Preliminary Contaminated Site Investigation
at
Rouse Hill Anglican College

Prepared by:

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1 Introduction

This is a preliminary contaminated site investigation of lands at the proposed Rouse Hill Anglican College. It is undertaken to accompany a development application following the requirements of the Blacktown City Council's *Policy and Procedures for the Determination of Rezoning, Development and Building Applications Involving Contaminated Land* (March 1996).

The proposed development includes a kindergarten, junior school, senior school, gymnasium, chapel and auditorium, tennis courts, administration block, 143-space car park, two sports ovals and a specialist block. It will occupy most of the 4.3 hectare site, requiring significant earth works to prepare the site for building construction and for subsequent site landscaping (figure 1).

Currently, the site is used for commercial duck farming, which includes the concentrated disposal of liquid manure within a defined area. The development works are expected to result in the stripping of topsoil from most of the site (including manured lands), stockpiling it during the works and subsequently spreading it back as part of the landscaping program. A possibility exists that the effluent disposal may result in land contamination, so Council has requested a Preliminary Contaminated Site Investigation before any redevelopment is undertaken. It is expected that it will take 12 to 18 months from the closure of the duck farm to the commissioning of the school.

The preliminary or initial identification stage is described in Council guidelines as follows:

> *" This stage involves an investigation and reporting of the site history and is typically based on readily available information such as historical records of land use, aerial photographs and consultations with previous occupants and relevant authorities".*

This report, then, details the results of a site and soil investigation undertaken by Mr Sean Harris of Morse McVey & Associates on 11 May 2000. The site visit included:

(i) discussions with the current owner, Mr Warren Talbot, to identify the historic and current land management practices, including those related to:
- on-site waste management
- uses of fuel and oils, veterinary products, dietary additives or disinfectants used within farming operations, and similar products;

(ii) discussions with the previous owner, Mrs Knappe, to identify historic land management practices such as chemical use and waste disposal;

(iii) an inspection of the on-site waste management activities (including neighbouring property), for disposal of wastewater and bedding material used with the duck rearing program; and

(iv) soil profile examination.

