

FACSIMILE



Brisbane City

File 902196.

FOR REPLY NOTES AND
CONTAMINATED SITES SECTION

14 APR 1999

C/SITES

City Design

TO: Mack Dryerer

DATE: 12-4-99

Level 3 T.C. Beirne Centre
315 Brunswick Street Mall
Fortitude Valley Qld 4006

CC:

FAX: 3227 7677

FROM: Derek Neuhold

PH.30576

Locked Mail Bag 6996
Albion Qld 4040

RE: POWERHOUSE CONTAMINATION LINING

No. OF PAGES 24.

Ph: 07 3403 3489
Fax: 07 3403 0507
Mobile:
Email:

REF:

14 APR 1999

CIRCULAR

Mack,

99/04645

As per our conversation I enclose the details of the proposed clay liner to be used for containing the on-site contamination materials.

Please refer to the attached figure 1 for specific locations.

I am endeavouring to maintain all contaminated material on site by placing it on the eastern terrace (ignore the proposed car parking as it will now be a footpath and public access) as highlighted on figure 1. The material will be capped with the proposed bentonite liner (10mm which swells to 20mm when wet) and an additional 300mm of clean fill will be placed over the liner. In addition to this will be another 75-100mm of topsoil for landscaping purposes. This is proposed for the landscaped areas and grassed areas.

Attached are the specs for the clay liner and several examples of where it has been used for contamination elsewhere.

I hope this information is sufficient. Please call if you require further info.

Regards
Derek

Discussed with Derek Neuhold agreed that liner along with 300 mm of clean fill and 100 mm of top soil would be suitable for disturbed area on lot 101. However I also advised that PK were going to be doing further investigations in this area for the placement of trees and he needs to have with PK on these investigations. Advised further that I can't give comment on use of material ~~over~~ on Powerhouse PK as site not fully assessed. They will need to also look at vegetation where this material is used as it would have to be shallow rooted. They wanted to use clean spoil from the site as part of the clean fill. I advised that they would have to validate this as clean.

RT 103-106

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Collection 14

sch4p4(6) Personal information

20/4/99

Page 1

Bentofix®

Australian Made

NEEDLE-PUNCHED BENTONITE LINER

SPECIFICATIONS

Property	Test Method	X1000	X2000
Non woven geotextile protection layer mass (g/m ²)	ASTM D5261	220	270
Bentonite layer mass (g/m ²)		4500	3000
Carrier woven mass (g/m ²)	ASTM D5261	110	110
Non woven geotextile protection layer mass (g/m ²)	ASTM D5261	N/A	270
Mass per unit area (min), (g/m ²)	DIN 53854	4830	3650
Thickness (dry) (mm)	DIN 53855	6	7
Peel Strength (N/10cm)	ASTM D413	≥ 30	≥ 60
Tensile Strength (kN/m)	DIN 53857		
- machine direction (MD)	Part 2	8	14
- cross-machine direction (CD)		6	24
Elongation - MD	DIN 53857	8%	60%
- CD	Part 2	8%	50%
k value (m/s) (d = 10mm)	DIN 18130	3 × 10 ⁻¹¹	3 × 10 ⁻¹¹
Roll Size (standard) (m)		4.55 × 30	4.55 × 30
Roll Diameter (cm)		≈ 60	≈ 60

Values published here-in are true and correct to the best of our knowledge at the time of publication. These values are subject to change at any time without notice. BNTX.Spec 11/12/96

Bentofix®

GEOSYNTHETIC CLAY LINER

GENERAL INSTALLATION GUIDELINES

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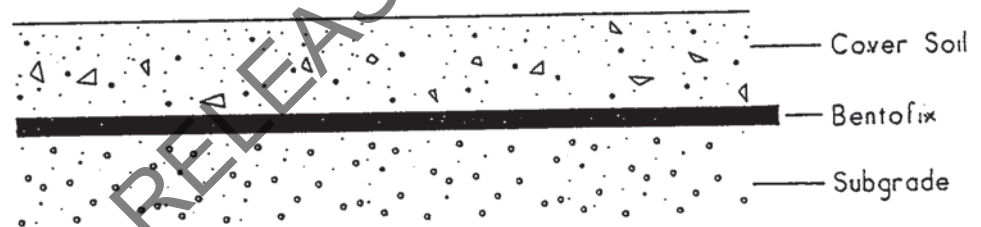
1. INTRODUCTION

Bentofix® is a needle-punched bentonite liner produced by Geofabrics Australasia Pty Ltd in accordance with Quality Standard ISO9002.

Bentofix® consists of bentonite powder which acts as the swelling sealing component, embedded and sandwiched between two or more geotextiles. The composite liner system is then needle-punched through all layers developing a high connection strength. Thus Bentofix® is a shear strength transmitting liner.

Bentofix® is relatively easy to install, however careful handling and installation will ensure that the liner will fulfill its functional requirements.

Typically, the sealing system has three elements: the subgrade, Bentofix®, and cover material.



The preparation of each element in the installation procedure will be discussed in this document. The treatment of overlaps in both the longitudinal and transverse directions will also be addressed.

2. PACKAGING, TRANSPORTATION & UNLOADING ON SITE

Bentofix® rolls are packed in moisture tight plastic wrapping. The standard roll dimensions are 4.55m x 30m.

Bentofix® rolls are usually delivered in (closed/covered) containers on trucks, vehicles, etc. The loading space has to be dry, even and free from debris or foreign matter. The loading space has to be accessible at least from the top. Bags of bentonite powder and the non-woven fabric strips are to be protected from the weather once delivered.

Should any damage occur in transit it must be immediately brought to the attention of Geofabrics, who will advise on the required course of action.

A hard, dry free draining surface must be provided for unloading and storage. Rolls may be off-loaded using:

- two ≥ 55 mm slings (wrapped around the Bentofix® roll 1/3 of the width from the edge) fixed to an excavator bucket or a front end loader. A steel tube or similar reinforcement should be inserted into the roll to prevent excessive deformation across the roll during off-loading.
- a spreader bar with steel tube insert, ensuring that the chains or belts do not damage the roll.
- or Bentofix® may be unloaded and handled using a "carpet prong" protruding from the front end of a forklift or other equipment. The prong should be at least three-fourths the length of the core and also must be capable of supporting the full weight of Bentofix® without significant bending.

Under no circumstances should Bentofix® rolls be dragged, lifted by one end only, pushed to the ground from the delivery vehicle, or otherwise unloaded in a fashion which could damage the roll.

After transportation and unloading the plastic wrapping should be checked. Minor damage should be repaired with weather-resistant adhesive tape. Wrapping should only be removed immediately before use. The maximum storage height is four rolls.

3. STORAGE

Bentofix® rolls should be stored in their original, unopened packaging in a location away from construction traffic but sufficiently close to the active work area to minimise handling.

The designated storage area should be level, dry, well-drained, stable and should protect the product from:

- precipitation
- standing water
- ultraviolet radiation
- chemicals
- excessive heat
- vandalism and animals

Bentofix® rolls should always be stored lying flat, continuously supported, and should never be stored standing on one end. Enclosed indoor storage is preferred if Bentofix® is to be stored for long periods.

4. INSTALLATION REQUIREMENTS

- Excavator (tracked or wheeled) or front-end loader
- Spreader bar (rotatable, possible with shackle)
- Water (water container)
- Heavy duty drill with industrial whisk (high shear force required)
- Mixing containers
- Trowel
- Carpet knife, angle grinder or similar, preferably electric cutter
- Felt pens or chalk
- Measuring tape
- Broom

5. QUALIFICATIONS OF THE INSTALLATION STAFF

The quality of installation is decisive for the success of a project. Before installation this installation guideline and in particular the equipment requirements and bentonite paste mixing procedure must be read thoroughly. Any questions arising should be referred to Geofabrics.

6. WEATHER CONDITIONS FOR INSTALLATION

Bentofix® should be installed in dry weather conditions and frost free weather conditions where bentonite paste is used for overlaps.

7. SUBGRADE PREPARATION

The subgrade should be firm and unyielding, with no abrupt elevation changes, voids and cracks, and free from standing water.

The subgrade surface should be smooth and consist primarily of fine-grained soil (maximum aggregate size should not exceed 20mm) that is free of sharp and protruding edges, construction debris and other foreign matter.

Compaction of the subgrade should be in accordance with project specifications, and should be carried out in such a way that wheel ruts, footprints and other abrupt grade changes are removed.

8. BENTOFIX® PLACEMENT

Bentofix® factory wrapping should only be removed immediately before installation.

The edges of Bentofix® are marked on the bottom side with a coloured line to denote the standard overlap of 300mm. If an overlap other than 300mm has been specified please notify Geofabrics as early as possible so that the rolls can be marked accordingly.

On site Bentofix® is unrolled on the ground using the spreader bar (Figure 1). The overlap line should be visible on the top of the panel.

Installed liners must not be trafficked by vehicles, and walking on the liners must be kept to an absolute minimum.

Rolls are cut to length with a carpet knife or electric cutter.

Rolls must be laid without folds on the subgrade with a standard overlap of 300mm in both the longitudinal and transverse direction. Longitudinally the coloured line can be used during installation to control the overlap width.

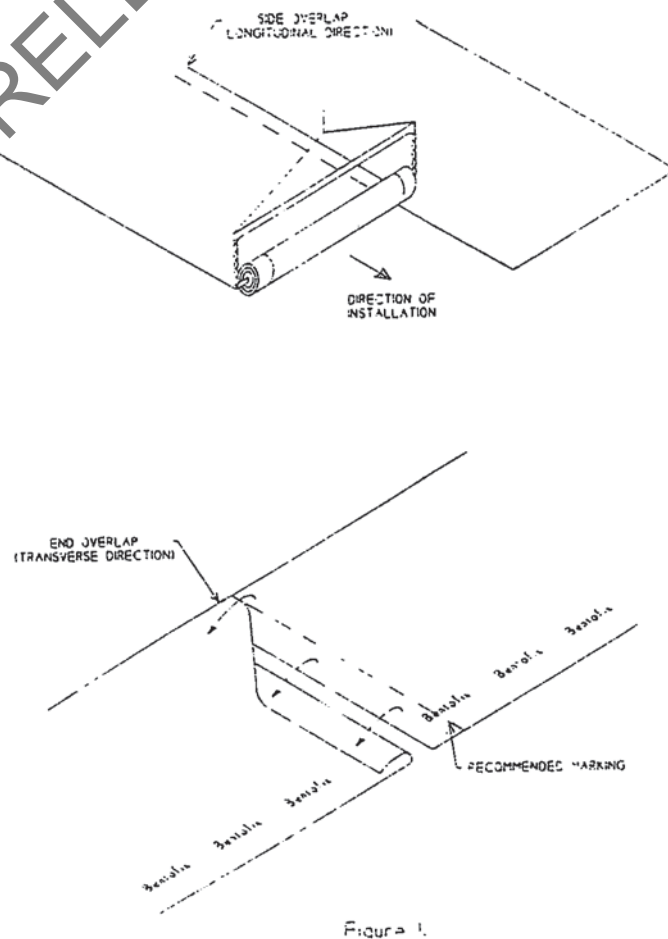


Figure 1.

