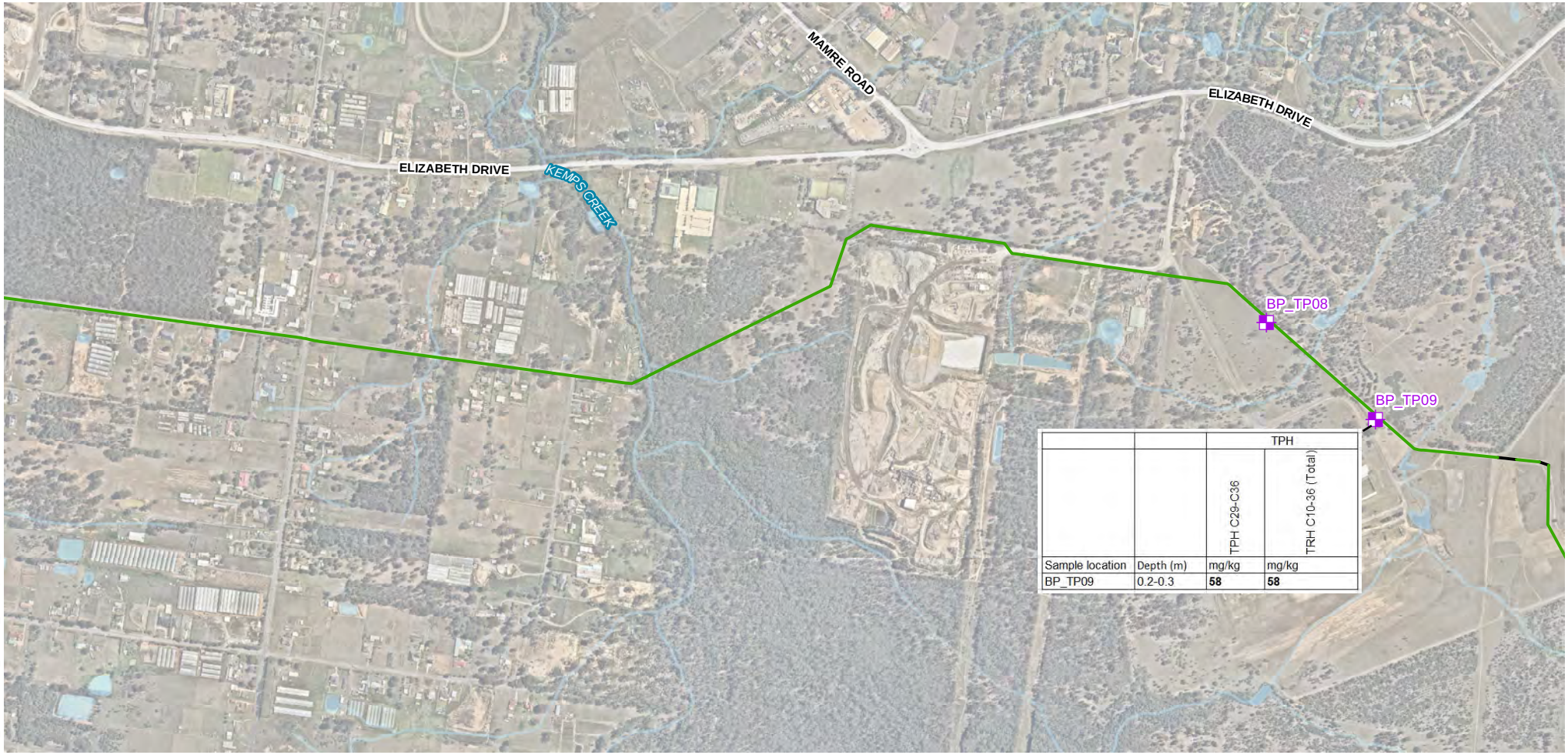
0 250 500m

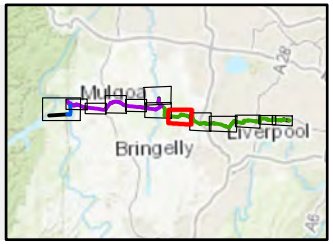
Projection: GDA2020 MGA Zone 56

Upper South Creek Advanced Water Recycling Centre **DSI**

Figure 2g: Investigation locations and exceedances



		TPH	
		TPH C29-C36	TRH C10-36 (Total)
Sample location	Depth (m)	mg/kg	mg/kg
BP_TP09	0.2-0.3	**58**	**58**



Brine Pipeline

Underbore

Contamination Test Locations

Test Pits

Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI

Date: 28/08/2020

1:14,000

0 250 500m

Projection: GDA2020 MGA Zone 56

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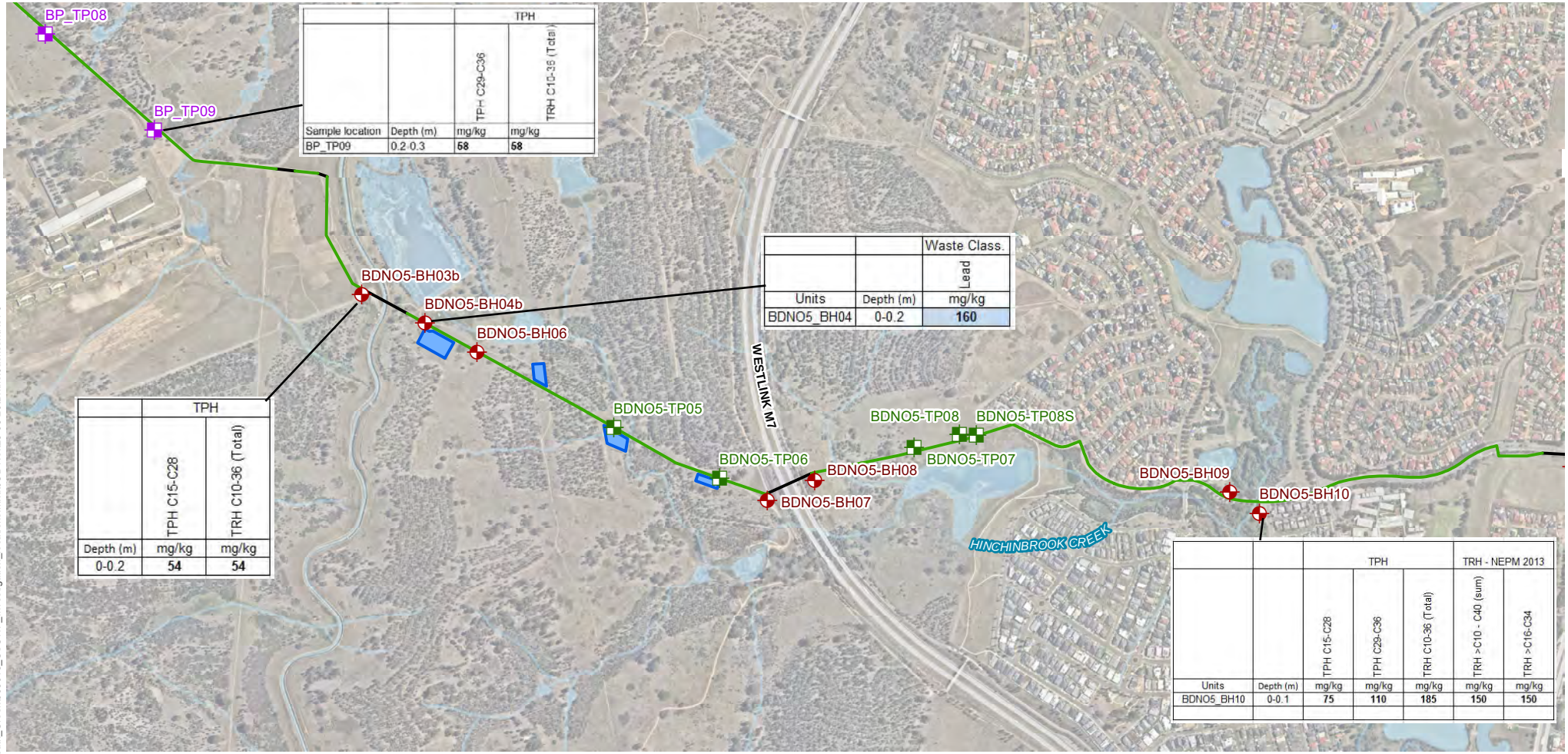
Upper South Creek Advanced Water Recycling Centre **DSI**

