



Landscape—undulating to rolling rises and low hills on Hawkesbury Sandstone. Local relief 20–120 m, slopes 20%. Rock outcrop >50%. Broad ridges, gently to moderately inclined slopes, wide rock benches with low broken scarps, small hanging valleys and areas of poor drainage. Open and closed-heathland, scrub and occasional low eucalypt open-woodland.

Soils—shallow (<50 cm) discontinuous Earthy Sands (Uc5.11, Uc5.22) and Yellow Earths (Gn2.2) on crests and insides of benches; shallow (<20 cm) Siliceous Sands/Lithosols (Uc1.2) on leading edges; shallow to moderately deep (<150 cm) Leached Sands (Uc2.21), Grey Earths (Gn2.81) and Gleyed Podzolic Soils (Dg4.21) in poorly drained areas; localised Yellow Podzolic Soils (Dy4.1, Dy5.2) associated with shale lenses.

Limitations—very high soil erosion hazard, rock outcrop, seasonally perched watertables, shallow, highly permeable soil, very low soil fertility.

LOCATION

Exposed plateau surfaces, convex ridges and coastal headlands of the Hornsby Plateau. Typical areas include much of Brisbane Water National Park and the Lambert Peninsula in Ku-ring-gai Chase National Park. Smaller occurrences are found at Terrey Hills and in the Manly Warringah area, Dover Heights and La Pouse.

LANDSCAPE

Geology

Hawkesbury Sandstone, which consists of medium to coarse-grained quartz sandstone with minor shale and laminite lenses.

Topography

Undulating to rolling low hills. Local relief 20–120 m and slopes <20%. Broad convex crests and plateau surfaces. Gently to moderately inclined sideslopes, often associated with small hanging valleys. Characteristic sandstone bedrock that outcrops as wide benches (10–100 m), with broken scarps 1–4 m high. Small, poorly drained seepage areas are common.

Vegetation

Predominantly uncleared open-heathlands, closed-heathlands and scrublands, with patches of low eucalypt woodland. The heathlands and scrublands are often exposed to strong winds. Their shallow, poorly drained soils fluctuate between being saturated or dry. Bushfires are frequent. Isolated lines and patches of trees are occasionally associated with joint crevices.

Shrub she-oak *Allocasuarina distyla* and/or heath banksia *Banksia ericifolia* are usually dominant. Other shrubs such as spiky hakea *Hakea teretifolia* may be locally dominant in areas subject to seepage or prolonged saturation. Associated shrubs include various spider flowers *Grevillea* spp., billy buttons *Kunzea* spp., eggs and bacon *Pultenaea* spp., teatree *Leptospermum* spp. and native heath *Epacris* spp.

Isolated occurrences of low eucalypt open-woodland with dry sclerophyll shrub understorey are found at sites with deeper soils and unimpeded soil drainage. Trees often have a mallee habit. Red bloodwood *Eucalyptus gummifera*, yellow-top ash *E. luehmanniana*, yellow bloodwood *E. eximia*, scribbly gum *E. haemastoma* and narrow-leaved apple *Angophora bakeri* are common mallee species.

Growth of introduced species in urban areas is stunted. Native trees rarely attain a height of 10 m.

Land use

Most of this unit is bushland managed by the National Parks and Wildlife Service. This includes Brisbane Water National Park, Ku-ring-gai Chase National Park, and Muogamarra Nature Reserve. National Parks and isolated vacant and crown land are used for recreational activities such as bushwalking. Urban residential areas include Dover Heights, Balgowlah Heights and Cromer.

Existing Erosion.

Severe sheet erosion can occur when bushfires destroy or damage vegetative ground cover. This is particularly so if the fires are followed by heavy rains (Atkinson, 1984). Poorly planned and maintained roads, fire trails, walking tracks and bridle trails are subject to severe erosion. Many gullies and rills on tracks and roads are eroded, exposing bedrock. Erosion can be severe and widespread in areas frequented by four-wheel drive vehicles, horses and trail bikes.

Associated Soil Landscapes

Hawkesbury (**ha**) soil landscape occurs in areas of steeper slopes. Small areas of North Head (**nh**) soil landscape and Newport (**np**) soil landscape are also included.

SOILS

Dominant Soil Materials

1a1—Loose, stony, yellowish-brown sandy loam. This is stony brown loamy sand to sandy loam with apedal single-grained structure and porous sandy fabric. It generally occurs as topsoil (A1 horizon).