9. END OVERLAPS (TRANSVERSE DIRECTION

To ensure the integrity of the Bentofix® liner it is essential that the treatment of end overlaps are carefully supervised.

No trafficking or walking should ever occur over the overlap region. The overlap must also be free from folds and foreign matter (eg. soil). Any soil particles on the laps must be swept away carefully.

End overlaps should occur in the direction of ground slope in a similar manner to roof tiles. End overlaps in sumps or inverts are to be avoided.

All end overlaps must be sealed with bentonite paste.

9.1 PREPARATION OF THE END OVERLAP AREA

It is recommended that the top side of the underlaying Bentofix® panel is marked as a reference point for inserting paste at overlaps. The top Bentofix® roll is then pulled back after marking.

9.2 UNDERCOAT

A thin - fluid paste is required as an undercoat in the overlap area. The aim is to fill the pores in the top non-woven geotextile of the underlying Bentofix® panel. The under coat is prepared as follows:

A sufficiently big mortar tub or bucket is filled with water, then bentonite powder is added through a sieve (6 parts water to 1 part bentonite). An electric drill with an industrial whisk is required to ensure sufficient mixing

The paste is spread with a trowel on the open overlaps as shown in Figure 2. The paste is applied into the cover non-woven of the bottom Bentofix® sheet to a width of 200mm, 150mm into the overlap area and 50mm in front of the overlap area.

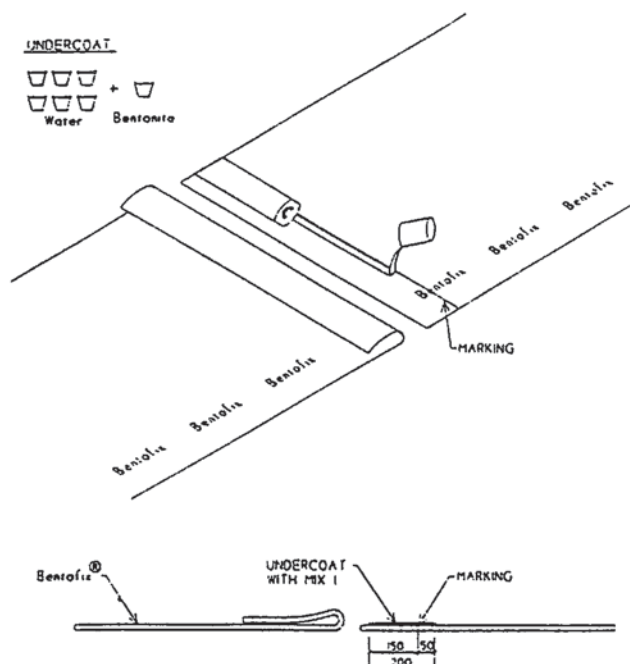


Figure 2 UNDERCOAT APPLICATION

9.3 TOP COAT

A thick bentonite paste is required for the top coat in the overlap area and is prepared as previously indicated (using a mix of 4 parts water to 1 part bentonite). The aim is to fill the free pore space of the overlap area.

This paste is evenly spread using a trowel applied on top of the undercoat to a thickness of approximately 10mm. The top coat is also spread to a width of 200mm, 150mm in the overlap and 50mm in front of the overlap area (see Figure 3).

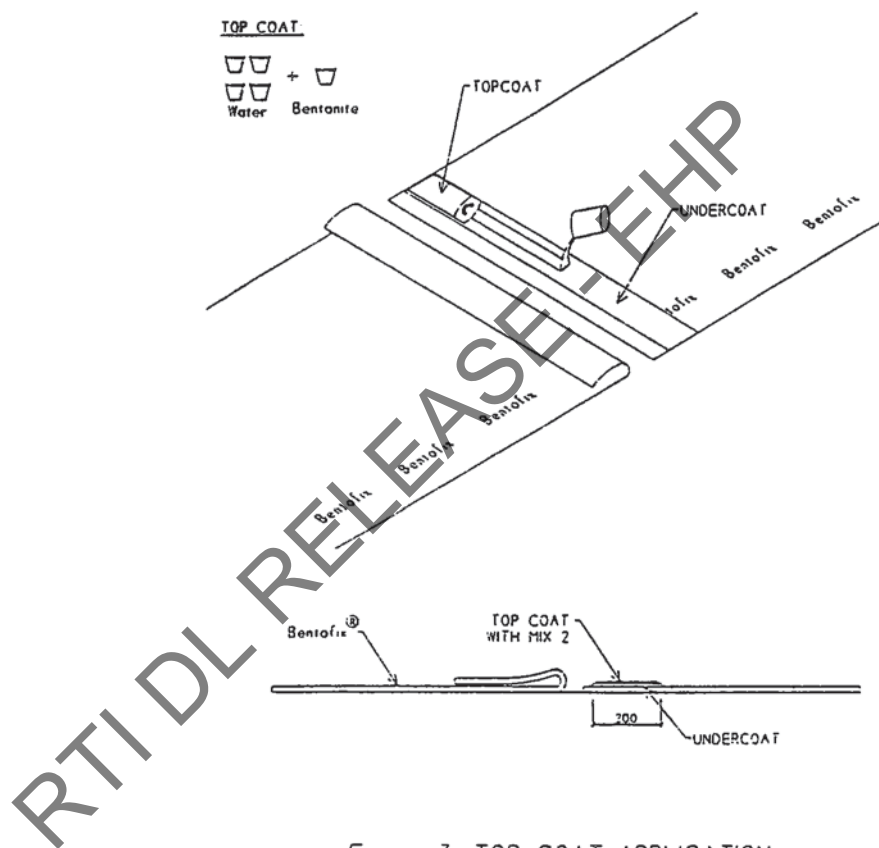


Figure 3: TOP COAT APPLICATION

Both the undercoat and top coat can be purchased premixed in 20 Litre containers from Geofabrics Australasia.

9.4 OVERLAP EDGE COVER

The top panel is then rolled back into place and pressed down. No folds or creases are allowed as these could result in flow paths forming.

9.4.1 BENTOFIX® X2000

Bentofix® X2000 requires an additional fillet of bentonite paste over the transverse seam area. After rolling back the upper Bentofix® panel, the overlap edge is covered with thick bentonite paste to a thickness of approximately 1-2cm and to a width of 10cm either side of the overlap (Figure 4). A non-woven fabric strip is then placed over the bentonite fillet.

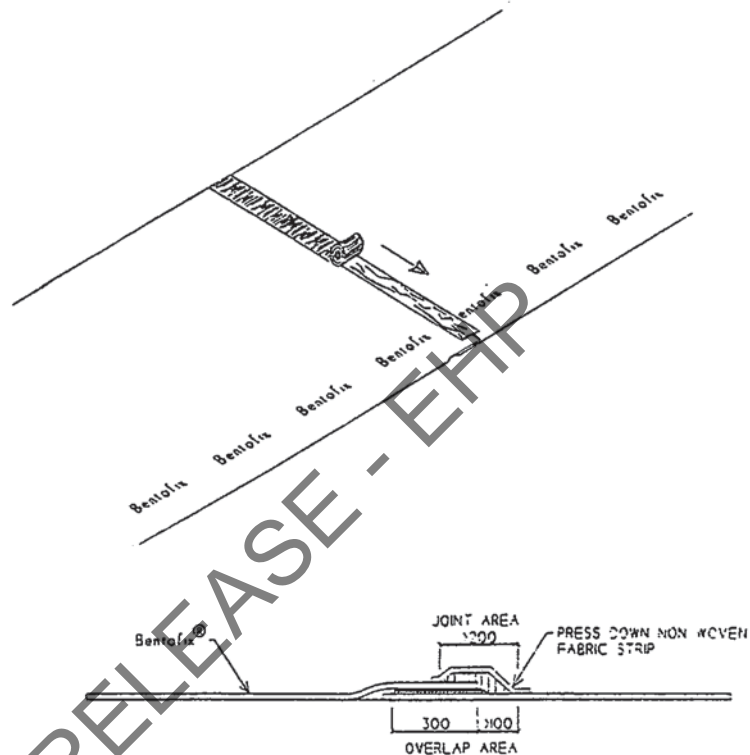


Figure 4: END OVERLAP DETAIL
FOR Bentofix X2000

NOTE: This step is not required with Bentofix® X1000 or Bentofix X500.

10. SIDE OVERLAPS (LONGITUDINAL DIRECTION)

During the Bentofix® manufacturing process, bentonite powder is encapsulated into the upper non-woven geotextile along the edges of each roll. Subsequently the edge overlaps do not require any additional treatment. Overlap lengths of 300mm are recommended unless specified otherwise.

11. INSTALLATION AT SLOPES

The stability of sealing elements on slopes should be assessed on a case by case basis. Geofabrics Australasia Pty. Ltd. can assist in this respect on request.

On long, steep slopes (3.5:1 with lengths $\geq 3\text{m}$) Bentofix® should be installed in the direction of the slope. Cross overlaps on slopes should be avoided. If they are unavoidable, the overlap should be carried out according to roof tile principal (Figure 5) and to section 9, and anchorage into the slope may be required. While Bentofix® can withstand considerable tensile and shearing forces, an installation plan should be adopted to eliminate overlaps subjected to tensile force, unless tension transfer between panels is achieved.

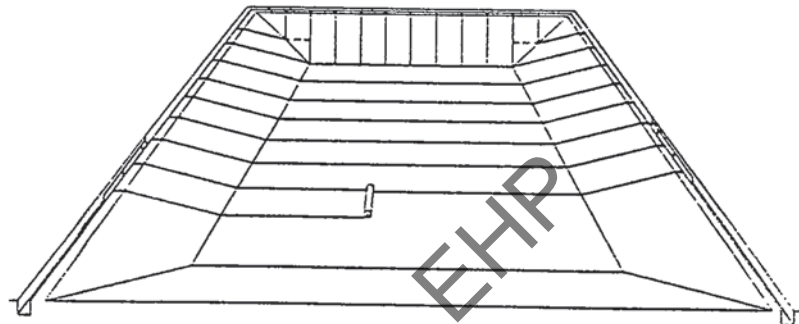


Figure 5: RECOMMENDED PANEL LAYOUT FOR SLOPING SITES

Cover soil should be placed up the slope (starting at the toe). It must not be installed down the slope unless stability for this approach has been carefully investigated.