Figure 2h: Investigation locations and exceedances



		TPH	
Sample location	Depth (m)	TPH C29-C36 mg/kg	TRH C10-36 (Total) mg/kg
BP_TP09	0.2-0.3	58	58

		Waste Class.
		Lead
Units	Depth (m)	mg/kg
BDNO5_BH04	0-0.2	160

	TPH	
	TPH C15-C28	TRH C10-36 (Total)
Depth (m)	mg/kg	mg/kg
0-0.2	54	54

		TPH			TRH - NEPM 2013	
		TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C16-C34
Units	Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
BDNO5_BH10	0-0.1	75	110	185	150	150

Brine Pipeline
Underbore
Site Compounds

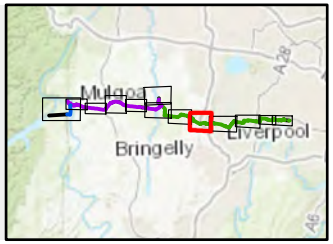
Contamination Test Locations

Test Pits

Geotechnical Investigations

Borehole (Brine Discharge – NRGS - Option 5)
Test Pit (Brine Discharge – NRGS - Option 5)

NSW EPA Waste Classification Guidelines (2014) Contaminant Thresholds for General Solid Waste without Leachate (CT1)



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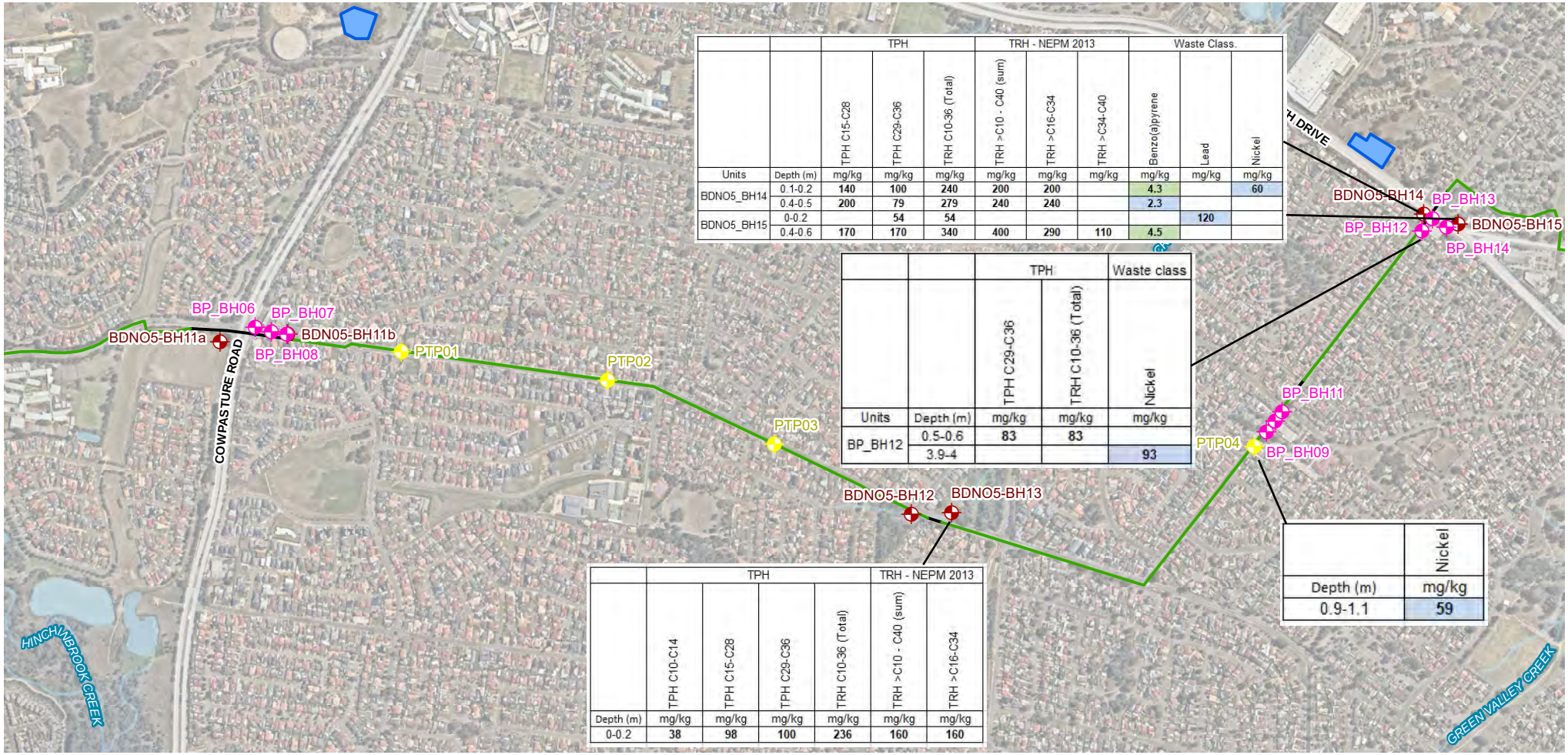
Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Date: 28/08/2020

1:14,000
0 250 500m

Projection: GDA2020 MGA Zone 56

Upper South Creek Advanced Water Recycling Centre **DSI**

Figure 2i: Investigation locations and exceedances



		TPH			TRH - NEPM 2013			Waste Class.		
		TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C16-C34	TRH >C34-C40	Benzo(a)pyrene	Lead	Nickel
Units	Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
BDNO5_BH14	0.1-0.2	140	100	240	200	200		4.3		60
	0.4-0.5	200	79	279	240	240		2.3		
BDNO5_BH15	0-0.2		54	54					120	
	0.4-0.6	170	170	340	400	290	110	4.5		

		TPH		Waste class
		TPH C29-C36	TRH C10-36 (Total)	Nickel
Units	Depth (m)	mg/kg	mg/kg	mg/kg
BP_BH12	0.5-0.6	83	83	
	3.9-4			93

	TPH				TRH - NEPM 2013	
	TPH C10-C14	TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C16-C34
Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
0-0.2	38	98	100	236	160	160

	Nickel
Depth (m)	mg/kg
0.9-1.1	59

Brine Pipeline
Underbore
Site Compounds

Contamination Test Locations

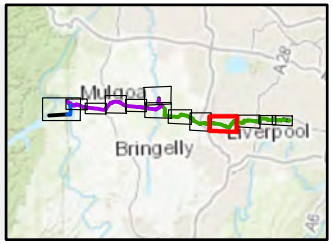
Boreholes

Geotechnical Investigations

Pavement Test Pit
Borehole (Brine Discharge – NRGS - Option 5)

NSW EPA Waste Classification Guidelines (2014) Contaminant Thresholds for General Solid Waste without Leachate (CT1)

NSW EPA Waste Classification Guidelines (2014) Contaminant Thresholds for Restricted Solid Waste without Leachate (CT2)



Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Date: 28/08/2020

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Projection: GDA2020 MGA Zone 56