Colour, which can vary from olive brown (2.5Y 4/4) to dark brown (10YR 3/4) is commonly a yellowish-brown (10YR 5/4, 10YR 5/6, 10YR 5/8). The pH ranges from strongly acid (pH 4.0) to

moderately acid (pH 5.5). Subrounded sandstone fragments and quartz pebbles are common and are occasionally concentrated as a stone line at depth. Charcoal fragments and roots are common.

1a2—Earthy, yellow-brown, light sandy clay loam. This is commonly a yellow-brown, light sandy clay loam with apedal massive to weakly pedal structure and porous earthy fabric. This material occurs as subsoil (B horizon) or occasionally as an A2 horizon.

Texture can range from clayey sand to sandy clay loam. Texture often increases gradually with depth. Peds when present, are usually rough-faced and sub-angular blocky. They range in size from 10 mm to 50 mm. Porosity often decreases with depth. Colour ranges from yellowish-brown (10YR 5/6, 6/6) to brownish-yellow (10YR 6/8). The pH ranges from strongly acid (pH 4.0) to moderately acid (pH 5.5). Sandstone and ironstone fragments are common, but charcoal fragments and roots are rare.

1a3—Angular blocky puggy clay. This is a fine sandy clay loam to medium clay with strongly developed angular blocky to occasionally prismatic structure when dry and apedal massive structure when wet. This material occurs as deep subsoil (B horizon) on shale lenses.

Peds are predominantly rough-faced (10-50 mm) and porous with isolated clusters of smooth faces and dense peds. Secondary sub-angular and polyhedral peds are common. When moist, this material is moderately sticky, and is apedal massive and plastic. It is equivalent to Buchanan's (1980) puggy clay. Colour in well-drained positions is commonly a yellowish-brown (10YR 6/6–6/8). In areas subject to prolonged saturation or seepage, colour varies from light yellow orange (10YR 8/4) to pale grey (10YR 8/2). Red, orange and grey mottles are common.

The pH ranges from extremely acid (pH 3.5) to moderately acid (pH 5.5). Platy, iron coated ironstone fragments are common. Roots and charcoal fragments are usually absent.

1a4—Blackish-brown, loose sandy loam. This is a dark loamy sand to sandy loam with apedal single-grained structure and porous sandy fabric. It usually occurs as topsoil (A1 horizon).

This material is often water repellent. Colour usually ranges from greyish yellow brown (10YR 4/2) to brownish-black (10YR 3/2). The pH ranges between strongly acid (pH 4.0) and slightly acid (pH 6.0).

Sandstone and ironstone fragments, charcoal fragments, roots and decaying plant remains are common.

1a5—Earthy, mottled, pale clayey sands. This is pale coloured clayey sand with apedal massive structure and porous earthy fabric. It generally occurs as subsoil in wet areas (B or C horizon).

Texture can vary from loamy sand to sandy clay loam, with clayey sands and sandy loams being the most common. Surface condition is loose and fabric is sandy. This material is characterised by pallid/grey soil colours such as light yellow (2.5Y 7/4) and bright yellowish-brown (2.5Y 7/6). In wet situations there are often rusty piped mottles around root traces. The pH ranges from extremely acid (pH 3.5) to moderately acid (pH 5.5). Sandstone fragments, charcoal fragments and roots are usually absent.

1a6—Friable sandstone. This is soft, friable, deeply weathered, sandstone with a coarse sugary appearance. It commonly occurs as deeply weathered parent material (C horizon) in joint lines and beneath perched watertables.

Texture is commonly clayey sand which often becomes sandier with depth. Structure is usually apedal and massive and the fabric is sandy or occasionally earthy. Colour can vary from light grey (10YR 8/1) to dull yellow-orange (10YR 7/2-7/4). Pale yellow and orange mottles may be present. Rusty mottles occasionally occur which follow root traces. This material can be crushed by hand

and the disrupted material has a feel and appearance similar to sugar crystals. The pH ranges from extremely acid (pH 3.5) to moderately acid (pH 5.0). Occasional bands of dark red (2.5YR 3/6) mottles associated with platy, angular, ironstone fragments occur. These ironstone fragments often occur in undisturbed and stratified bands. Strongly weathered fragments of sandstone are found at depth. Roots are rare and charcoal fragments are absent.

Associated Soil Materials

Litter and decomposing organic debris. This material consists of easily recognisable remnants of leaves, flowers, bark and twigs. Distribution is variable and depends on exposure, fire regime, location of nearby species and surface wetness. Fungal and root mats are common. There is a sharp even boundary with the mineral soil.