12. CONNECTIONS & PENETRATIONS

Overlaps at connections and cut areas should be carried out according to the methods outlined in section 9.

Penetrations such as pipe ducts can be carried out according to Figure 6.

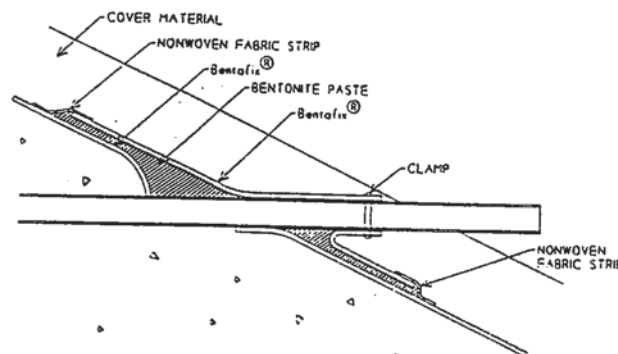


Figure 6: TYPICAL PIPE PENETRATION DETAIL

Further connection methods and penetrations may be discussed with Geofabrics Australasia Pty. Ltd.

13. PREPARATION FOR PLACING THE COVER SOIL

Disturbance of the overlap area during placement (by means of vehicles spreading cover soil) must be avoided. Otherwise it will be necessary to place the cover soil in this area manually.

Where the GCL is not covered within 24 hours, a temporary layer of plastic should be laid to protect Bentofix® from prematurely hydrating.

14. COVER SOIL PLACEMENT

A cover soil of at least 300mm (approx. 6 kN/m²) with a maximum stone size of 20mm should cover Bentofix® each working day after the installed area has been inspected. In general a fine-grained soil is advantageous.

Where a geosynthetic drainage system is installed on Bentofix® a suitable cover layer of at least 300mm has to be installed on the drainage system each working day.

Bentofix® may not be trafficked directly. The cover material should be pushed in front of the construction equipment thus creating a safe working platform. Overlaps should not be moved or squeezed during this process. In the case of an expected repeated dynamic load on Bentofix® a sand layer of at least 300mm should be laid first on the Bentofix®.

Generally, temporary roads should not go over sealed surfaces. These areas, if possible, should be sealed last to minimise traffic over the Bentofix®. Where site traffic cannot be avoided (eg. the delivery of cover material by lorries) additional protection measures will be required. Contact Geofabrics Australasia Pty. Ltd. for details.

For temporary roads, a minimum coverage over Bentofix® of at least 900mm is acceptable without any further analysis. Shallower coverage or alternative cover materials may be allowed after further analysis or field tests.

15. REPAIRS

Where Bentofix® has been damaged during installation, such areas can be repaired by covering with an overlapping piece of Bentofix®. The overlap should be at least 500mm and should be done in accordance with section 9.



Geofabrics JOURNAL

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JUNE 1996

NEWCASTLE'S COMPOSITE BASELINER WILL PAY FOR ITSELF

Newcastle's Summerhill Waste Management Centre recently constructed a new landfill cell. The site is situated over coal seams with large settlements predicted from the weight of the finished landfill.



Australian made **Bentofix**[®] X2000 Geosynthetic Clay Liner was used in conjunction with a 2.0mm HDPE geomembrane to form a composite baseliner over a 2m thick compacted bridging layer. This system has the following attributes:

- **Bentofix**[®] provides an additional 0.9m³ per square metre of landfill plan area, replacing a thick clay liner. Increased air space means increased revenue.
- **Bentofix**[®] X2000 is capable of withstanding large (>30%) biaxial strains due to settlement.
- Very low permeability. Composite liners are much less permeable than clay (a thousand times less than clay alone).
- **Bentofix**[®] X2000 will protect the HDPE from load induced puncture due to stones below the liner.
- **Bentofix**[®] X2000 has self healing properties due to the swelling capacity of natural bentonite.
- Clay desiccation prevention procedures are avoided. HDPE geomembranes can reach temperatures of 65°C which causes rapid desiccation and cracking of clay greatly increasing the permeability of the system. Very quickly installed without the constraints of moisture content control as with thick clay liners.

At the Summerhill Waste Management Centre approximately 25,000m² of **Bentofix**[®] X2000 was installed in conjunction with a HDPE geomembrane.

Newcastle City Council should be congratulated on their efforts to protect the environment.

SUBJECT:

"Preventing Lateral Squeezing of
Hydrated Bentonite in GCL's"
Benefits of Needle Punching

FIRST ISSUED:
19/08/96

Technical Note # BNTX001

During and after construction, static loads from the materials above the GCL and dynamic loads from construction equipment will be transmitted through any cover material to the GCL below.

Hydrated bentonite on its own often exhibits very low shear strength. Consequently, large static loads can cause a "toothpaste" effect, i.e. the hydrated bentonite will be laterally squeezed between the geotextiles layers or even extruded out through the geotextile.

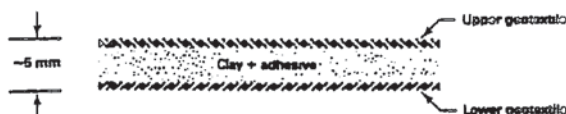
The second mechanism is not noted when thicker nonwovens are used. The potential for lateral squeezing will depend largely on the GCL's structural system.

In general, there are three commercially available GCL structural systems on the market:

1. **Adhesive bonded (e.g. Claymax® 200R)**
GCL consists of adhesively bonded bentonite sandwiched between two geotextiles. There are no yarns or fibres extending between the upper and lower geotextiles.

This structural system offers little resistance to lateral squeezing as the adhesive breaks down or becomes soluble on hydration. Considerable protection or cover soil over the GCL is required to increase the bearing capacity of this system and to ensure liner integrity.

In addition, if woven geotextiles only are used, extrusion of bentonite through the fabric is likely to occur.



2. **Needle punched (e.g. Bentofix® X1000)**
GCL consists of bentonite powder, encapsulated by a high density of needle punched fibres (over 1 million/ metre²), which extend from the upper nonwoven geotextile through the bentonite and lower geotextile. These fibres are then thermally

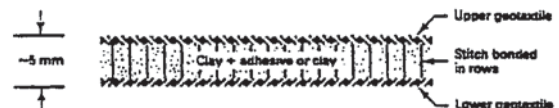
locked into place. This structural system offers a high level of resistance to lateral squeezing as the fibres increase the shear strength of the hydrated bentonite throughout the service life.



3. **Stitch bonded - GCL consists of bentonite powder contained by stitch bonding in the machine direction, which connects the upper and lower geotextiles.**

The degree of resistance to lateral squeezing offered by this structural system is minimal (as the stitching is in one direction only) and will depend on the spacing of the stitching.

The stitched rows are typically spaced between 25mm (e.g. NaBento®) and 100mm (Claymax® 500SP). Stitch spacings greater than 50mm would offer very little resistance to localised lateral squeezing.



Geosynthetic Clay Liners may be placed in situations where the potential for lateral squeezing of bentonite exists (i.e. where differential settlement may occur, side slopes, if the subgrade or cover soil contains stone sized particles).

In these situations a structural system incorporating needlepunching (system 2) will offer the greatest level of protection. Needle-punching provides even confinement of bentonite across the whole panel width, increasing the shear strength and reinforcing the bentonite clay.

SUBJECT:

Alternatives to
Compacted Clay Liners
Leakage Rate Comparisons

FIRST ISSUED:
19/08/96

Technical Note # BNTX002

A Geosynthetic Clay Liner (GCL) such as Bentofix® X1000 can be used to fully, or partially replace a compacted clay liner (CCL) to overcome the difficulties associated with constructing a low permeability, thick clay liner in the field, under strict quality control. In many cases, the clayey material that is locally available will not be suitable as a barrier (see *Technical Note: Compacted Clay Liners - Suitable Clay Types and Design Requirements*).

Bentofix® is manufactured in Australia to stringent quality control standards. The barrier material consists of high grade bentonite powder, which is sourced locally in Australia. The end result being consistently low hydraulic conductivity (10^{-11} m/s), and greatly reduced installation time and cost.

Bentofix® has been shown to be hydraulically equivalent to up to 1 metre of clay (10^{-9} m/s), and when used in a composite liner system with either a CCL or Geomembrane (GM) the reduction in leakage rate is remarkable. Koerner and Daniel 1994, provide a suggested method for assessing the technical equivalency of a GCL to a CCL. In terms of steady flux of water, the required GCL permeability for equivalence to a CCL is given by:

$$(k_{GCL})_{required} = k_{CCL} \times \frac{T_{GCL}}{T_{CCL}} \times \frac{H + T_{CCL}}{H + T_{GCL}}$$

Where T = thickness of layer

H = depth of liquid ponded on the layer

- For equivalence to a 300mm thick compacted clay liner ($k = 10^{-9}$ m/s)

$$(k_{GCL})_{required} = 4.6 \times 10^{-11} \text{ m/s}$$

- For equivalence to a 600mm thick compacted clay liner ($k = 10^{-11}$ m/s)

$$(k_{GCL})_{required} = 3.4 \times 10^{-11} \text{ m/s}$$

The hydraulic conductivity of the Bentofix® range of GCL's is typically ≤ 1 to 5×10^{-11} m/s.

Leakage rates through various liners (Table 1) provided by Giroud *et al* indicate the exceptional performance of GCL's. It should be noted that the leakage rate for HDPE is based on a single 0.1cm² defect (or hole) per 4000m². On-site electrical leak detection work by Laine (1991) reports on average 12 holes per acre with a combined area of approximately 0.097cm², even with strict quality control. Hence small leaks may be an important contributing factor in overall geomembrane performance. The ability of Bentofix® to swell and self heal small holes and punctures provides another distinct advantage.

TABLE 1: Leakage Rate Through Various Liners (in litres per hectare per day)

	Hydraulic Head	
	~ 0.01	~ 0.3
CCL ($k \sim 1 \times 10^{-8}$ m/s) ^a	9000	15000
CCL ($k \sim 1 \times 10^{-9}$ m/s) ^a	900	1500
HDPE Geomembrane ^a	600	3000
Bentofix® X1000 ($k \sim 1 \times 10^{-11}$ m/s, D = 1cm)	17	270

^a. From Giroud *et al* 1994.

1. Koerner R.M & Daniel D.E, "A suggested methodology for assessing the technical equivalency of GCL's to CCL's", Geosynthetic Clay Liners, A.A Balkema, Rotterdam, 1994.
2. Giroud J.P, Badu-Tweneboah K., & Soderman K.L, "Evaluation of Landfill Liners", Fifth International Conference on Geotextiles, Geomembranes and Related Products, Vol 3, pp 981-986, 1994.
3. Laine D.L (1991), "Analysis of pinhole seam leaks located in geomembrane liners using the electrical leak location method", Case Histories, Proc. of Geosynthetic '91, Atlanta, USA, 1; 239-253.