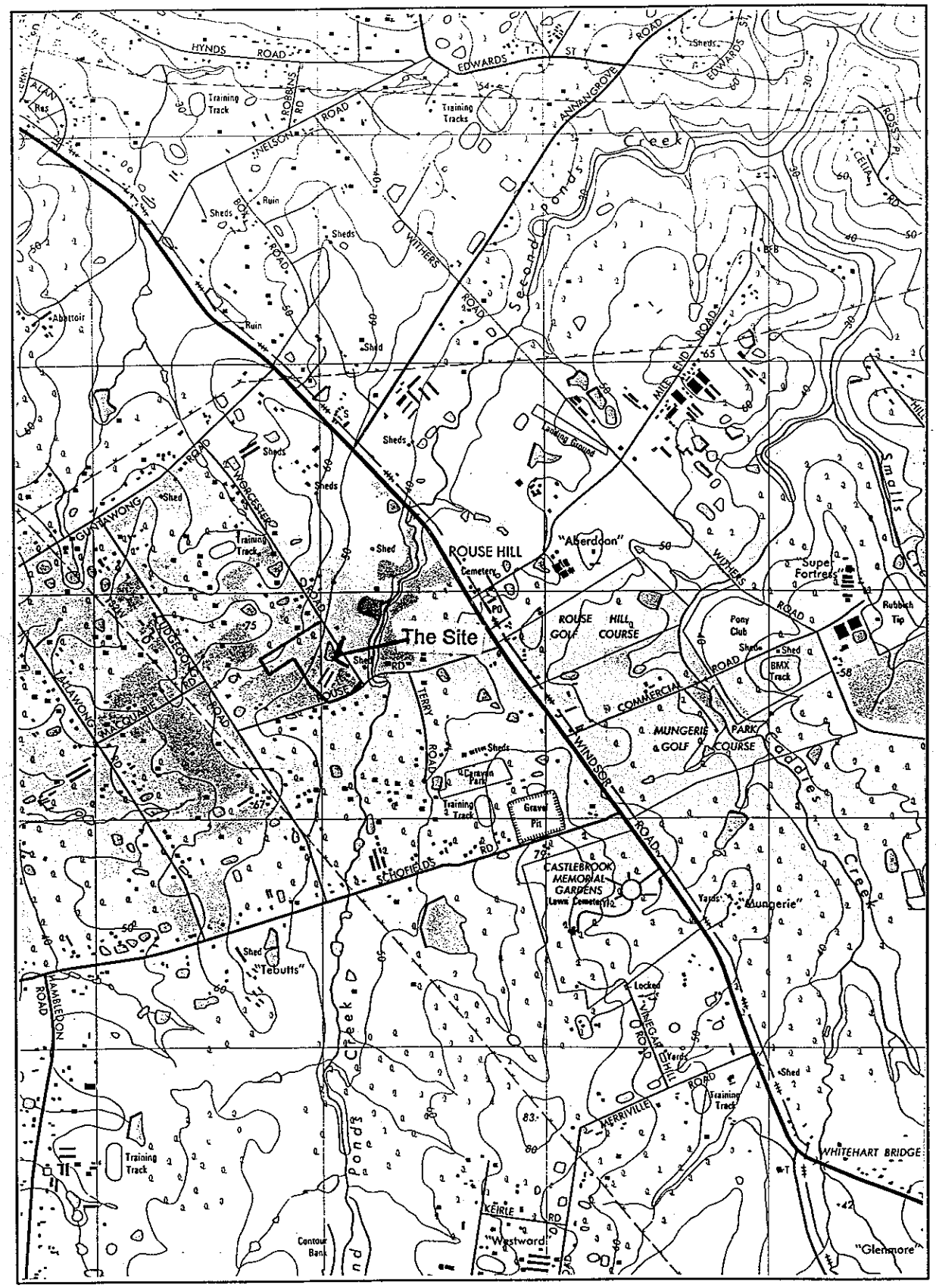

Figure 1 Site location

2 Site Description & Historical Usage

The 4.3 hectare property is on the corner of Rouse and Worcester Roads, Rouse Hill. The undeveloped part of the property, which is most of the property (figure 2), is covered with scattered native trees (open woodland) and exotic pasture grasses (kikuyu). Second Ponds Creek is approximately 200 metres from the eastern boundary, but no permanent or intermittent drainage lines pass through the property to this creek. The property has a low gradient of approximately 2 per cent with an easterly aspect.

Presently, the property is operating as a commercial duck farm. Facilities include:

- two sheds measuring 75 metres by 12 metres
- a manager's house
- a farm shed
- a farm dam
- internal access road.

The sheds were built 24 years ago and have been used for duck or turkey production for most of this time.

The current owners have had the property for 16 years. For the first seven years they reared turkey, then changed to duck production. The previous owner also reared ducks and turkeys under a similar management system.

At any one time, the current enterprise has held up to 1,000 ducks in the breeder shed and 6,000 ducks in the grower shed. They are fed a pelletised ration and no chemicals are used within any aspect of the enterprise.

Water, provided from a dam on the northern side of the property, is used for the ducks drinking supply and to wash down effluent that collects in a narrow concrete trough (about two metres wide). This trough runs along the length of the sheds. Effluent from it is pumped to a septic tank that is periodically pumped to the disposal area on the eastern side of the grower shed.

The disposal pipe is moved around the disposal area as required. It has an area of about 2,000 square metres. At the time of the site inspection, about 100 square metres of this land were wet and boggy, probably because of the effluent disposal practice.

The current owner, Mr Talbot, was interviewed on the 11 May and 6 June 2000 to identify those activities that may have caused soil contamination over the last 16 years. He believes that the enterprise has not used chemicals typical on many other intensive bird enterprises. The reason for this being that ducks are particularly resilient to parasites and diseases.