White loose sand. This material is composed almost entirely of quartz sand grains and is found in recently deposited surface washes such as small debris dams and fans located on breaks of slope.

Dark peaty sand. In poorly drained areas heavy accumulations of organic matter are associated with shallow, dark, peaty sands.

Occurrence and Relationships

Crests and plateaux. Generally 20–100 cm of earthy, yellow-brown, light sandy clay loam (**la2**) occurs as both topsoil and subsoil, with texture characteristically increasing gradually with depth (Earthy Sands (Uc5.11, Uc5.22), Yellow Earths (Gn2.21)). This material may merge with friable sandstone (**la6**), or with sandstone bedrock. Total soil depth is <100 cm.

Occasionally up to 30 cm of loose, stony, yellow-brown sandy loam (**la1**) overlies 10–40 cm of **la2**. Total soil depth is <100 cm. The boundary between the soil materials may be gradual (Yellow Earths (Gn2.2)) or clear (Yellow Podzolic Soils (Dy2.61, Dy4.51)). A stone line is often present.

Plateau surfaces and larger benches are often characterised by areas of exposed bedrock with shallow (<30 cm), discontinuous pockets or islands of up to 10 cm of brownish-black sandy loam (**la4**) which overlies up to 10 cm of **la1**. Total soil depth is usually <60 cm. The boundary between the soil materials is gradational (Siliceous Sands/Earthy Sands/Lithosols (Uc1.21, Uc5.11)).

Sideslopes. The soils on sideslopes are discontinuous, with up to 50% of the surface covered by sandstone rock outcrop. On the benches, a variety of shallow soils occur (<50 cm). Soils in crevices such as joint lines may be >100 cm deep.

Outside of benches. The leading edges of most benches, adjacent to rock outcrops, have up to 20 cm of **la1** and/or **la4** overlying bedrock (Siliceous Sands/Lithosols (Uc1.2)). In other locations, up to 20 cm of **la4** overlies up to 20 cm of **la1** and up to 50 cm of **la2**. Total soil depth is <60 cm. Boundaries between soil materials are gradational (Yellow Earths, Earthy Sands (Gn2.24)).

Inside of benches. Up to 20 cm of **la1** or **la4** overlies up to 50 cm of **la2**. Total soil depth is usually <100 cm and the boundary between the soil materials is gradual (Earthy Sands (Uc5.2), Yellow Earths (Gn2.2)). Where occasional shale lenses have influenced soil formation, up to 20 cm of **la4** and/or **la1** overlie up to 50 cm of white puggy clay (**la3**) (Yellow Podzolic Soils (Dy4.11, Dy5.21, Dy5.51)). Total soil depth is <60 cm. Boundaries between the soil materials are clear to sharp.

Wet areas. Up to 20 cm of **la4** overlies up to 50 cm of earthy, mottled, pale clayey sands (**la5**). **la3** may substitute for **la5** or occur below **la5**. Total soil depth rarely exceeds 100 cm. The boundary between the soil materials is gradual (Leached Sands (Uc2.21), Grey Earths (Gn2.81)) to sharp (Gleyed Podzolic Soils (Dg4.21)).

Drainage depressions and hanging valleys. Close to drainage depressions up to 20 cm of **la4** overlies up to 60 cm of **la5** and occasionally up to 30 cm of **la6**. Total soil depth is <100 cm. Boundaries between soil materials are gradual (Leached Sands (Uc2.21), Grey Earths (Gn2.81)). In other areas litter, decomposing organic debris and white loose sand commonly overlie up to 60 cm of **la1** (Siliceous Sands (Uc1.2)). Secondary depositional yellow earth material (**la2**) is often found adjacent to drainage lines (Paton, 1978).

Hanging valleys. The deep subsoil of the hanging valleys usually consists of **la6**, especially in waterlogged and swampy areas.

LIMITATIONS TO DEVELOPMENT

Urban Capability

Low to moderate capability for urban development.

Rural Capability

Land not capable of being cultivated or grazed.

Landscape Limitations

Seasonal waterlogging

Rock outcrop

Shallow depth

Erosion hazard

Perched watertables (localised)

Soil Limitations

- la1** High permeability
 Low available water capacity
 Stoniness
 Low fertility
- la2** High permeability
 Low available water capacity
 Stoniness
 Low fertility
 Strongly acid
 Very high aluminium toxicity
- la3** Low wet strength
 Low permeability
 Stoniness (localised)
 Very low fertility
 Very strongly acid
 High aluminium toxicity
- la4** Stoniness (localised)
 High organic matter (localised)
 Low fertility
 Very strongly acid
 High aluminium toxicity
- la5** Low available water capacity
 Very low fertility

Strongly acid
High aluminium toxicity

1a6 Low available water capacity
Low permeability (localised)
Stoniness (localised)
Very low fertility
Strongly acid
Very high aluminium toxicity

Fertility

The soils of this unit are shallow, stony, moderately acid, have low available water capacity, very low to low CEC and often are severely deficient in nitrogen and phosphorus. In many areas these soils are poorly drained. The subsoil has very high aluminium toxicity.