Geofabrics
AUSTRALASIA PTY LTD
A.C.N. 005 479 961

SUBJECT:

Compacted Clay Liners
Suitable Clay Types
& Design Requirements

FIRST ISSUED:
19/08/96

Bentofix® Technical Note

Technical Note # BNTX003

Natural soil barriers containing clay minerals are used extensively to prevent the migration of various leachates and liquids from containment facilities. Clayey barriers vary from thin bentonite liners (1cm thick) to recompacted clay liners (0.9 to 3m thick), or even undisturbed clay deposits in excess of 30 metres thick. Compacted (or re-compacted) Clay Liners (CCLs) have commonly been used in the past due to the availability of soil deposits containing enough clay size particles to provide the required low permeability (hydraulic conductivity) in accordance with standards.

However, the performance of a specific clay as a barrier to municipal, industrial and hazardous wastes cannot be assumed or inferred from permeability estimates alone, especially if measured in a controlled laboratory environment. Hydraulic performance will depend on a number of important factors, including: the method of placement and compaction of the clay, and the clay mineralogy, or more specifically the interaction between the clay minerals and leachate and the resulting effect on hydraulic conductivity.

Compacted Clay Liners (CCLs)

The performance of a CCL will depend on the choice of material (the geological origin, particle size distribution and mineralogy) and the way in which the material is broken up and re-compacted. The EPA (NSW) have proposed the following criteria for a recompacted clay liner in the 1996 *Environmental Guidelines: Solid Waste Landfills*:

A recompacted clay or modified soil liner at least 90 centimetres thick with an in-situ coefficient of permeability of less than 10^{-9} m/s. Successive layers should be of compatible material and each underlying layer should be scoured to prevent excessive permeability due to laminations. The sides should generally have a slope not exceeding a gradient of one vertical to three horizontal in order to allow suitable compaction of the barrier and to facilitate subsequent testing.

In addition, CCL specifications should take into consideration, the following (Rowe *et al* 1995):

1. A hydraulic conductivity of 10^{-10} m/s is probably preferable to 10^{-9} m/s as the

dominant chemical flux mechanism becomes diffusion, as opposed to advection. This leads to better attenuation of contaminants through sorption.

2. Low hydraulic conductivity is usually associated with the presence of clay minerals. Hence a minimum percentage by weight of soil with particle size less than $2\mu\text{m}$ should be specified, along with a plasticity index (PI) and importantly an Activity value ($A_c > 0.3$ typically). Alternatively, a minimum cation exchange capacity (CEC) may be specified.
3. The CCL should be compatible with the leachates to be retained (i.e. hydraulic conductivity should not increase over time when exposed to the leachate).

Clay Minerals and Compatibility

Many natural soils contain two or three different clay minerals, often mixed with quartz, feldspars and carbonates. Interstratification of clay materials is also common, adding to the complexity of soil characterisation procedures. Not all clay minerals are suitable for use in CCL's, hence Rowe *et al* provide the following guidelines:

- Inert clay materials (low activity) with modest CEC, such as chlorite and illite, produce the most reliable CCLs.
- Kaolins are very inert but suffer from very low CEC and relatively high permeability (10^{-7} m/s).
- Vermiculites tend to fix K^+ and NH_4^+ causing reductions in CEC.
- Smectites (e.g. montmorillonite) are susceptible to volume instability due to c-axis contraction and expansion. Volume instability is not usually encountered with GCLs due to the small thickness of the product ($< 1\text{cm}$), and confinement by surcharges and the needlepunching between upper and lower geotextile layers.
- Quantitative mineral analyses and even leachate compatibility testing will be necessary for soils for which no data exists or whose clay mineralogy indicates relatively minor mineral constituents.

Compaction Requirements for CCLs

- In order to construct a CCL that is able to withstand any significant differential settlement or strain, field compaction should be done with the soil wet of optimum moisture content (w_{opt}) and probably close to the plastic limit.

Compaction at around 2% to 4% wet of optimum produces the minimum hydraulic conductivity value for most clayey soils.

- Compaction requires excessive passes with a pad-foot or sheeps-foot roller to break down any clods of soil and eliminate voids. The interface between successive lifts should be scoured to prevent delamination and macro-cracks.
- Many on-site borrow pits contain stratified clayey soil deposits. This non-homogeneity will lead to different w_{opt} , γ_d and k values. Careful control will be required to obtain a uniform field distribution.

Even homogeneous deposits are often variably weathered, leading to the same problem.

- CCLs must be covered immediately and kept moist to prevent volume instability and desiccation. Desiccated sections should be removed, broken up, re-wetted and recompacted.

Alternatives to CCLs

Synthetic barrier systems such as Geosynthetic Clay Liners (GCL) or Geomembranes (GM) provide technically sound, cost effective alternatives to compacted clay, especially when suitable clay material is not locally available.

Leakage rate comparisons between various liner systems are provided in the Technical Note: *Alternatives to Compacted Clay Liners*.

1. Rowe R.K, Quigley R.M, Booker J.R, "Clayey Barrier Systems for Waste Disposal Facilities", E & FN Spon, 1995.

SUBJECT: Geomembrane Protection

FIRST ISSUED
11 / 05 / 97

Introduction

Geomembranes are commonly used as an alternative to compacted clay in low permeability barrier systems. A geomembrane (GM) however is flexible and considerably softer in relation to soil and stone. The potential for impact and puncture damage during installation and for long-term damage to the GM during its service life dictates the need for some form of protection.

Recent efforts to improve lined landfill and containment facilities have focused on increasing the efficiency of leachate collection/removal systems, whilst minimising installation related damage to the liner. However, the pursuit of these two goals are mutually exclusive as the use of larger aggregates in collection systems to minimise clogging leads to increased potential for installation damage to the geomembrane.

The level of protection required and ultimately used usually depends on:

- Physical factors such as
 - ⇒ normal load
 - ⇒ surrounding material size, shape and grading
 - ⇒ subgrade conditions (stiff or yielding, smooth or rough)
- Design Philosophy
 - ⇒ consequences of GM puncture/damage
 - ⇒ cost acceptability

Potential Damage Mechanisms

Geomembrane damage in the short term can generally be attributed to

- placement and installation

- ⇒ scratching due to sliding of GM over subgrade
- ⇒ placement and spreading of cover material
- ⇒ construction equipment traffic. (Figure 1)

- Application of normal load
 - ⇒ placement of waste in landfill
 - ⇒ hydrostatic pressure (filling of dam etc)

Potential long term damage mechanisms include:

- differential settlement induced strains
- stress-cracking / crazing
- creep
- biological and chemical attack.



Figure 1: Construction Equipment on a HDPE Bentofix Composite Liner

Protection Methods

1 Geotextiles (GT).

Geotextiles can be very effective in minimising the occurrence of punctures in a liner by sharp objects and damage due to construction stresses. The use of a GT cushion can also reduce the required geomembrane thickness by increasing the combined puncture resistance.

Important geotextile properties for the function of protection include:

- fabric weight and thickness
- puncture and tear strength
- abrasion resistance.

The same GT used for protection can perform secondary functions such as drainage/leachate collection, filtration, separation and gas relief. Geotextiles can also provide a clean working surface for seaming and testing when placed beneath the geomembrane.

Guidance on the recommended weight for a non-woven geotextile protection layer is offered by several sources including Richardson (1996), who provides a simple recommended design envelope of geotextile weight versus allowable normal pressure. Wilson-Fahmy *et al* (1994) also provide a design

methodology for geotextile selection, again based on allowable pressure and factors relating to the material in contact with the geotextile/geomembrane system (eg. leachate collection stone). Both of these selection methodologies recommend a minimum geotextile weight, which is 400 gsm and 540 gsm respectively. These default geotextile weights may be conservative for stone gradations smaller than 16/32 mm, (both methodologies adopt a factor of safety of 3), however, even very heavy geotextiles will not provide sufficient protection to resist the shearing forces generated when tracked vehicles are aggressively operated over the stone layer.

German protection standards require that localised geomembrane deformation (strains) be limited to 0.25% for critical applications, leading to the use of very thick, expensive protection layers. Often it becomes more viable to consider materials other than geotextiles

2. Soil Protection.

Natural soil layers such as sand or clay are mechanically effective in the protection of GM's. They are also resistant to biological and chemical attack. However, they take up valuable landfill space and are difficult to install on side slopes.

3. Combined Geosynthetic/Soil Layers.

Composite soil/synthetic cushions such as Bentofix X1000 (bentonite sandwiched between two geotextiles then needle-punched) provide superior protection than most light to medium weight geotextiles (Tables 1 and 2). They also combine the benefits of both geotextile and natural soil layers, ie long-term performance, ease of placement and landfill space efficiency.

Table 1: Rough indications for the selection of protection - for collection/drainage layers consisting of 16/32mm gravel.

Waste Height (m)	Geosynthetic	Mass (gsm)
$0 \leq h \leq 2$	non-woven GT	600
$2 \leq h \leq 10$	non-woven GT	1800
$h > 10$	GCL (Bentofix®)	≈ 4200

[Adapted from: Saathoff & Sehrbrock, 1994]

Table 2: Deformation values of different protection layers for a geomembrane - for 16/32 mm gravel and landfill heights of approximately 40m.

Geosynthetic	Mass (gsm)	max %
non-woven GT	1200	> 3.5
non-woven GT	1800	> 1.5
non-woven GT	3000	> 0.5
GCL (Bentofix®)	4200	≈ 0.2

[Adapted from: Saathoff & Sehrbrock, 1994]

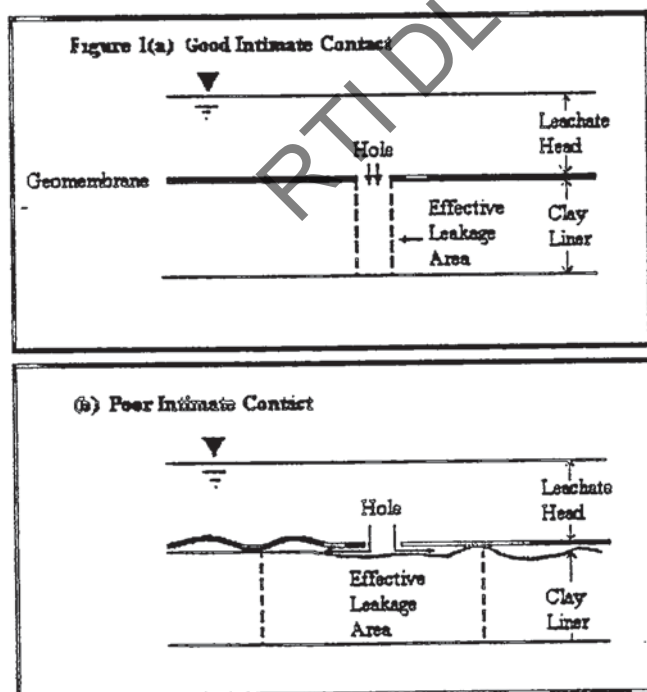
1. Richardson G.N., "Field Evaluation of Geotextile Protection Cushions" - Geotechnical Fabric Report, March 1996.
2. Wilson-Fahmy, R.F, Narejo, D.B. and Koerner, R.M., 1994, "A Design Methodology for Puncture Protection of HDPE Geomembranes", GRI Report #13, Philadelphia, PA, USA, September 1994, 93 p
3. Saathoff & Sehrbrock U., "Indicators for Selection of Protection Layers for Geomembranes", Fifth International Conference on Geotextiles & Related Products.