The previous owner, Mrs Knappe, lives on the neighbouring property and owned the property between 1966 and 1984. She produced broilers in the two sheds, but has no recollection of specific chemical use apart from disinfection undertaken between each batch of broilers by a contractor. The main purpose of the disinfection was to control lice and black beetles, so it is assumed organophosphates were used. Mrs Knappe

believes that no chemicals were used for termite control.

Neither the current nor previous owner recalls the property being used for other intensive agricultural activities. As for the site's suitability for market gardening or orcharding, the site is currently limited by extensive cover of trees, many with trunk diameters between 300 and 600 mm. So, cultivation for market gardening in recent times would not have been possible. In addition, the site is on the Blacktown Soil Landscape which is generally unsuitable for intensive agricultural production due to its low inherent fertility.

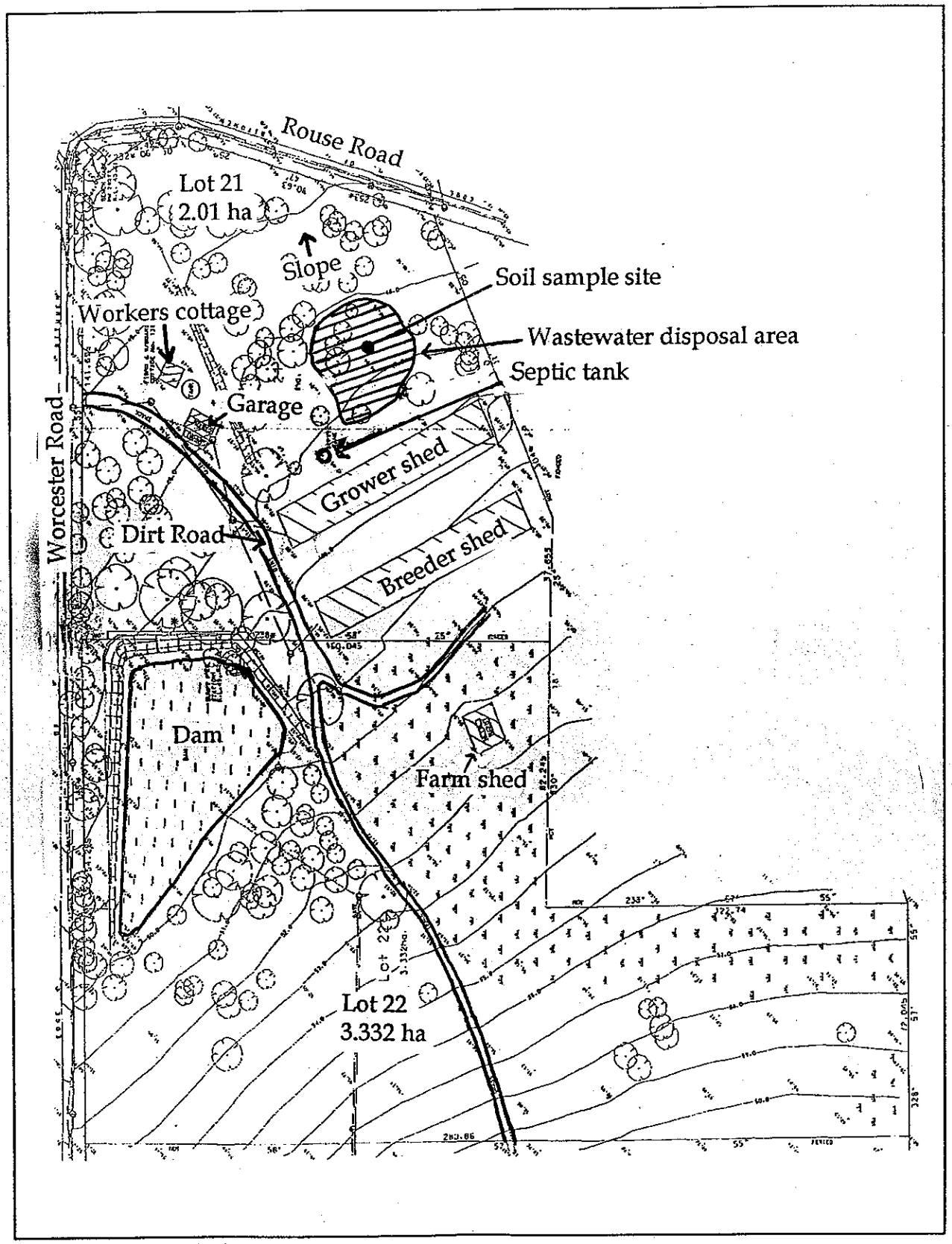

Figure 2 Existing site layout

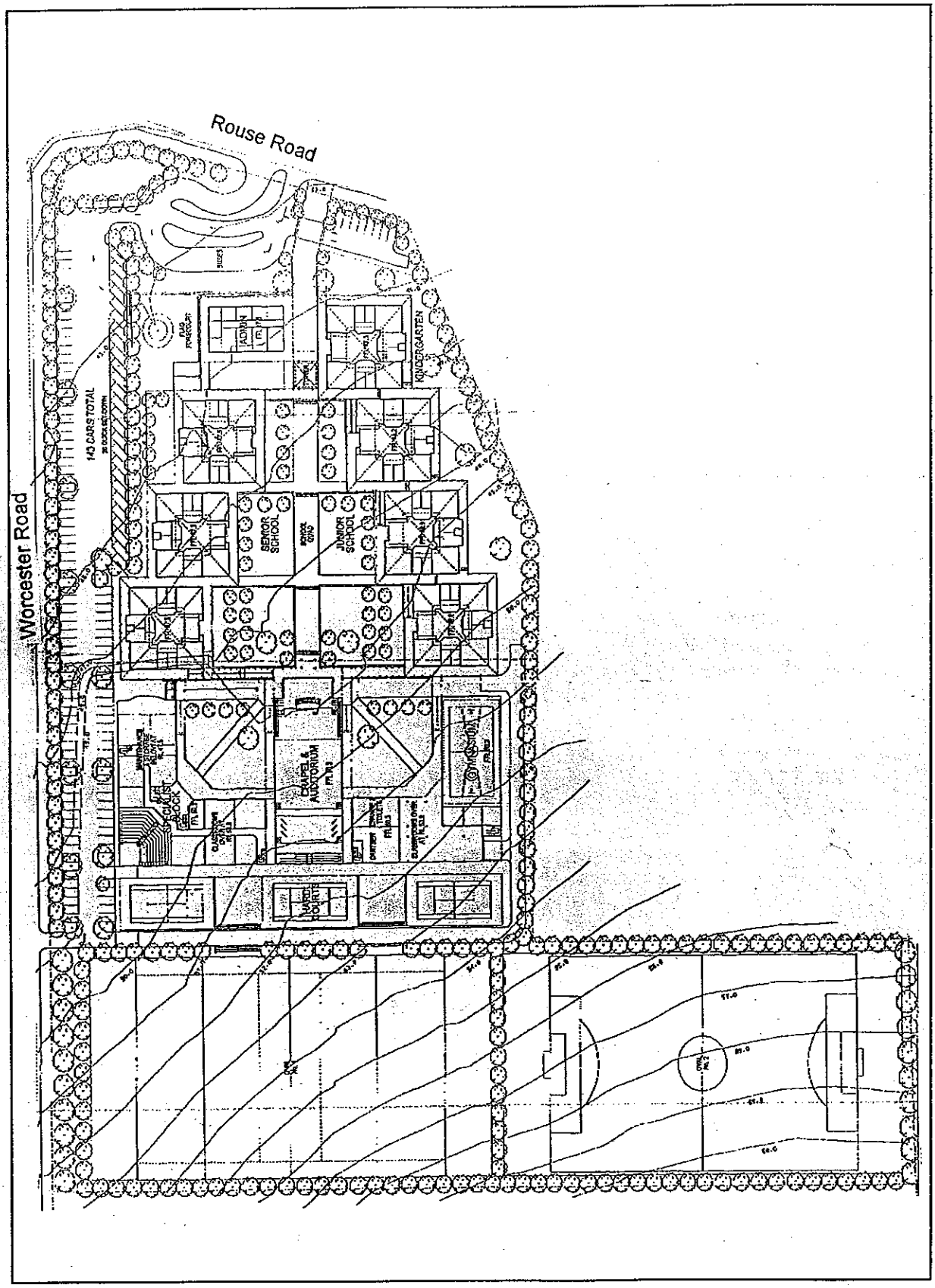

Figure 3 *Proposed Development*

3 Study Methodology

3.1 Soil and Site Assessment

The soil profile was assessed at four locations:

- two in the wastewater disposal area
- two beyond the influence of wastewater disposal.

The field description gives a preliminary assessment of soil profile and drainage characteristics, including soil texture and depth, colour, structure and subsequent classification according to published soil landscape information.