Erodibility

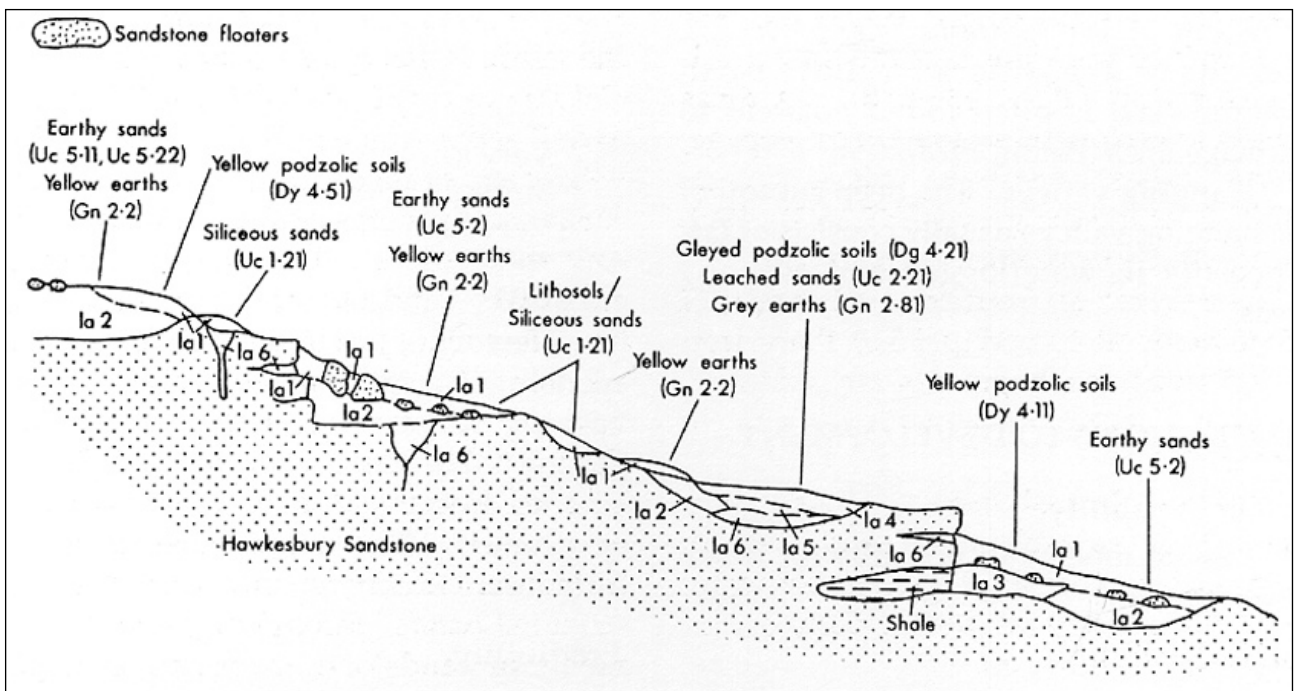
Soil materials **1a1–1a4** are moderately erodible. They consist of either well-drained coarse sand with moderate (**1a2**) to high (**1a1, 1a4**) amounts of organic matter or weakly cemented earths and clays (**1a3**). Most aggregates are stable or prone only to slaking. The clays in **1a3** are occasionally dispersible and this material is then considered to be highly erodible. However, **1a5** and **1a6** have low erodibility as they are firmly cemented by clays and/or iron oxides.

Erosion Hazard

The soil erosion hazard for non-concentrated flows is usually very high, but ranges from low to extreme. Calculated soil losses for the first twelve months of urban development range up to 17 t/ha for topsoils and 197 t/ha for exposed subsoils. The soil erosion hazard from channelled flow is extreme.

Surface Movement Potential

The sandy shallow soils are stable to slightly reactive. Only in isolated instances where **1a3** is >100 cm thick would the reactivity be moderate.



Schematic cross-section of Lambert soil landscape illustrating the occurrence and relationship of the dominant soil materials.