Introduction

Bentofix® has been shown to perform well when used as the primary and sole liner component in comparison to compacted clay or geomembranes (Technical Note #BNTX002). However, the performance of any liner system can be improved significantly by exploiting the composite action that results from adopting a two component (or composite) system.

Composite liners - in landfill technology generally refer to hydraulic barriers consisting of a synthetic membrane (HDPE, PVC, PP etc.) underlain by a clay-based component such as a compacted clay liners (CCL's) or Bentofix®.

Composite action - describes the synergistic effect on the combined liner systems performance when *intimate contact* is achieved between the components. Figure 1 shows schematically how intimate contact between the liner components can reduce the effective leakage area, which is directly proportional to the leakage rate.



If intimate contact has been achieved then flow through any hole or defect is forced to migrate in a radial configuration. This greatly reduces the net amount of flow through the composite.

Development of 'Intimate Contact' Theories

Recent experiences in the landfill technology industry have highlighted several problems with existing lining methods. One discovery is that compacted clay liners are far more permeable than laboratory testing indicated (Figure 2). This can be attributed to small and large-scale defects in the liner, such as:-

- desiccation cracks
- stress cracks (from settlement)
- inter-lift delamination

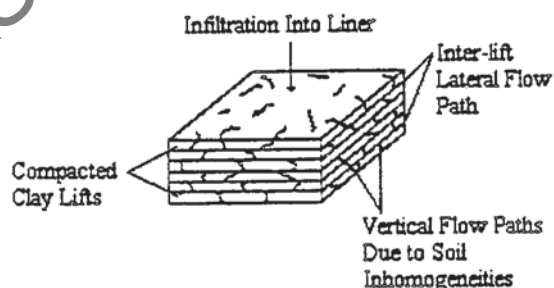


Figure 2: Mechanisms for increased flow through a CCL.

Another discovery is that geomembranes (GM's) usually leak far more than anticipated as a result of small holes and defects that escape even the most stringent quality controls (Laine 1991).

The obvious solution is to use a composite liner system in order to minimise overall leakage and prevent the 'short circuiting' of the CCL or GM that results from the inherent defects in each component. For this to occur in practice, intimate contact between the two components is vital. However, achieving intimate contact in the field between a CCL and GM is not an easy task. Geomembranes undergo significant expansion and contraction during construction as a result of changes in ambient temperatures and exposure to direct sunlight. When a membrane heats up, wrinkles and folds develop across the surface which act as flow channels between the membrane and CCL (Figure 3), eliminating the benefit in adopting a composite system.

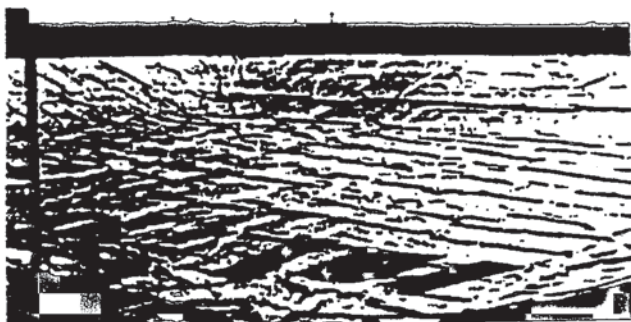


Figure 3: Wrinkles in HDPE liner due to thermal expansion.

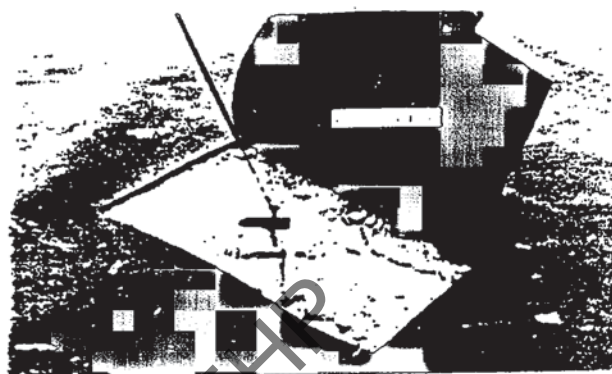


Figure 4: Condensation and desiccation beneath HDPE liner.

Clay Desiccation Beneath Geomembranes.

Immediately after construction the moisture near the surface of a compacted clay layer of a composite liner will begin to evaporate if exposed to high temperatures. The moisture from the clay can condensate on the underside of the geomembrane and migrate to low points along the liner system. Severe desiccation of the CCL can result, as shown in Figure 4. (Basnett and Bruner 1993).

Geomembrane / Bentofix® Composite System.

The *intimate contact* concept cannot be directly applied to geosynthetic clay liners such as Bentofix as GCL's do not possess the preferential flow paths that are common with CCL's (Figure 2). Subsequently leakage rates will never be as great as in the case of a short-circuited compacted clay liner. Thus, the issue of *intimate contact* is not as important for geomembrane/GCL interfaces, and therefore there is less concern over the presence of wrinkles and seams in the geomembrane. Thus in practice and in theory (as shown in leakage rate estimates by Giroud *et al* 1994) a composite system utilising a geosynthetic clay liner such as Bentofix will perform well.

Table 1: Leakage Rate Through Various Liner Systems (in litres per hectare per day)

	Hydraulic Head (m)	
	~ 0.01	~ 0.3
CCL ($k \sim 1 \times 10^{-8}$ m/s) ^a	9000	15000
CCL ($k \sim 1 \times 10^{-9}$ m/s) ^a	900	1500
HDPE Geomembrane ^a	600	3000
Bentofix X1000 ($k \sim 1 \times 10^{-11}$ m/s, D = 1 cm)	17	270
Composite Liner, HDPE & CCL, ($k_{CCL} \sim 1 \times 10^{-9}$ m/s) ^a	0.05	1
Composite Liner, HDPE & GCL, ($k_{GCL} \sim 1 \times 10^{-11}$ m/s) ^a	0.002	0.2

a. From Giroud *et al* 1994.

1. "Technical Note #BNTX002" - Geofabrics Australasia, Pty. Ltd. 1996.
2. Laine D.L, "Analysis of pinhole seam leaks located in geomembrane liners using the electrical leak location method", Case Histories. Proceedings of Geosynthetics '91, Atlanta, USA. 1: 239-253.
3. Basnett C.R. and Bruner R.J, "Clay Desiccation of a Single-Composite Liner System". Geosynthetics '93 - Vancouver, Canada, 1329-1340.



Geofabrics
AUSTRALASIA PTY LTD
A.C.N. 005 478 961

SUBJECT: Landfill Capping Systems

FIRST ISSUED:
13 / 3 / 97

Bentofix®
Technical
Note

Technical Note # BNTX006

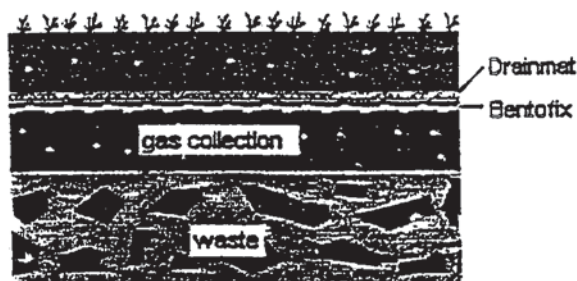
Introduction

With the advent of stringent environmental laws overseas and now in Australia, landfills are now required to have sophisticated base liners and capping systems. The new requirements are often difficult to meet using technologies transferred from older landfill facilities. Owners are now seeking simple and affordable solutions to meet the stricter guidelines that have been implemented.

The main function of the capping system is to separate the waste from the surrounding environment - which prevents disease carriers such as birds and rodents from causing public health problems. It also protects the surrounding groundwater regime from contamination, by controlling rainfall infiltration rates into the waste material. This allows control over leachate generation and the rate at which the waste stabilises.

Modern landfill capping systems usually consist of the following (Fuller 1995):

- a surface layer (including top soil and vegetation)
- a protective layer
- a drainage layer
- a barrier layer
- a gas collection system



Although each layer requires considerable design attention, the focus of this technical note will be on the barrier layer.

Traditional Compacted Clay Caps.

The barrier component of a landfill cap has traditionally been a 0.3 to 1.0m thick compacted clay liner (CCL). CCL's however, have numerous drawbacks in capping applications.

- Constructing a low permeability clay layer involves a high level of quality control over clay suitability, moisture content and compaction techniques (see Bentofix Technical Note BNTX002). Compaction is particularly difficult with a landfill cap due to the underlying waste's low density and high compressibility.
- It has been shown that wet/dry cycles can severely and permanently crack a CCL (Koerner and Daniel 1995), which will leave the cap far more permeable than the designer intended, and render it useless as a barrier to landfill gases. (see Bentofix Technical Note BNTX005).
- The differential settlement that often occurs in municipal and other contained wastes will pose serious problems to CCL's as most clays can only withstand up to about 0.85% strain before cracking as shown in Table 1.

Type of Soil	Water Content %	Plasticity Index %	Failure Tensile Strain %
Clayey Soil	19.9	7	0.80
Bentonite	101	487	3.40
Illite	31.5	34	0.84
Kaolinite	37.6	38	0.16
Portland Dam	16.3	8	0.14
Rector Creek Dam	19.8	16	0.10
Woodcrest Dam	10.2	non-plastic	0.18
Shell Oil Dam	11.2	non-plastic	0.07
Willard Test Emb.	16.4	11	0.20

[source: LaGatta 1992]

- Another drawback in using a CCL lies in the additional landfill volume that it occupies. In many cases an additional space saving in excess of 1 metre (in depth) can be realised by using a Geosynthetic Clay Liner such as Bentofix®.