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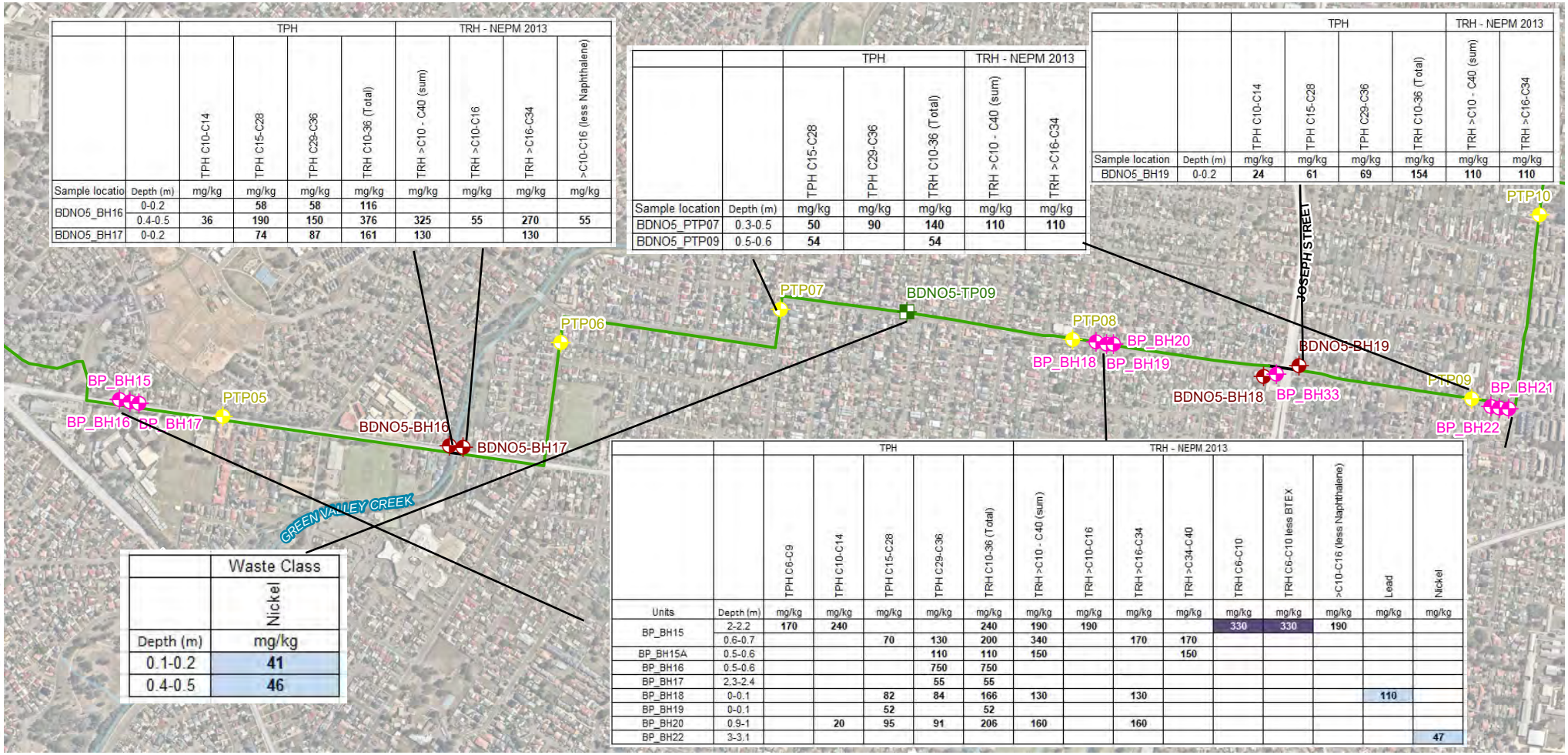
Upper South Creek Advanced Water Recycling Centre DSI

Figure 2j: Investigation locations and exceedances



		TPH				TRH - NEPM 2013			
		TPH C10-C14	TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C10-C16	TRH >C16-C34	>C10-C16 (less Naphthalene)
Sample locatio	Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
BDNO5_BH16	0-0.2		58	58	116				
	0.4-0.5	36	190	150	376	325	55	270	55
BDNO5_BH17	0-0.2		74	87	161	130		130	

		TPH			TRH - NEPM 2013	
		TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C16-C34
Sample location	Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
BDNO5_PTP07	0.3-0.5	50	90	140	110	110
BDNO5_PTP09	0.5-0.6	54		54		

		TPH			TRH - NEPM 2013	
		TPH C10-C14	TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C16-C34
Sample location	Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
BDNO5_BH19	0-0.2	24	61	69	154	110	110

		Waste Class
		Nickel
Depth (m)		mg/kg
0.1-0.2		41
0.4-0.5		46

		TPH					TRH - NEPM 2013								
		TPH C6-C9	TPH C10-C14	TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C10-C16	TRH >C16-C34	TRH >C34-C40	TRH C6-C10	TRH C6-C10 less BTEX	>C10-C16 (less Naphthalene)	Lead	Nickel
Units	Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
BP_BH15	2-2.2	170	240			240	190	190			330	330	190		
	0.6-0.7			70	130	200	340		170	170					
BP_BH15A	0.5-0.6				110	110	150			150					
BP_BH16	0.5-0.6				750	750									
BP_BH17	2.3-2.4				55	55									
BP_BH18	0-0.1			82	84	166	130		130					110	
BP_BH19	0-0.1			52		52									
BP_BH20	0.9-1		20	95	91	206	160		160						
BP_BH22	3-3.1														47

Brine Pipeline
Underbore

Borehole (Brine Discharge – NRGS - Option 5)
Test Pit (Brine Discharge – NRGS - Option 5)

Contamination Test Locations

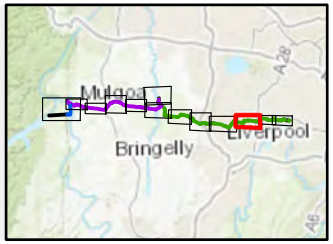
Boreholes

Geotechnical Investigations

Pavement Test Pit

NSW EPA Waste Classification Guidelines (2014) Contaminant Thresholds for General Solid Waste without Leachate (CT1)

National Environmental Protection Council (NEPC) 2013 Amendment of the National Environmental Protection Measure (NEPM) 1999. Soil Health Screening Levels (HSL) D for Soil Vapour Intrusion - Commercial/Industrial (Sand)



Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Date: 28/08/2020

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Projection: GDA2020 MGA Zone 56

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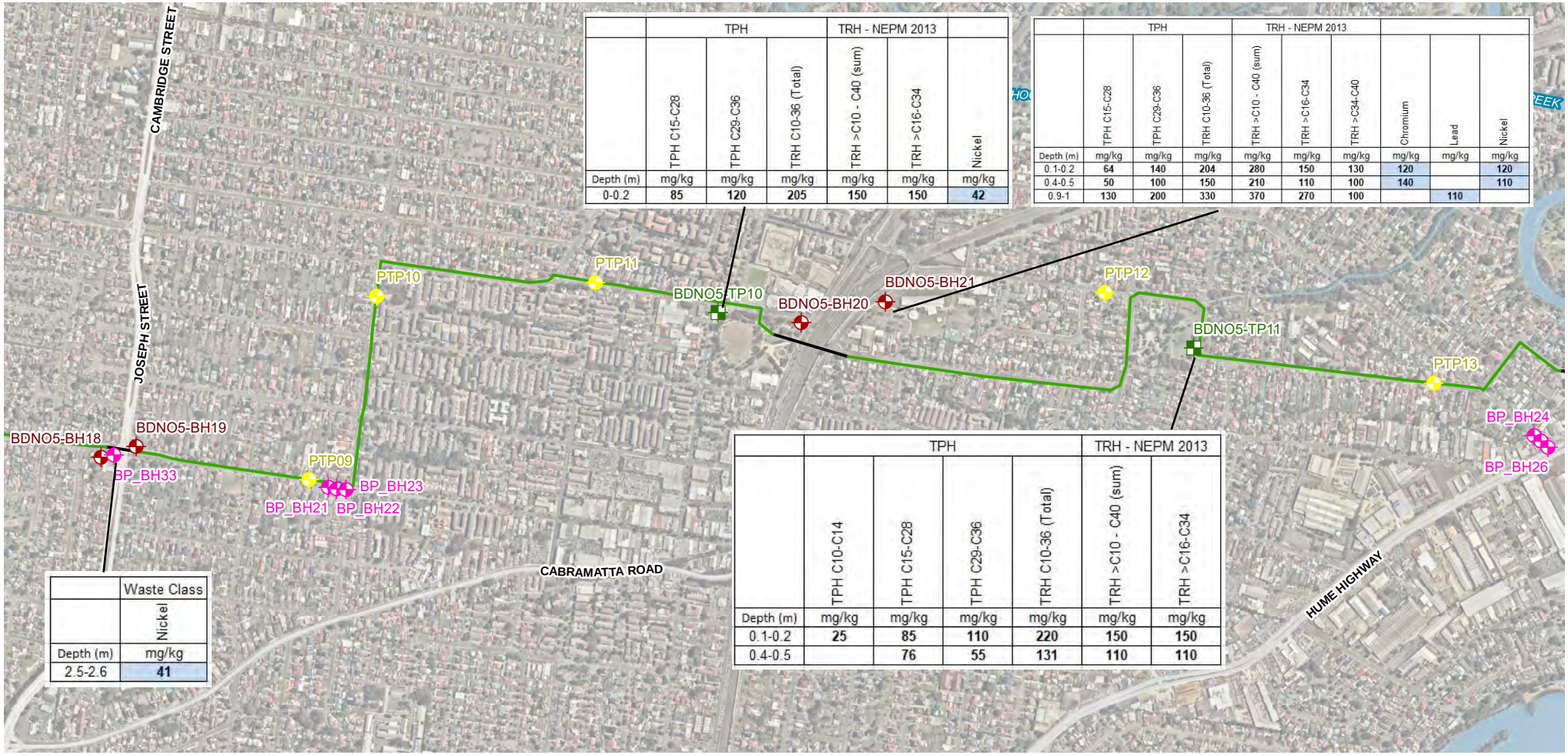
Upper South Creek Advanced Water Recycling Centre **DSI**