The samples collected in the wastewater disposal area were taken from a depth of 150 mm following NSW EPA (1995). This document suggests depths of up to 400 mm are appropriate for this type of investigation and to sample materials with the highest expected levels of contamination. The samples were sent to East Laboratories Pty Ltd (NATA-registered) for testing. The results were further analysed to assess:

- the likelihood of contamination
- the need for further detailed investigation.

3.2 Risk Assessment

The soil test results were compared with the recommended end-use investigation levels contained within guidelines published by ANZECC & NHMRC (1992) and NEPC (1999). These documents define "investigation level" as:

> *". . . .the concentration of a contaminant above which further appropriate investigation and evaluation will be required".*

They are commonly health and ecologically-based with the actual levels adopted being determined on a site-specific basis using professional judgement.

Five classes of health-based investigation levels (HILs) are described in NEPC (1999) based on the exposure setting and land use, i.e. the risk of soil accession. For this study we have chosen to use HIL(A). Class A exposure settings are defined by NEPC (1999) as:

> *"Standard residential with garden/accessible soil (home-grown produce contributing less than 10% of vegetable and fruit intakes; no poultry): this category includes children's play-centres, kindergartens, preschools and primary schools".*

Ecological investigation levels (EILs) have also been published. However, the use of these is limited due to regional variations in flora, fauna, soils, climate, etc. (NEPC, 1999). EILs are considered less relevant for this site as it is surrounded by disturbed land. Therefore, significant ecological communities or habitats are not expected to be under threat of exposure to potentially harmful contaminants. Nevertheless, some appropriate EILs are included with the results of soil tests and recommended HILs later in this report.

Background ranges are also provided in the guidelines cited previously, being derived from information contained within many other texts. However, the natural elemental concentrations in soils can vary considerably, depending on the origins of the soil. Consequently, where a lack of region-specific data is available, this information should be used with caution. These ranges are included with soil test results for comparison.

Note that ecological investigation levels have been derived from overseas data, soil survey information from four Australian capital cities and a consideration of phytotoxicity. Ideally, these data should be developed further at a regional level and related to specific land uses. This would require acquisition of data relevant to the regional flora, fauna, soils, climate, etc. This information is currently not available and, so, the published investigation levels are arbitrary (NEPC, 1999).

Published investigation levels are not intended as clean up or response levels nor are they desirable soil quality criteria. Natural soils have a wide variability of elemental concentrations depending on their origin and investigation levels can at times be exceeded on uncontaminated soils. Therefore, an exceedence of investigation levels should prompt a site specific assessment where there is the likelihood of adverse effects on human health or ecological values for the site. Inappropriate use of investigation levels as default cleanup criteria can result in unnecessary remediation costs (NEPC, 1999).