SUBJECT:**Landfill Capping Systems**

FIRST ISSUED:

13/3/97

Technical Note # BNTX006

page 2

Bentofix® as a Barrier Layer

Bentofix® offers many advantages over traditional compacted clay liners. The extremely low permeability of Bentofix® compared to a CCL, even at low confining pressures encountered in a landfill capping system, significantly reduces the amount of infiltration.

Geosynthetic Clay Liners such as Bentofix® are not permanently damaged by wet/dry or freeze/thaw cycles. This can be attributed to bentonite's high swelling and self-healing capability, coupled with the confinement imposed on the bentonite from the high density of needled fibres passing through all layers of the composite.

Bentofix® is able to withstand far greater differential settlement than CCL's. Research conducted by Koerner *et al* (1996) show 3-Dimensional (out of plane) strains at failure for unconfined needle-punched GCL's to be 15 to 22%. Similar work by LaGatta (1992) confirm GCL hydraulic integrity at strains up to 10 to 15%.

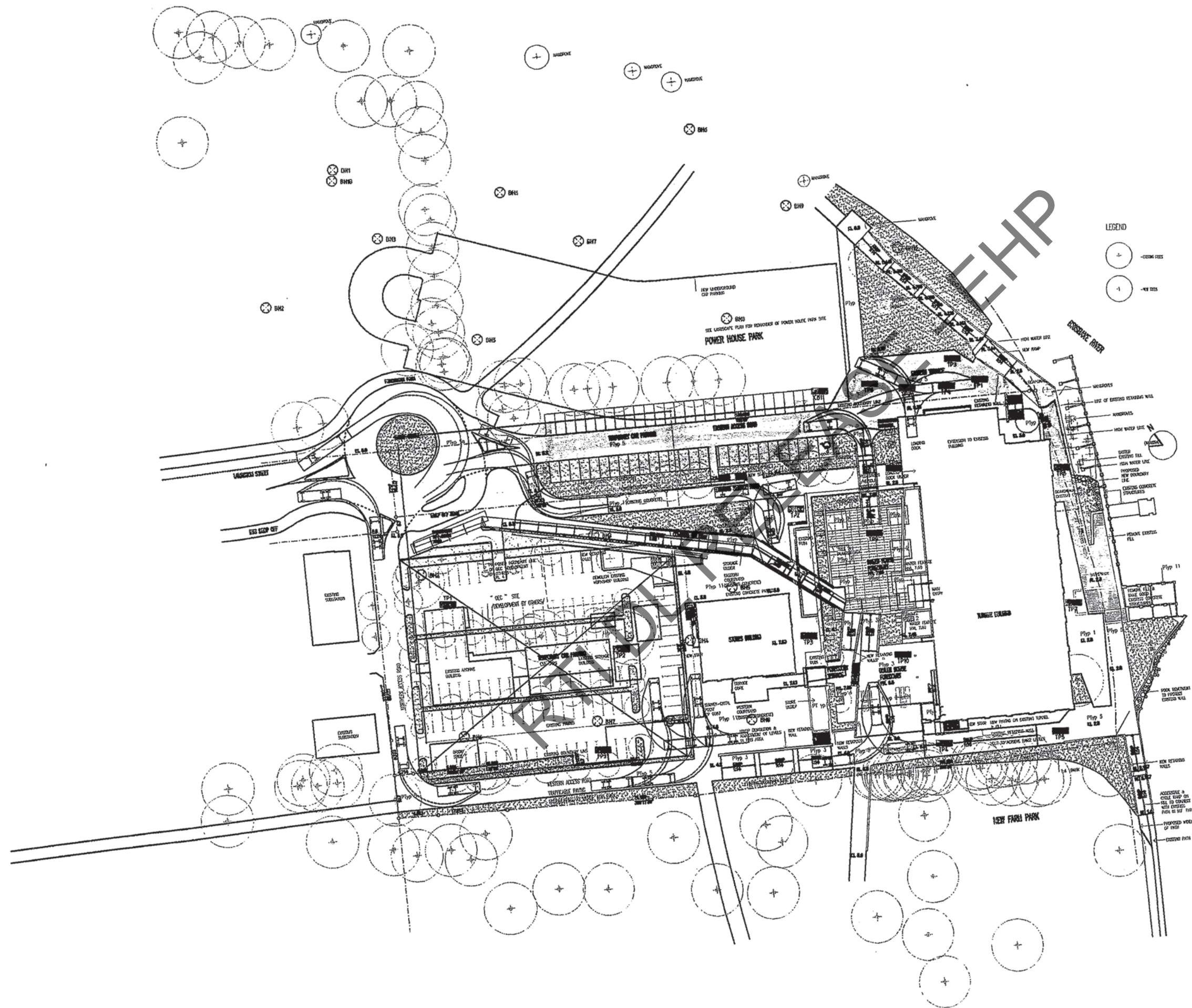
The ability of a GCL to withstand differential settlement, coupled with its ability to absorb and retain high moisture contents, makes it a far superior gas barrier than compacted clay.

Bentofix® also offers many construction benefits. Because Bentofix® is manufactured under controlled conditions, little construction quality assurance is required in comparison to geomembranes and CCL's. The speed and ease of construction with Bentofix® offers significant advantages. Over 5000m² can be placed per day with minimal heavy equipment.

As already mentioned, a GCL offers considerable landfill space saving. This is due to equivalency, in terms of hydraulic flux, to a CCL of around 1 metre thick or more. In addition to this space saving, GCL's can be placed on steeper slopes than most compacted clays, which also increases the potential volume for waste disposal.

Finally, GCL costs are generally competitive with compacted clay after consideration of construction and CQA costs - even if suitable clay is readily available on-site. Thus a GCL is an excellent choice as the barrier component of landfill capping systems, whereas in many cases a compacted clay liner is unsuitable.

1. Fuller J.M., "Landfill cap designs using Geosynthetic Clay Liners", Geosynthetic Clay Liners - edited by Koerner, Gartung and Zanzinger, A.A Balkema Publishers, 1995.
2. "Technical Note #BNTX002" - Geofabrics Australasia Pty. Ltd. 1996.
3. Koerner R.M & Daniel D.E., "A suggested methodology for assessing the technical equivalency of GCL's to CCL's", Geosynthetic Clay Liners, A.A Balkema, Rotterdam, 1995.
4. "Technical Note #BNTX005" - Geofabrics Australasia Pty. Ltd., 1996.
5. LaGatta D.M., "Hydraulic conductivity tests on Geosynthetic Clay Liners subjected to differential settlement", M.S.Thesis, University of Texas at Austin. 1992.
6. Koerner R.M, Koerner G.R, Eberle M.A., "Out-of-plane tensile behaviour of Geosynthetic Clay Liners", Geosynthetics International, Vol3, No.2, 1996.



EASTERN TERRACE,

LEGEND

- BOREHOLE
SOIL RESULT GREATER THAN DEH GUIDELINES
- BOREHOLE
SOIL RESULT LESS THAN DEH GUIDELINES
- TESTPIT
SOIL RESULT GREATER THAN DEH GUIDELINES
- TESTPIT
SOIL RESULT LESS THAN DEH GUIDELINES



FIGURE 1
SITE PLAN - TEST PITS AND BORE
HOLE LOCATIONS
14/12/98

SCALE A 0 10 20 1:500 AT A1

ANNEXURE 1 - SITE MANAGEMENT PLAN

LOT : 101 PLAN : SP102967 FILE REF : 902196 PRINTED: 02/03/1999

DATE OF EFFECT : 23/02/1999

1.0 Summary of Contamination

Lot 101 on SP 102967 was a part of a coal-powered power station facility, (formerly known as the New Farm Power Station site). Material used/generated during the operation of the power station has been used as fill across large areas of the site (including boiler ash and building rubble).

Levels of selected heavy metals (arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), zinc (Zn) and/or mercury (Hg)), Total Petroleum Hydrocarbons (TPHs) and/or Polycyclic Aromatic Hydrocarbons (PAHs) in excess of Department of Environment & Heritage (DEH) Environmental Investigation levels have been identified at various locations across the site. The elevated levels were typically associated with fill material consisting of boiler ash, waste and building rubble. Asbestos cement sheeting/debris was also noted in building rubble in the former boiler house area of the site.

The identified As, Cd, Cu, Zn and Hg concentrations were below DEH health-based investigation levels for parkland, recreational and/or commercial land-use. With the exception of 2 samples, Pb and PAH levels were also within the DEH health-based guidelines for parkland, recreational and/or commercial land use. The elevated TPH levels were predominantly longer chain hydrocarbons and therefore exposure to hydrocarbon vapours or the risk of an explosive gas build up is considered unlikely.

Site layouts showing sample locations (and highlighting locations which contained heavy metal and/or organic compounds above current DEH threshold levels) is presented in Figures 1 & 2.

2.0 Objectives

The objective of the Site Management Plan (SMP) is to manage contamination on Lot 101 on SP 102967 during the site's development and post development in a manner which protects human health and the environment. The objective will be achieved by:

- . Implementation of controls on site excavation, building refurbishment and redevelopment works;
- . Establishment of barriers between users of the site and the contamination (ie site capping);
- . Minimisation of surface water infiltration; and
- . Implementation of monitoring programs.

3.0 Achievement and Management of Objectives

The owner is to ensure the following conditions are complied with in order to achieve and maintain the plan objectives:

3.1 Pre Construction and Construction

3.1.1 With the exception of landscaped garden areas, a capping layer consisting of a concrete slab, bitumen/asphalt paving, compacted clay to a minimum depth of 0.5 m and/or other equivalent impermeable cover is to be installed to maintain a barrier between contamination and site users as well as to minimise water infiltration. The integrity of the capping material is to be maintained to ensure water does not infiltrate through the contaminated zone and prevent/minimise erosion of clay capping layers (where installed).

3.1.2 Landscaped garden areas shall not exceed 10% of the site in area (Figures 1 & 2) and be constructed to ensure that exposure/infiltration to potentially contaminated material is minimised. To this end, gardens shall be constructed on beds of at least 300 mm of clean (imported) top soil (AS4419) on top of a minimum of 300 mm of compacted clay (or other suitable capping material). Measures shall be implemented to ensure that water does not infiltrate through the contaminated zone, (eg. agricultural drainage lines designed to discharge stormwater).

3.1.3 Plants selected for garden bed areas shall be such that the root system does not penetrate the capping material.

3.1.4 The area of land, on Lot 101 on SP 102967, to the east of the former Power Station building and adjacent to the river (including land under the boardwalk) is to be capped as per 3.1.1.