Figure 2k: Investigation locations and exceedances



	TPH			TRH - NEPM 2013		
	TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C16-C34	Nickel
Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
0-0.2	85	120	205	150	150	42

	TPH			TRH - NEPM 2013					
	TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C16-C34	TRH >C34-C40	Chromium	Lead	Nickel
Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
0.1-0.2	64	140	204	280	150	130	120		120
0.4-0.5	50	100	150	210	110	100	140		110
0.9-1	130	200	330	370	270	100		110	

	TPH				TRH - NEPM 2013	
	TPH C10-C14	TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C16-C34
Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
0.1-0.2	25	85	110	220	150	150
0.4-0.5		76	55	131	110	110

	Waste Class
	Nickel
Depth (m)	mg/kg
2.5-2.6	41

Brine Pipeline
Underbore
Borehole (Brine Discharge – NRGS - Option 5)
Test Pit (Brine Discharge – NRGS - Option 5)

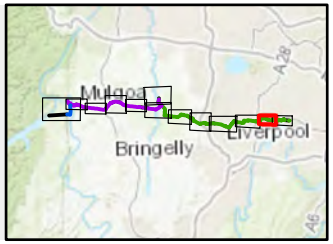
Contamination Test Locations

Boreholes

Geotechnical Investigations

Pavement Test Pit

NSW EPA Waste Classification Guidelines (2014) Contaminant Thresholds for General Solid Waste without Leachate (CT1)



Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Date: 28/08/2020

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0 250 500m

Projection: GDA2020 MGA Zone 56

Upper South Creek Advanced Water Recycling Centre DSI

Figure 2I: Investigation locations and exceedances

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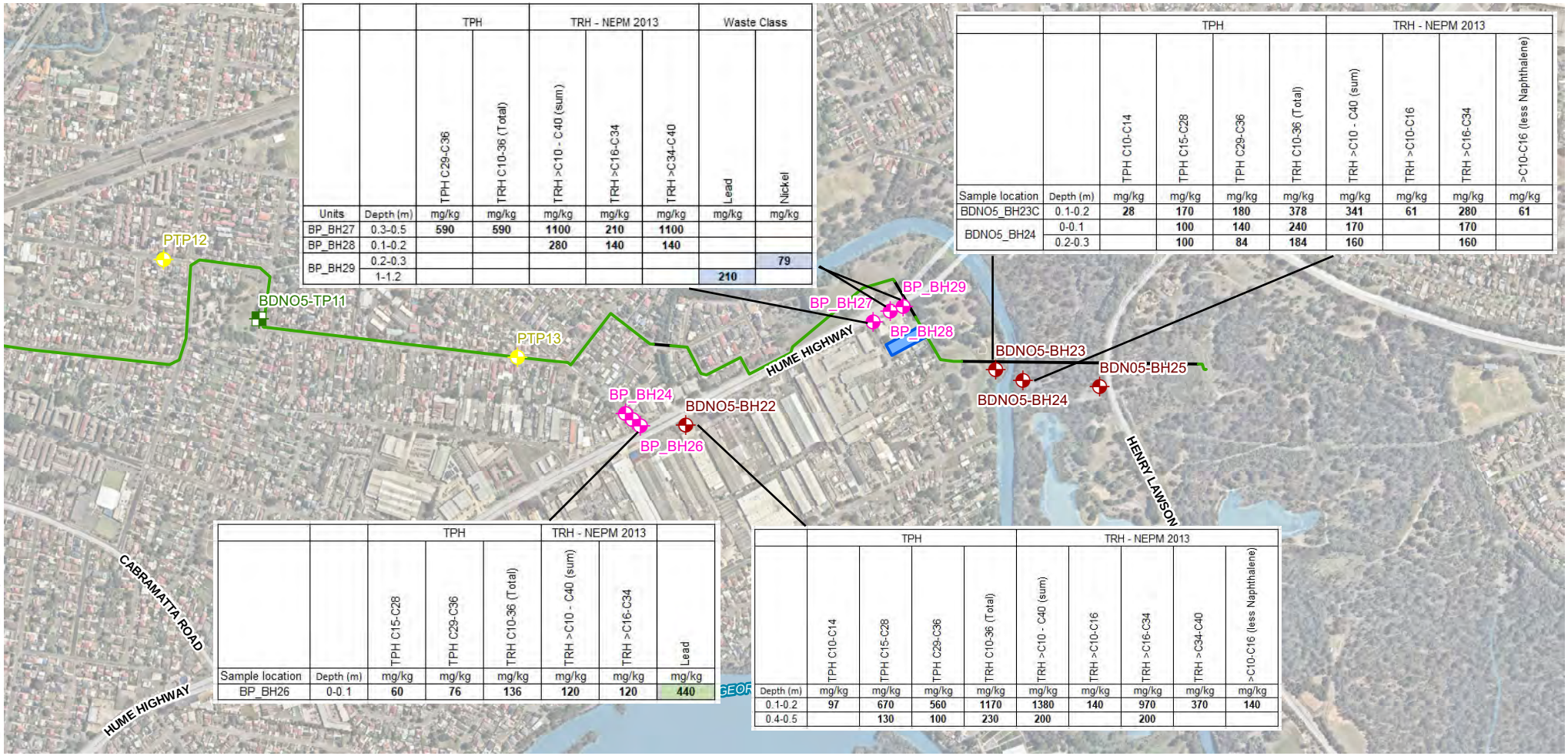


		TPH		TRH - NEPM 2013			Waste Class	
		TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C16-C34	TRH >C34-C40	Lead	Nickel
Units	Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
BP_BH27	0.3-0.5	590	590	1100	210	1100		
BP_BH28	0.1-0.2			280	140	140		
BP_BH29	0.2-0.3							79
	1-1.2						210	

		TPH				TRH - NEPM 2013			
		TPH C10-C14	TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C10-C16	TRH >C16-C34	>C10-C16 (less Naphthalene)
Sample location	Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
BDNO5_BH23C	0.1-0.2	28	170	180	378	341	61	280	61
BDNO5_BH24	0-0.1		100	140	240	170		170	
	0.2-0.3		100	84	184	160		160	

		TPH			TRH - NEPM 2013		
		TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C16-C34	Lead
Sample location	Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
BP_BH26	0-0.1	60	76	136	120	120	440

	TPH				TRH - NEPM 2013				
	TPH C10-C14	TPH C15-C28	TPH C29-C36	TRH C10-36 (Total)	TRH >C10 - C40 (sum)	TRH >C10-C16	TRH >C16-C34	TRH >C34-C40	>C10-C16 (less Naphthalene)
Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
0.1-0.2	97	670	560	1170	1380	140	970	370	140
0.4-0.5		130	100	230	200		200		

Brine Pipeline
Underbore
Site Compounds

Contamination Test Locations

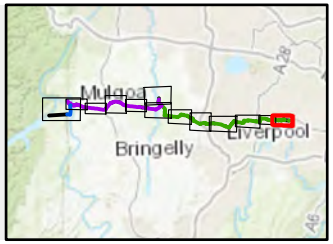
Boreholes

Geotechnical Investigations

Pavement Test Pit
Borehole (Brine Discharge – NRGS - Option 5)
Test Pit (Brine Discharge – NRGS - Option 5)