3.3 Potential Soil Contamination

In determining the risk associated with the proposed development on the site, the ANZECC/NHMRC guidelines in DUAP & EPA (1997) were reviewed (Appendix 1). These guidelines provide lists of land use activities that have higher probabilities of site contamination. Duck or poultry farms are not listed as separate entities and, of the available choices, primary production is considered the most similar. On this basis,

contaminants originating from past and present chemical use, building materials, animal feed, bedding materials and wastewater contaminants such as microbiological organisms were considered. The choice of possible analytes tested was based on the site history and reference to NEPC (1999).

3.3.1 *Heavy metals*

Due to the possibility of heavy metals being concentrated within the duck manure, degradation of building materials or other inorganic substances being applied to the site, a general purpose screen for metal contamination was undertaken, including the following:

- arsenic
- cadmium
- copper
- lead
- manganese
- mercury
- nickel
- zinc.

3.3.2 *Nutrients*

Phosphorus and sulfur are present in duck manure and, therefore, are potential contaminants of the receiving waters. Ecological Investigation Levels are provided within the ANZECC/NHMRC (1992) guidelines for phosphorus and sulfur.

3.3.3 *Organophosphates*

Based on similar practices undertaken on intensive poultry farms over the last 35 years, organophosphates might have been used for the control of lice and parasites. These compounds are not persistent in the soil, and have a half life less than one week. Consequently, no soils' tests were undertaken for them.

3.3.4 *Organochlorines*

Based on similar practices undertaken on intensive poultry farms over the last 35 years, organochlorines might have been used for treating timber for termite and white ants. Because these compounds are persistent for long periods, the soils were tested for several organochlorine anolytes.

4 Results and Discussion

4.1 Profile Description

Soils at this site are consistent with those for the Blacktown Soil Landscape as described in Hazelton & Tille (1990). These are residual soils derived from the Wianamatta Group shales. A general profile description as observed at this site is as follows:

Layer 1 (0 to 150 mm) ..... black, clay loam with weakly pedal structure, no coarse fragments, well drained with no mottling (bt1)

Layer 2 (150 to >400 mm) ... red, medium clay with moderately pedal structure, up to 20% orange mottles (bt3).

4.2 Soil Contaminants

No prescribed investigation standards have been prepared for assessing soil contamination for duck farms. So, this assessment has held that the worst case scenario could involve contamination by an unknown land use, or a build up in contaminants within the soil through the feed materials used.

Therefore, the soils were tested for heavy metals, nutrients and organochlorines due to the significance of the proposed development. The results were analysed according to the Health Investigation Levels for a "standard" residential development with gardens and accessible soil. This includes children's day care centres, kindergartens, preschools and primary schools.

Table 1 contains a list of the tested pollutants, the measured concentrations and the corresponding background and investigation levels.

(i) Nutrients within duck manure.

The NEPC (1999) investigation levels shown in Table 1 provide Ecological Investigation Levels for the nutrients phosphorus and sulfur only. There is no risk to human health associated with high levels of these elements in the soil.

The high phosphorus levels (five times the ecological investigation level) can be attributed to the presence of this nutrient in the duck feed and subsequently within the duck manure. Table 2 shows a typical analysis of duck feed and duck nutrients. The elevated level of phosphorus within the soil sample was expected to be high due to:

- the location of the sample site in relation to the wastewater disposal site
- high phosphorus retention of the clay loam topsoil.