3.1.5 All slopes, batters and retaining walls are to be geotechnically stable and not subject to slumping, or erosion.

3.1.6 Site works relating to excavation, removal and/or disposal of soil must ensure that environmental harm is prevented. To achieve this an Environmental Management Plan (EMP) shall be developed and implemented. The EMP shall detail controls on site works (eg stormwater runoff controls, excavation methodology, dust and noise suppression etc). This plan shall be developed prior to the commencement of site works (upon finalisation of development plans) and be available to the administering authority on request. As a minimum the EMP must consider:

- . the staging of site works to minimise the extent of disturbed areas and to reduce the potential for potentially contaminated runoff to impact surrounding areas;
- . methodologies to control the emission of potentially contaminated dust;
- . stormwater controls around stockpiles and/or excavations to minimise the potential for off-site migration of contaminants;
- . the identification and management of potentially Acid Sulphate Soils;

- . minimising the exposure of humans and the environment to potentially contaminated sub-surface soils during excavation works;
- . controls for material cartage (eg covering loads, wetting material to reduce airborne dust emissions);
- . monitoring of pollution control equipment and new/existing environmental monitoring points and recording of results for review; and
- . documentation of all contaminated soil transport operations including the descriptions of processes, personnel and/or organisations involved and approvals given.

3.1.7 A site specific Workplace Health and Safety Plan (WHASP), satisfying the relevant obligations imposed by the Workplace Health and Safety Act 1997 (or equivalent), shall be developed for the site and shall specifically address exposure to PAHs, asbestos, TPH and heavy metal contaminated soils and/or waters. This WHASP shall be developed prior to the commencement of any civil construction works on-site.

3.1.8 Contaminated soil must not be excavated or removed from the site without adequate sampling and without the prior approval of Administering Authority under Section 118ZZF (or equivalent) of the Environmental Protection Act 1994.

3.1.9 The groundwater monitoring well installed on-site as part of previous site investigation works at location BH 8 (see Figure 2) shall be maintained in an operational condition to allow on-going monitoring of the groundwater aquifer. If damaged the monitoring bore is to be replaced.

3.2 Achievement of Management Objectives - Post Construction (development)

3.2.1 The site capping layer (other than the landscaped garden areas, see Figures 1 & 2), which consists of a concrete slab, bitumen/asphalt paving, compacted clay to a minimum depth of 0.5 m and/or other equivalent impermeable cover is to be maintained in good condition at all times.

3.2.2 Landscaped garden areas, which are not to exceed 10% of the site in area, are to be maintained so that at least 300 mm of clean (imported) top soil (AS4419) overlies a minimum of 300 mm of compacted clay (or other suitable capping material). A water management strategy shall be developed and implemented for the watering of garden beds to ensure that infiltration into potentially contaminated soil is minimised. This watering strategy shall consider watering rates, watering intensity and the design of appropriate drainage points within the gardens. Garden drainage systems are to be maintained in an operational condition.

3.2.3 Plants selected for garden bed areas shall be such that the root system does not penetrate the capping material.

3.2.4 Subsequent open space design changes to the site (ie. increasing the landscaped garden areas to more than 10% of the site area) will require a review of capping/sealing requirements and approval by the Administering Authority.

3.2.5 Contaminated soil must not be excavated or removed from the site without adequate sampling and without the prior approval of the Administering Authority under Section 118ZZF (or equivalent) of the Environmental Protection Act 1994.

3.2.6 Excavations which extend below the capping layer must receive the prior approval of the Administering Authority.

3.2.7 A site specific Workplace Health and Safety Plan (WHASP), satisfying the relevant obligations imposed by the Workplace Health and Safety Act 1997 (or equivalent), shall be developed for the site and shall specifically address exposure to PAHs, asbestos, TPH and heavy metal contaminated soils and/or waters. This WHASP shall be developed prior to the commencement of any approved (refer to 3.2.6) excavation works on-site.

3.2.8 Pollution control equipment, erosion control systems and/or safety equipment installed during the period of the redevelopment and/or the operation of the site to ensure environmental impact is being minimised must be maintained in an operational state.

3.2.9 The groundwater monitoring well installed on-site as part of previous site investigation works at location BH 8 (see Figure 2) shall be maintained in an operational condition to allow on-going monitoring of the groundwater aquifer. If damaged the monitoring bore is to be replaced.

4.0 Monitoring & Reporting

To ensure compliance with the SMP, the owner of the site is to ensure that the following monitoring and reporting requirements are performed.

4.1 Monitoring and Reporting - Pre Construction and Construction

4.1.1 During the pre-construction and construction phases of the development a report is to be submitted on a six monthly basis (and at the completion of the construction phase) to the administering authority detailing the results of all monitoring and compliance with SMP conditions.

4.2 Monitoring and Reporting - Post Construction

4.2.1 An inspection of the site is required at a minimum of every six months to ensure that the SMP conditions have been satisfied.

4.2.2 Written records of details of inspections, monitoring and maintenance programs, site excavations, soil movements and soil disposals are to be documented and available to the Administering Authority on request.

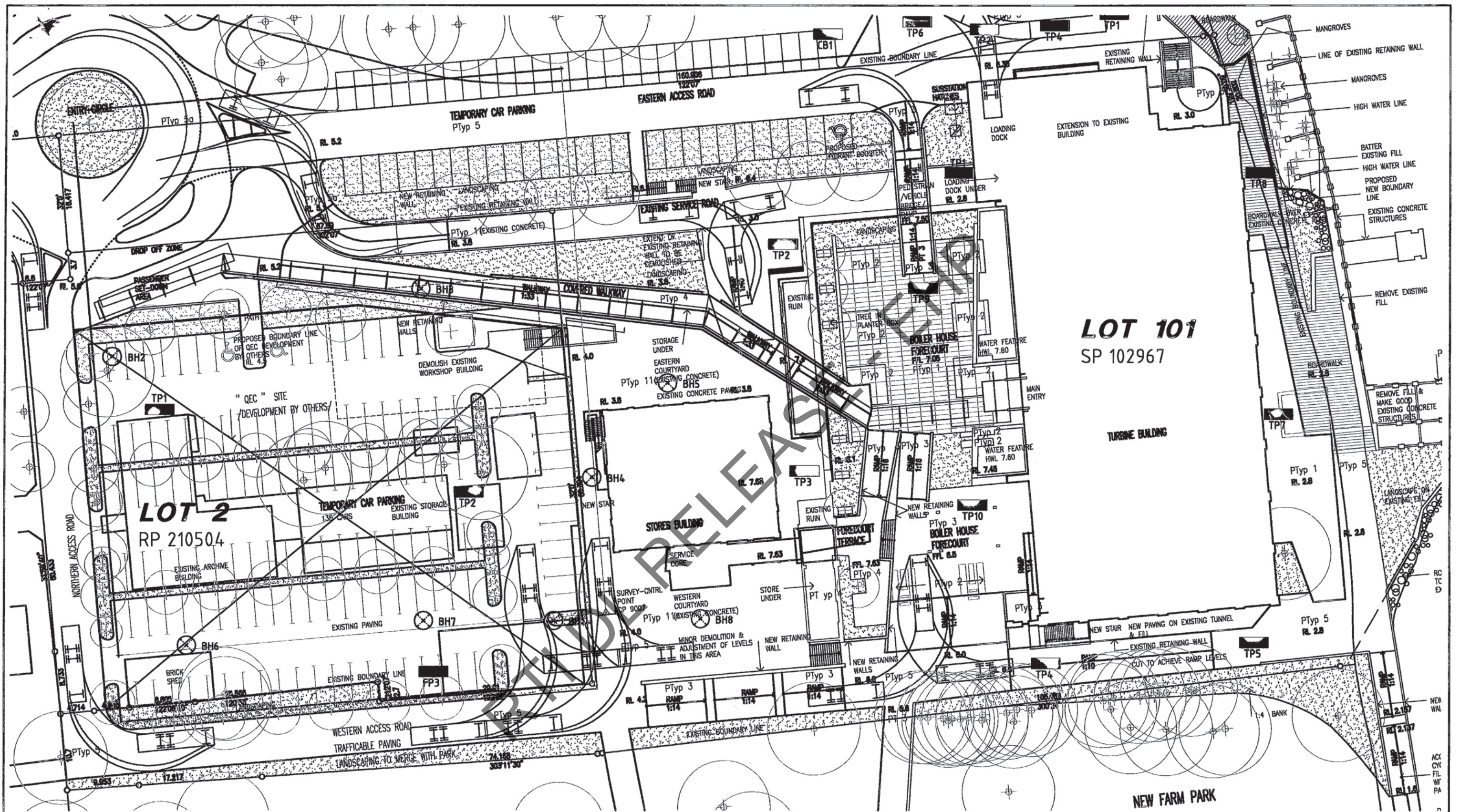
4.2.3 A round of groundwater sampling is to be undertaken from the on-site groundwater monitoring well BH 8 (see Figure 2) prior to 30 November 1999 (Note BH 3 and BH 6 on Lot 2 on RP 210504 should be sampled at the same time - see SMP for

Lot 2 on RP 210504). Samples collected from this initial round of sampling shall be submitted for analysis of TPH, phenol's, PAHs and selected heavy metals (ie. As, Cd, Cr, Cu, Hg, Ni, Pb and Zn). The groundwater monitoring event shall include gauging of the wells (including BH 3 and BH 6- see SMP Lot 2 on RP 210504) and recalculation of the local groundwater flow direction to confirm previous monitoring results. The results shall be provided in a written report to the Adminstrating Authority by 31 December 1999. Based on this round of sampling, subsequent groundwater monitoring and reporting requirements (and the SMP conditions) are to be reassessed by the Administering Authority.

This Site Management Plan makes reference to a plan attachments which are available from the administering authority if required.

NOTE: This Site Management Plan has been developed to manage site contamination present at the issue date. Subsequent uses of the site may result in the need to review this plan.

RTI DL RELEASE - EHP



LEGEND

- ⊗ BH1 BOREHOLE
SOIL RESULT GREATER THAN ADMINISTRATING
AUTHORITY INVESTIGATION GUIDELINES
- ⊗ BH2 BOREHOLE
SOIL RESULT LESS THAN ADMINISTRATING
AUTHORITY INVESTIGATION GUIDELINES
- RP BOUNDARY

- TP1 TESTPIT
SOIL RESULT GREATER THAN ADMINISTRATING
AUTHORITY INVESTIGATION GUIDELINES
- TP2 TESTPIT
SOIL RESULT LESS THAN ADMINISTRATING
AUTHORITY INVESTIGATION GUIDELINES



FIGURE 2

SITE PLAN - LOT 101, SP 102967

SCALE 1:250 AT A1



QUEENSLAND GOVERNMENT

**Department of
Environment and Heritage**

SUITABILITY STATEMENT

DATE PRINTED: 25/02/1999

OWNER

BRISBANE CITY COUNCIL
GPO BOX 1434
BRISBANE 4001

DATE OF ISSUE : 23/02/1999

PROPERTY DESCRIPTION

LOT : 2 PLAN : RP210504
119 LAMINGTON STREET
NEW FARM 4005

BRISBANE CITY COUNCIL
EMR Site ID: 926 FILE REFERENCE: 902196

FINAL SUBMISSION RECEIVED ON: 02/02/1999

**STUDIES UNDERTAKEN BY APPLICANT OR REQUESTED BY
DIRECTOR**

Preliminary Site Investigation New Farm Power Station, prepared by Brisbane City Council Scientific Services Branch, dated September 1993.