NSW EPA Waste Classification Guidelines (2014) Contaminant Thresholds for General Solid Waste without Leachate (CT1)

NSW EPA Waste Classification Guidelines (2014) Contaminant Thresholds for Restricted Solid Waste without Leachate (CT2)



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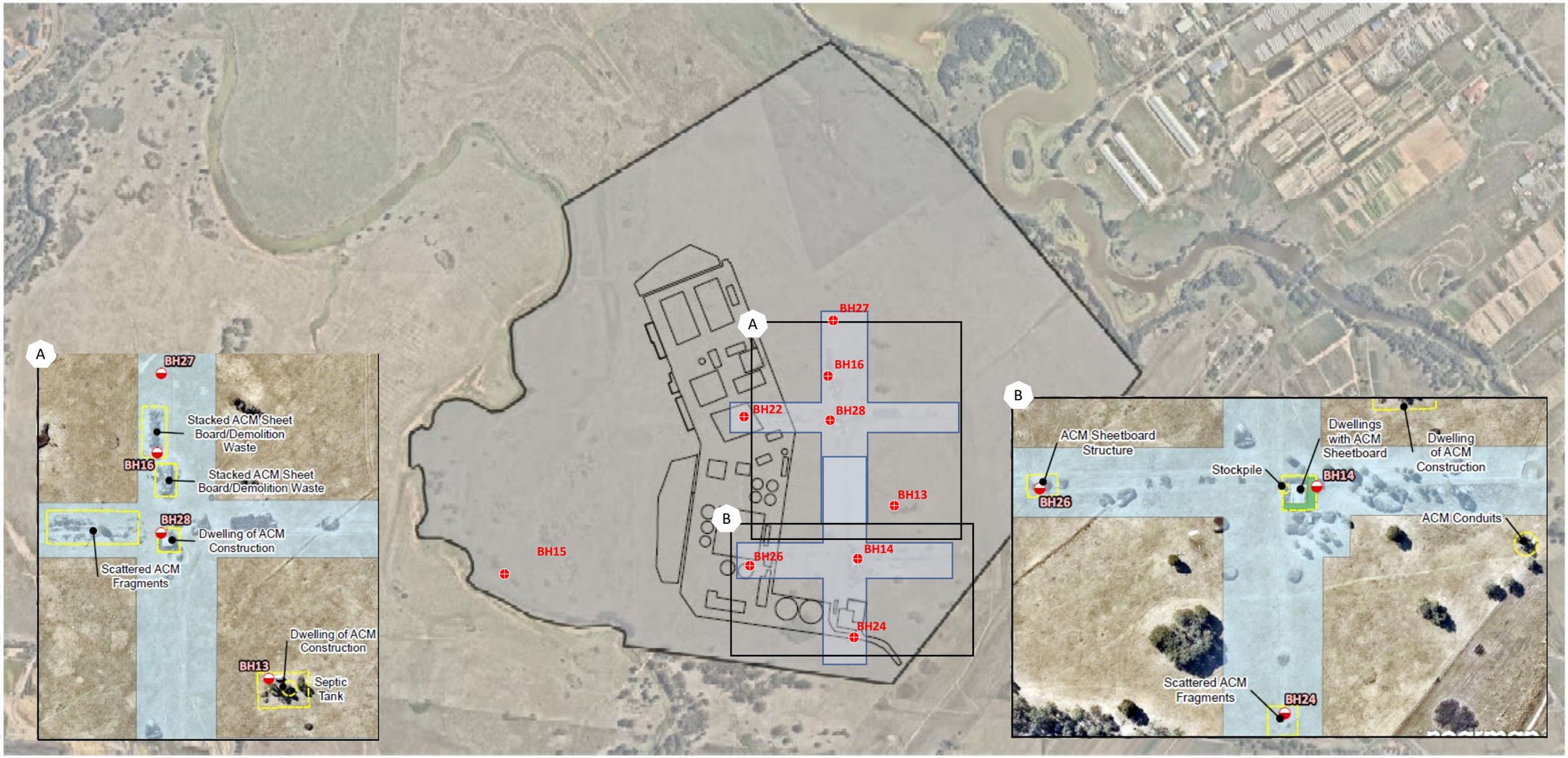
Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Date: 28/08/2020

1:13,000
0 250 500 m

Projection: GDA2020 MGA Zone 56

Upper South Creek Advanced Water Recycling Centre **DSI**

Figure 2m: Investigation locations and exceedances



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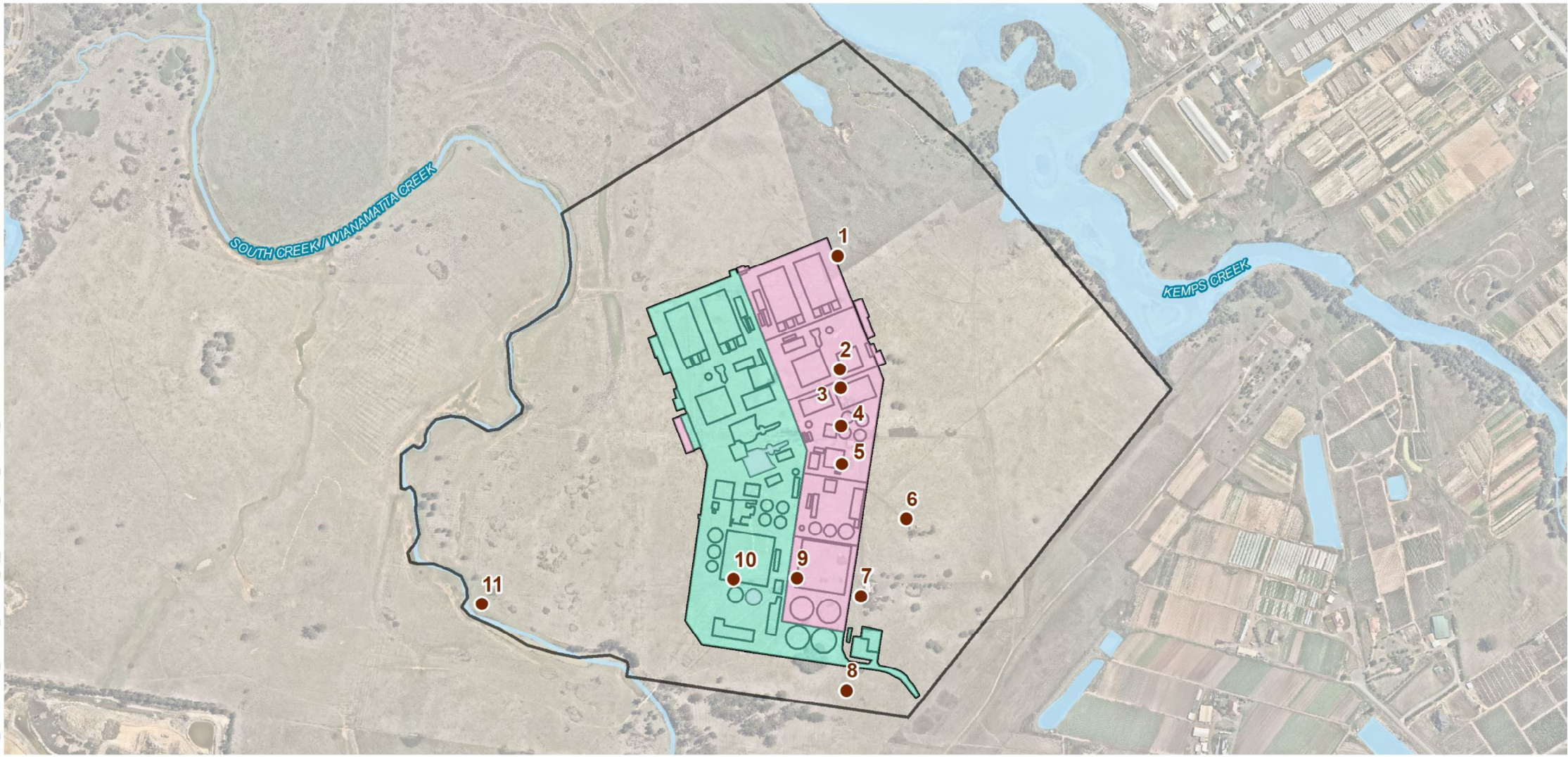
Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Date: 12/03/2021