Table 1 Soil contaminants test results*

Analyte	Pollutant loads (mg/kg)			
	Our results	Background [1]	Investigation level [2]	
			HILs (A)	EILs
Heavy metals				
Cadmium	3.2	0.04 - 2	20	3
Copper	33	1 - 190	1,000	100
Lead	39	<2 - 200	300	600
Zinc	351	10-300	7,000	200
Arsenic	6.6	0.2 - 30	100	20
Mercury	<0.10	0.001 - 0.1	10	1
Manganese	1,447	850	1,500	500
Nickel	23	5-500	600	60
Nutrients				
Total Phosphorus	10,871	na	na	2,000
Sulphur	3,840	na	na	600
Organochlorines				
alpha BHC	<0.05			
HCB	<0.05			
beta BHC	<0.05			
G-BHC (Lindane)	<0.05			
delta BHC	<0.05			
Heptaclor	<0.05			
Aldrin	<0.05		20	
Heptaclor Epoxide	<0.05		20	
trans-Chlordane	<0.05			
Endosulphan 1	<0.05			
cis-Chlordane	<0.05			
Dieldrin	<0.05			
p,p DDE	<0.05		20	
Endrin	<0.05	1-50	400	3
Endosulphan 2	<0.05			
p,p DDD	<0.05			
Endrin Aldehyde	<0.05		400	3
Endosulphan sulfate	<0.05			
p,p DDT	<0.05			
Endrin Ketone	<0.05		400	3
Methoxychlor	<0.05			

[1] Background levels are taken from ANZECC & NHMRC, (1992).
[2] Investigation levels are taken from NEPC (1999) using Health Investigation Levels (HILs) "A" for Standard residential with garden/accessible soil.
[3] Value relates to total concentration DDD + DDE + DDT
* Where investigation levels are not listed, these are not quantified by [1]or [2].

Table 2 Nutrients and heavy metals in duck feed and poultry manure

Source of nutrient	Cl (%)	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Na (%)	Mn (ppm)	Cu (ppm)	Zn (ppm)	Boron (ppm)
Duck feed *	0.2	-	0.8	0.5	0.8	0.3	0.17	-	-	6.0	-
Duck manure **	0.75	2.8	3.39	1.93	11.06	0.93	0.44	556	27	194	14

* Millmaster Feeds, Tod McPherson (pers. comm. 5 June 2000)
** Embury, I. and Allan J. (Undated)

The ecological concern associated with high levels of phosphorus in the natural environment include weed invasions in native bushland (Leishman, 1986), and algal blooms and other prolific plant growth in waterways (DLWC, 1995). A potential target for this is Second Ponds Creek, approximately 200 metres from the southeastern corner of the site.

The proposed development will result in most of the site being developed with new buildings, and this will require the complete removal of topsoil. The topsoil will be stripped from the site and may be used elsewhere on the property, such as the development of the sports oval and general landscaping. Despite whether topsoil is retained on-site or moved to another location within the property, the ecological impact caused by the high levels of phosphorus will be minimal providing adequate erosion and sediment control measures are put in place. Furthermore, once the current practice of wastewater disposal is stopped, the phosphorus held in the soil will decline to acceptable levels due to the natural processes of plant uptake and leaching through the soil profile.

As a rule, the maximum availability of phosphorus to plants is between pH 6.0 and pH 7.0. Availability decreases at levels both higher and lower than these limits. The soil pH at the site was 6.7, suggesting the soil is within the range for maximum plant uptake.

Management of erosion and sediment control throughout site development will be necessary to prevent the ecological impact of phosphorus removal from the site. This includes monitoring of soil pH to maximise plant uptake, and placing emphasis on the design and implementation of an erosion and sediment control plan during construction.

(ii) Microorganisms

Potential disease causing organisms associated with duck manure was discussed with Dr. George Arzey, Senior Veterinary Officer (Poultry) at the Elizabeth Macarthur Agricultural Institute at Camden. It is the opinion of Dr Arzey that the risk to human health from microorganisms within duck wastes is minimal because:

- most bacteria spores that can persist outside the host and in dry environments are widespread in most areas where animals and humans coexist,

- no duck viruses present in Australia are known to cross over from ducks to humans; and
- most disease causing organisms likely to be present require a combination of organic matter and moist conditions to survive outside the host organism for long periods.