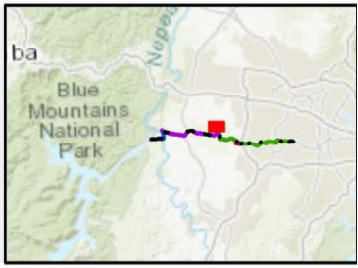
1:10,000
0 50 100m

Projection: GDA2020 MGA Zone56:

Figure 3: Previous investigation locations (JBS&G, 2018)



Suspect Hazardous Materials Locations
AWRC Layout (Stage 1)
AWRC Layout (Stage 2)
AWRC Footprint
Advanced Water Recycling Centre



Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Date: 16/07/2020

1:9,500
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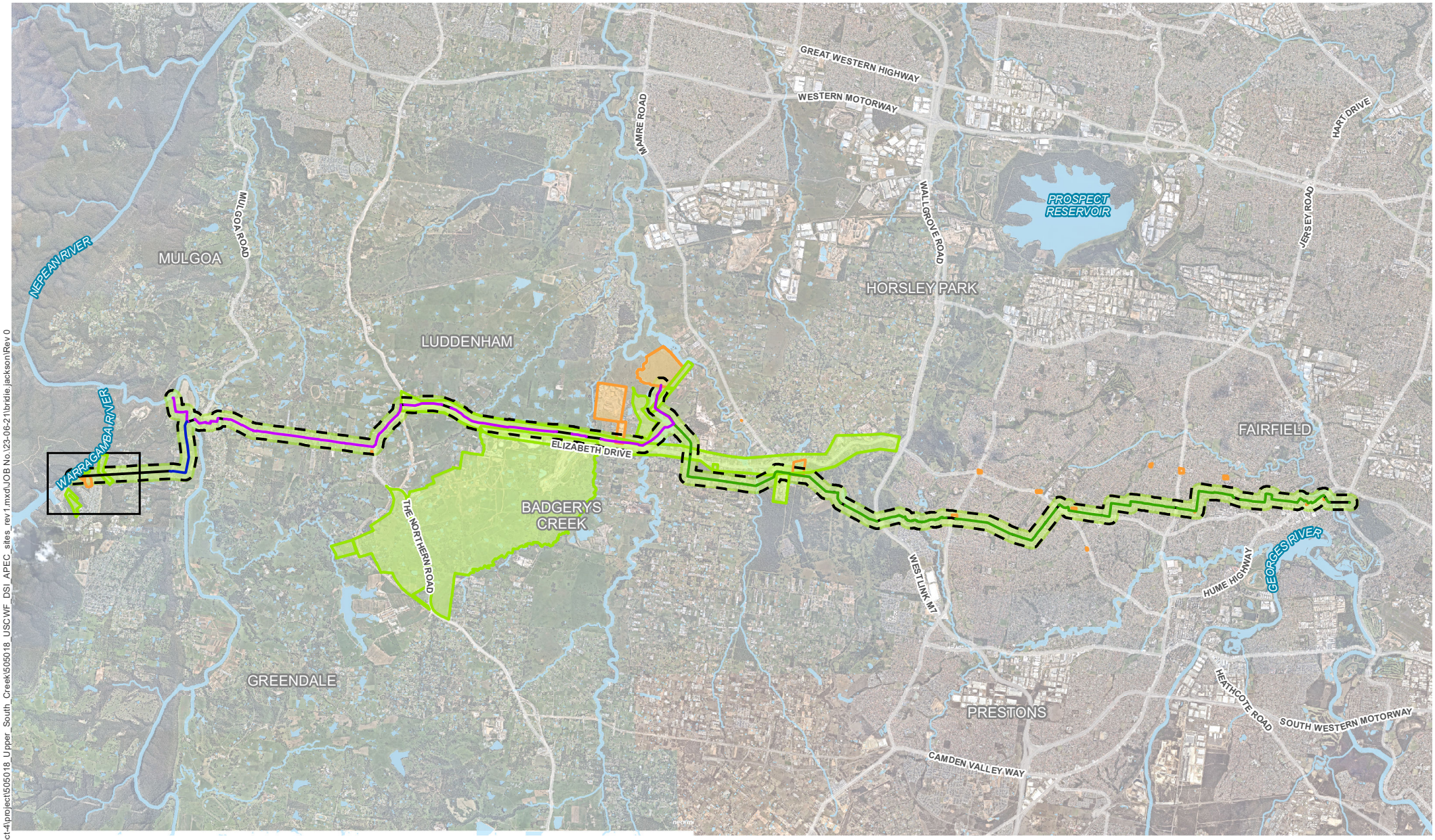
Projection: GDA2020 MGA Zone 56

Figure 5-1a HazMat Survey Upper South Creek Advanced Water Recycling Centre HazMat Memorandum

Figure: Suspect Hazardous Materials Locations



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Environmental Flows Pipeline
Treated Water Pipeline
Brine Pipeline
Underbore

Areas of Environmental Concern

Risk Rating

Low
Moderate

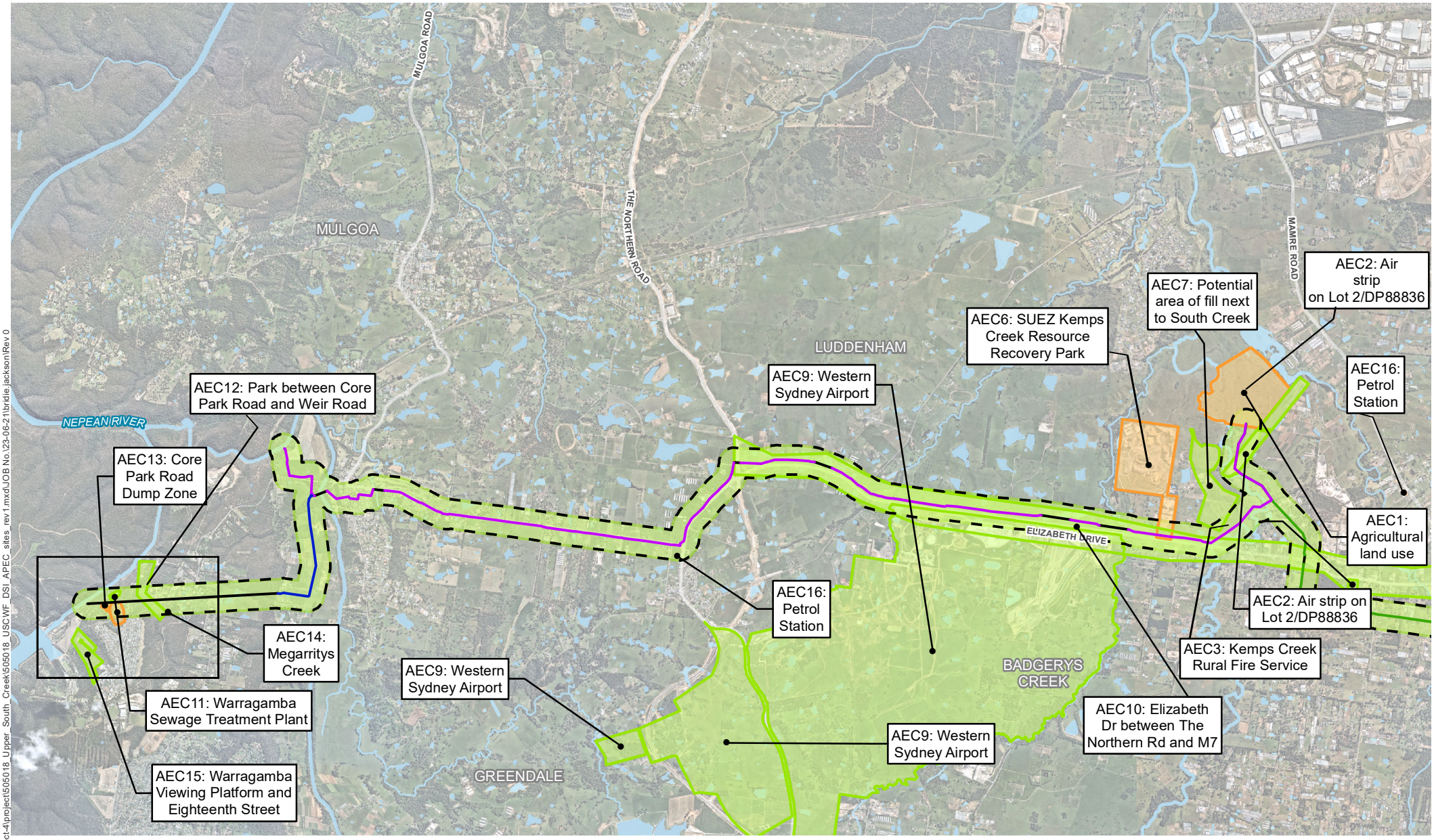
Base Data

Watercourse
Waterbody

Figure 6-2a Pipelines Contamination AECs

1:138,000
0 0.5 1km

Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Projection: GDA2020 MGA Zone 56



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Environmental Flows Pipeline
Treated Water Pipeline
Brine Pipeline
Underbore

Areas of Environmental Concern

Risk Rating

Low
Moderate

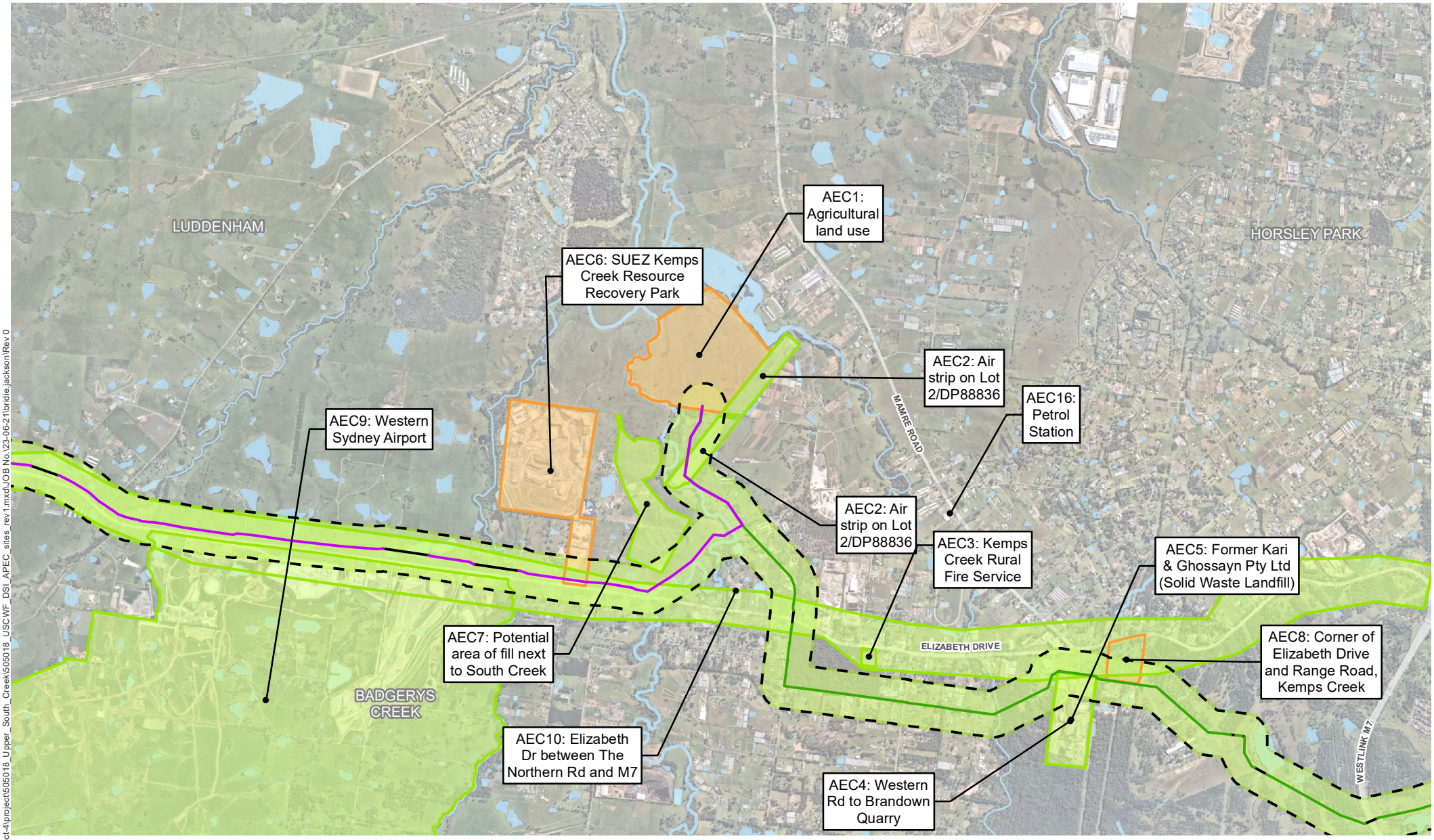
Base Data

Watercourse
Waterbody

1:70,000
0 0.5 1km

Figure 6-2b Pipelines Contamination AECs

Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Projection: GDA2020 MGA Zone 56



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Treated Water Pipeline
Brine Pipeline
Underbore

Areas of Environmental Concern

Risk Rating

Low
Moderate

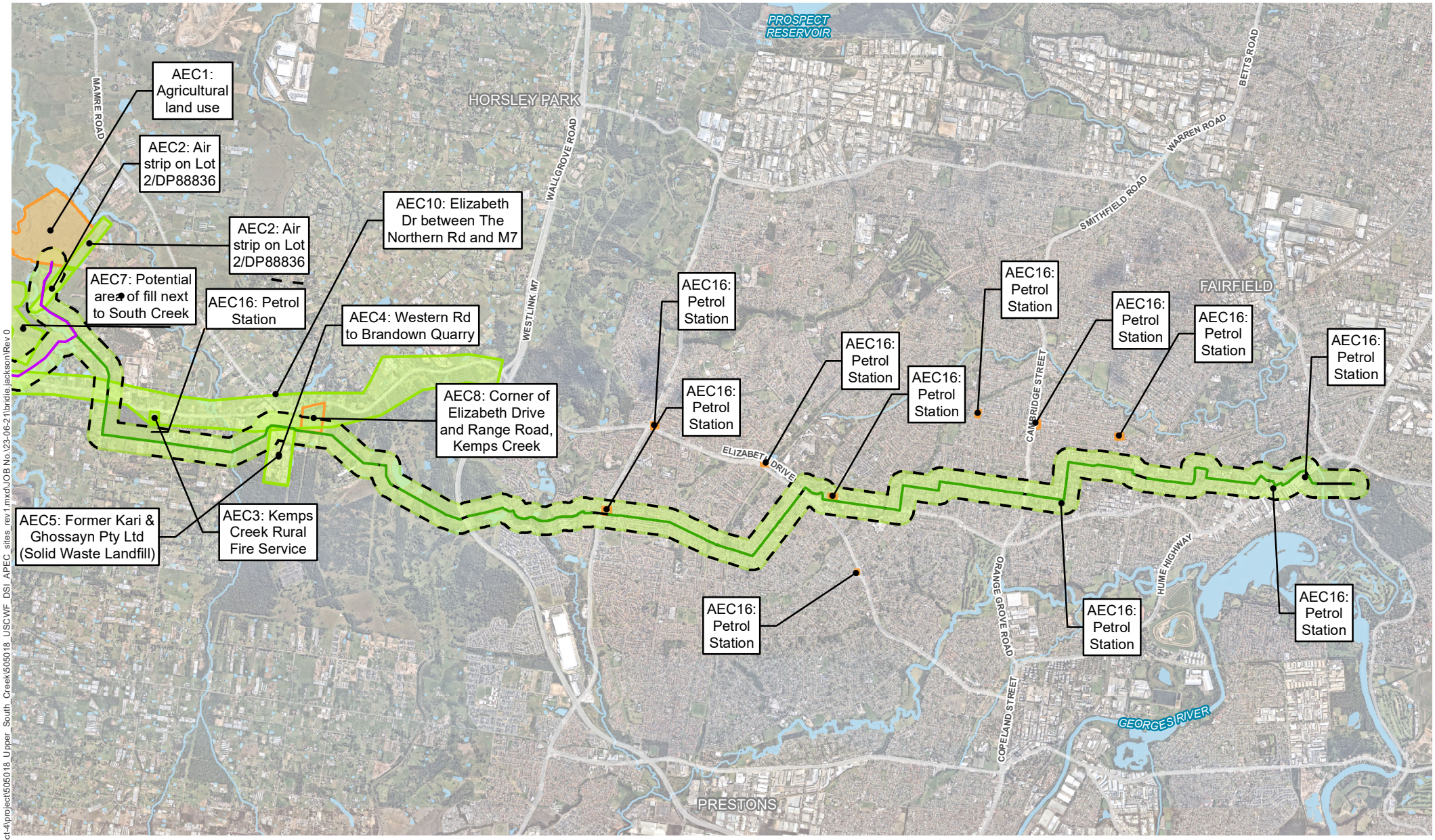
Base Data

Watercourse
Waterbody

Figure 6-2c Pipelines Contamination AECs

1:45,000
0 0.5 1km

Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Projection: GDA2020 MGA Zone 56