It is assumed that all concentrated sources of manure, including wood shavings and feathers on the floor of the duck sheds, will be removed from the site. Consequently, providing the stockpiles of manure are removed and the site is allowed to dry out and receive exposure to sun, there is no reason to believe the site will carry any significant health risk.

(iii) Heavy metals

Heavy metals can pose a threat to human health and the environment where elevated concentrations occur. Some metals, such as zinc and copper are essential trace elements to living organisms, but become toxic at higher concentrations. Others, such as cadmium and lead have no known biological function. Heavy metals that can cause water pollution include zinc, copper, lead, cadmium, mercury, nickel, chrome and aluminium.

The levels of cadmium, zinc and manganese measured at this site exceed the Ecological Investigation Levels, although they fall below recommended Health Investigation Levels where these are documented. These heavy metals are likely to be elevated due to the disposal of concentrated duck manure within a relatively small footprint. Zinc and manganese are incorporated as trace constituents within the type of commercial duck feed used here:

- zinc bacitracin is an additive to the duck feed and this can concentrate in the manure
- manganese is also an additive to duck feed that is likely to concentrate in the manure.

Cadmium can enter the body through inhalation or ingestion with effects to human health, including acute pneumonia, gastroenteritis, obstructive lung disease and kidney dysfunction. The origin of cadmium within the soils tested here is unknown, but several options are possible. For example, it is a naturally occurring, toxic, heavy metal; it is produced as a byproduct of lead and zinc refining processes, and is present as an impurity in phosphate fertilizers – a common source of cadmium contamination in soils.

Natural soils typically have cadmium concentrations around 0.04 to 2.0 milligrams per kilogram and have been measured up to 6.0 milligrams per kilogram. Soils derived from shales typically have higher background levels (Jinadasa *et al*,1997). Soils at this site are derived from the Wianamatta Shales with high clay content and, although not

tested, are expected to have high background cadmium concentrations.

Another possible source of cadmium could be the historical use of blood and bone or fishmeal as a protein source in the duck feed. Blood and bone may have been manufactured from animals that grazed on lands with high cadmium concentrations with a subsequent accumulation in the food chain.

The potential for overland transport of these heavy metals to the watercourse is low, given the low gradients. It can be further reduced through retention of soil onsite during construction processes following appropriate erosion and sediment control practices.

Soil and groundwater leaching potential of these metals is very low due to the fine-grained nature of soils at this site. Heavy metals are most easily leached through sandy, acid soils. The soils at this site have a high clay content and will retain heavy metals through adsorption.

Finally, the site is currently of low ecological significance, given that it has been extensively cleared of native vegetation and is highly disturbed. Future development of this site as a school therefore, will have no further impact on the biological diversity. The heavy metals have made no impact on the growth of grass and are unlikely to limit future landscaping. Therefore, the environmental threats to human and other ecological communities due to heavy metal contamination are considered negligible.

(iv) Organochlorines

Most of the organochlorines tested have no published investigation levels. In all cases, the soils tested were found to exist at non detectable concentrations (i.e. >0.05 mg/kg).

(v) Fuel and oil

For the last 16 years, the current owners have brought fuel and oil onto the farm in small (20 litres) containers to operate small farm equipment that includes:

- a small 20 HP diesel tractor
- sludge pump, using unleaded petrol
- hand-operated rotary hoe.

However, between 1966 and 1982, the previous owner had a similar fuel requirement for the small farm equipment, with the additional use of oil heaters during the winter. These were along the side of the shed and there were no reported incidences involving spillage or leakage of stored fuel.

5 Conclusion

This assessment has considered the potential soil contamination because of land use on the site and in respect to the proposed development of a primary and secondary school. Soils' analysis was undertaken for the common heavy metals, nutrients and organochlorines that could be associated with intensive poultry production, and this concluded the risk to human health to be very small. Based on the information contained within this report, I recommend that no further investigations into land contamination are required at this site.

6 References

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