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Treated Water Pipeline
Brine Pipeline
Underbore

Areas of Environmental Concern

Risk Rating

Low
Moderate

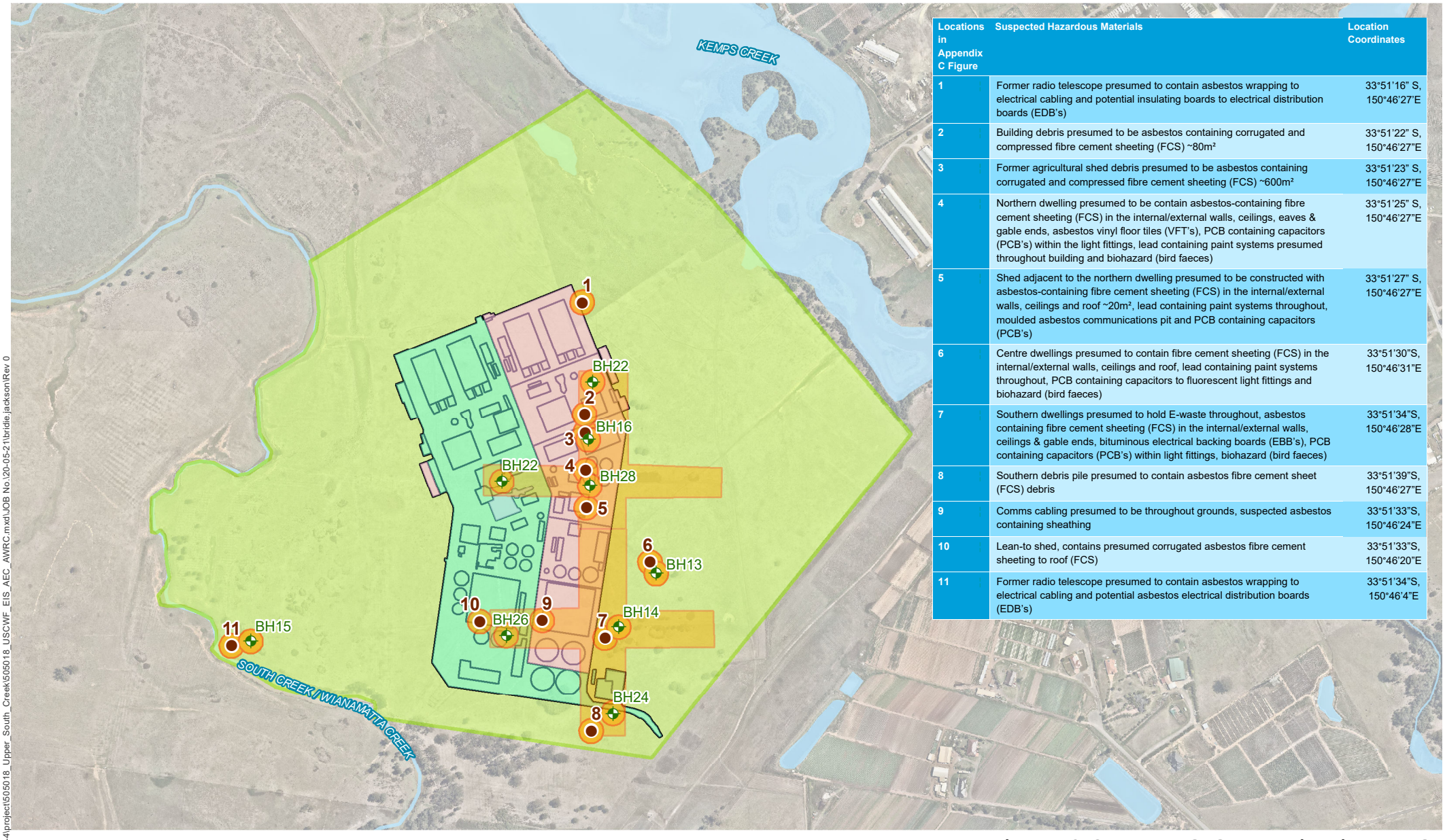
Base Data

Watercourse
Waterbody

1:73,000
0 0.5 1km

Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Projection: GDA2020 MGA Zone 56

Figure 6-2c Pipelines Contamination AECs



Locations in Appendix C Figure	Suspected Hazardous Materials	Location Coordinates
1	Former radio telescope presumed to contain asbestos wrapping to electrical cabling and potential insulating boards to electrical distribution boards (EDB's)	33°51'16" S, 150°46'27"E
2	Building debris presumed to be asbestos containing corrugated and compressed fibre cement sheeting (FCS) ~80m²	33°51'22" S, 150°46'27"E
3	Former agricultural shed debris presumed to be asbestos containing corrugated and compressed fibre cement sheeting (FCS) ~600m²	33°51'23" S, 150°46'27"E
4	Northern dwelling presumed to be contain asbestos-containing fibre cement sheeting (FCS) in the internal/external walls, ceilings, eaves & gable ends, asbestos vinyl floor tiles (VFT's), PCB containing capacitors (PCB's) within the light fittings, lead containing paint systems presumed throughout building and biohazard (bird faeces)	33°51'25" S, 150°46'27"E
5	Shed adjacent to the northern dwelling presumed to be constructed with asbestos-containing fibre cement sheeting (FCS) in the internal/external walls, ceilings and roof ~20m², lead containing paint systems throughout, moulded asbestos communications pit and PCB containing capacitors (PCB's)	33°51'27" S, 150°46'27"E
6	Centre dwellings presumed to contain fibre cement sheeting (FCS) in the internal/external walls, ceilings and roof, lead containing paint systems throughout, PCB containing capacitors to fluorescent light fittings and biohazard (bird faeces)	33°51'30"S, 150°46'31"E
7	Southern dwellings presumed to hold E-waste throughout, asbestos containing fibre cement sheeting (FCS) in the internal/external walls, ceilings & gable ends, bituminous electrical backing boards (EBB's), PCB containing capacitors (PCB's) within light fittings, biohazard (bird faeces)	33°51'34"S, 150°46'28"E
8	Southern debris pile presumed to contain asbestos fibre cement sheet (FCS) debris	33°51'39"S, 150°46'27"E
9	Comms cabling presumed to be throughout grounds, suspected asbestos containing sheathing	33°51'33"S, 150°46'24"E
10	Lean-to shed, contains presumed corrugated asbestos fibre cement sheeting to roof (FCS)	33°51'33"S, 150°46'20"E
11	Former radio telescope presumed to contain asbestos wrapping to electrical cabling and potential asbestos electrical distribution boards (EDB's)	33°51'34"S, 150°46'4"E

AWRC Layout (Stage 1)
AWRC Layout (Stage 2)
AWRC Footprint
Suspect Hazardous Materials Locations
Borehole conducted by JBS&G

Areas of Environmental concern

Risk Rating

Low
Moderate

1:8,500
0 100 200m

Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Projection: GDA2020 MGA Zone 56

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Figure 6-3 AWRC Contamination AECs