Preliminary Site Assessment on QTC Site - New Farm, prepared by Woodward-Clyde, dated 13 March 1997 (doc no. A3200900001).

Environmental Site Assessment of New Farm Power Station, New Farm, prepared by PPK Environment and Infrastructure Pty Ltd, dated September 1997 (doc no. 84j153B/PR002A1sr).

Environmental Site Assessment - Lot 2 on RP 210504, New Farm Power Station, Lamington Road, New Farm, Queensland, prepared by PPK Environment and Infrastructure Pty Ltd, dated April 1998 (doc no. 84K043A-PR001Ajf).

Additional Site Assessment Works, Former New Farm power Station, prepared by PPK Environment and Infrastructure Pty Ltd, dated 6 November 1998 (doc no. 84K109B-LT002Act:sysg).

Analytical Results - New Farm Power Station Coal Bunker, prepared by PPK Environment and Infrastructure Pty Ltd, dated 4 August 1998 (doc no. 84J248A).

Daft Site Management Plans for Lot 101 and Lot 2, prepared by PPK Environment and Infrastructure, dated 25 January 1999.

Additional information in correspondence via e-mail from PPK Environment and Infrastructure Pty Ltd dated 23 December 1998, 14,18 and January 1999.

Additional information in correspondence from Brisbane City Council dated 2 February 1999.

STATEMENT OF SUITABILITY

On the basis of the information supplied to this Department, the subject site is suitable for the following use(s) providing the site is used and managed as per the Site Management Plan attached as Annexure 1.

Commercial and recreational use (including arts and cultural centre).

Other specific uses may be suitable for the site, please contact this Department for further advice. The suitability statement provides information on appropriate land uses at the date of effect. Subsequent uses of the site for notifiable activities or for situations where a hazardous contaminant is released into the soil may result in the need to review suitable uses or amend the attached site management plan.

ENVIRONMENTAL MANAGEMENT REGISTER

LOT : 2 PLAN : RP210504 is recorded on the Environmental Management Register with a Site Management Plan. A copy of the Site Management Plan is attached as Annexure 1.

sch4p4 (6) Personal information

Dr Dagogo Ibiebele

Manager, Hazardous Waste and Contaminated Sites Section

ANNEXURE 1 - SITE MANAGEMENT PLAN

LOT : 2 PLAN : RP210504 FILE REF : 902196 PRINTED: 23/02/1999

DATE OF EFFECT : 23/02/1999

1.0 Summary of Contamination

Lot 2 on RP 210504 was formerly used for the purpose of power distribution. Waste material from the adjacent New Farm Power Station site has been used as fill material on this land parcel. As a consequence, fill consisting mostly of boiler ash, was deposited across much of the site.

Levels of selected heavy metals (arsenic, chromium, copper, lead and zinc) and/or Total Petroleum Hydrocarbons (TPH) in excess of Administrating Authority Environmental Investigation level were reported in soils in the northern corner, south western boundary, centre and south eastern boundary of Lot 2, RP 210504 (the QTSC site).

The contaminated material was present at depths between 0.2 and 2.0 metres below ground level (mBGL), and was associated with fill material (consisting of ash and/or wood) and/or natural silty clay. This fill material was typically overlain by concrete between 0.2 and 0.5 m in thickness. Groundwater samples, collected during March 1998, did not report contaminant levels greater than current regulatory threshold criteria.

With the exception of one reported lead level, all elevated heavy metal concentrations were within currently proposed Administrating Authority health-based investigation thresholds for parkland, recreational and/or commercial land-use. The elevated TPH levels were predominantly longer chain hydrocarbons and therefore exposure to hydrocarbon vapours or the risk of an explosive gas build up is considered unlikely.

Site layouts showing sample locations (and highlighting locations which contained heavy metal and/or organic compounds above current Administrating Authority thresholds) is presented in Figures 1 & 2.

2.0 Objectives

The objective of the Site Management Plan is to manage contaminants identified on Lot 2 on RP 210504 in such a manner as to minimise potential human health and/or environmental effects during construction and post construction phases of the development. This shall be achieved through:

- . Implementation of controls on site excavation, building refurbishment and redevelopment works;

- . Establishment of barriers between users of the site and the contamination (ie. site capping);
- . Minimisation of surface water infiltration; and
- . Implementation of monitoring programs.

3.0 Achievement and Management of Objectives

The owner is to ensure the following conditions are complied with in order to achieve and maintain the plan objectives.

3.1 Pre Construction and Construction

3.1.1 With the exception of landscaped garden areas, a capping layer consisting of a concrete slab, bitumen/asphalt paving, compacted clay to a minimum depth of 0.5 m and/or other equivalent impermeable cover is to be installed to maintain a barrier between contamination and site users as well as to minimise water infiltration. The integrity of the capping material is to be maintained to ensure water does not infiltrate through the contaminated zone and prevent/minimise erosion of clay capping layers (where installed).

3.1.2 Landscaped garden areas shall not exceed 10% of the site in area (Figures 1 & 2) and be constructed to ensure that exposure/infiltration to potentially contaminated material is minimised. To this end, gardens shall be constructed on beds of at least 300 mm of clean (imported) top soil (AS4419) on top of a minimum of 300 mm of compacted clay (or other suitable capping material). Measures shall be implemented to ensure that water does not infiltrate through the contaminated zone, (eg. agricultural drainage lines designed to discharge stormwater).

3.1.3 Plants selected for garden bed areas shall be such that the root system does not penetrate the capping material.

3.1.4 All slopes, batters and/or retaining walls are to be geotechnically stable and not subject to slumping, or erosion.

3.1.5 Groundwater monitoring wells installed on-site as part of previous site investigation works at locations BH 3 and BH 6 (see Figure 2) shall be maintained in an operational condition to allow on-going monitoring of the groundwater aquifer. If damaged the monitoring bores are to be replaced.

3.1.6 Site works relating to excavation, removal and/or disposal of soil must ensure that environmental harm is prevented. To achieve this an Environmental Management Plan (EMP) shall be developed and implemented. The EMP shall detail controls on site works (eg stormwater runoff controls, excavation methodology, dust and noise suppression etc). This plan shall be developed prior to the commencement of site works (upon finalisation of development plans) and be available to the administering authority on request. As a minimum the EMP must consider:

- . the staging of site works to minimise the extent of disturbed areas and to reduce the potential for potentially contaminated runoff to impact surrounding areas;
- . methodologies to control the emission of potentially contaminated dust;
- . stormwater controls around stockpiles and/or excavations to minimise the potential for off-site migration of contaminants;
- . the identification and management of potentially Acid Sulphate Soils;
- . minimising the exposure of humans and the environment to potentially contaminated sub-surface soils during excavation works;
- . controls for material cartage (eg covering loads, wetting material to reduce airborne dust emissions;
- . monitoring of pollution control equipment and new/existing environmental monitoring points and recording of results for review; and
- . documentation of all contaminated soil transport operations including the descriptions of processes, personnel and/or organisations involved and approvals given.

3.1.7 A site specific Workplace Health and Safety Plan (WHASP), satisfying the relevant obligations imposed by the Workplace Health and Safety Act 1997 (or equivalent), shall be developed for the site and shall specifically address exposure to PAHs, asbestos, TPH and heavy metal contaminated soils and/or waters. This WHASP shall be developed prior to the commencement of any civil construction works on-site.

3.1.8 Contaminated soil must not be excavated or removed from the site without adequate sampling and without the prior approval of Administering Authority under Section 118ZZF of the Environmental Protection Act 1994 (or equivalent).

3.2 Achievement of Management Objectives - Post Construction (development)

3.2.1 The site capping layer (other than the landscaped garden areas, see Figures 1 & 2), which consists of a concrete slab, bitumen/asphalt paving, compacted clay to a minimum depth of 0.5 m and/or other equivalent impermeable cover is to be maintained in good condition at all times.

3.2.2 Landscaped garden areas, which are not to exceed 10% of the site in area, are to be maintained so that at least 300 mm of clean (imported) top soil (AS4419) overlies a minimum of 300 mm of compacted clay (or other suitable capping material). A water management strategy shall be developed and implemented for the watering of garden beds to ensure that infiltration into potentially contaminated soil is minimised. This watering strategy shall consider watering rates, watering intensity and the design of appropriate drainage points within the gardens. Garden drainage systems are to be maintained in an operational condition.

3.2.3 Plants selected for garden bed areas shall be such that the root system does not penetrate the capping material.

3.2.4 Subsequent open space design changes to the site (ie. increasing the landscaped garden areas to more than 10% of the site area) will require a review of capping/sealing requirements and approval by the Administering Authority.

3.2.5 Contaminated soil must not be excavated or removed from the site without adequate sampling and without the prior approval of the Administering Authority under Section 118ZZF (or equivalent) of the Environmental Protection Act 1994.

3.2.6 Excavations which extend below the capping layer must receive the prior approval of the Administering Authority.

3.2.7 A site specific Workplace Health and Safety Plan (WHASP), satisfying the relevant obligations imposed by the Workplace Health and Safety Act 1997 (or equivalent), shall be developed for the site and shall specifically address exposure to PAHs, asbestos, TPH and heavy metal contaminated soils and/or waters. This WHASP shall be developed prior to the commencement of any approved (refer to 3.2.6) excavation works on-site.

3.2.8 Pollution control equipment, erosion control systems and/or safety equipment installed during the period of the redevelopment and/or the operation of the site to ensure environmental impact is being minimised must be maintained in an operational state.

3.2.9 Groundwater monitoring wells installed on-site as part of previous site investigation works (BH 3 and BH 6 see Figure 2) shall be maintained in an operational condition to allow on-going monitoring of the groundwater aquifer. If damaged the monitoring bores are to be replaced..

4. Monitoring & Reporting

To ensure compliance with the SMP, the owner of the site is to ensure that the following monitoring and reporting requirements are performed.

4.1 Monitoring and Reporting - Pre Construction and Construction

4.1.1 During the pre-construction and construction phases of the development a report is to be submitted on a six monthly basis (and at the completion of the construction phase) to the administering authority detailing the results of all monitoring and compliance with SMP conditions.

4.2 Monitoring and Reporting - Post Construction

4.2.1 An inspection of the site is required at a minimum of every six months to ensure that the SMP conditions have been satisfied.

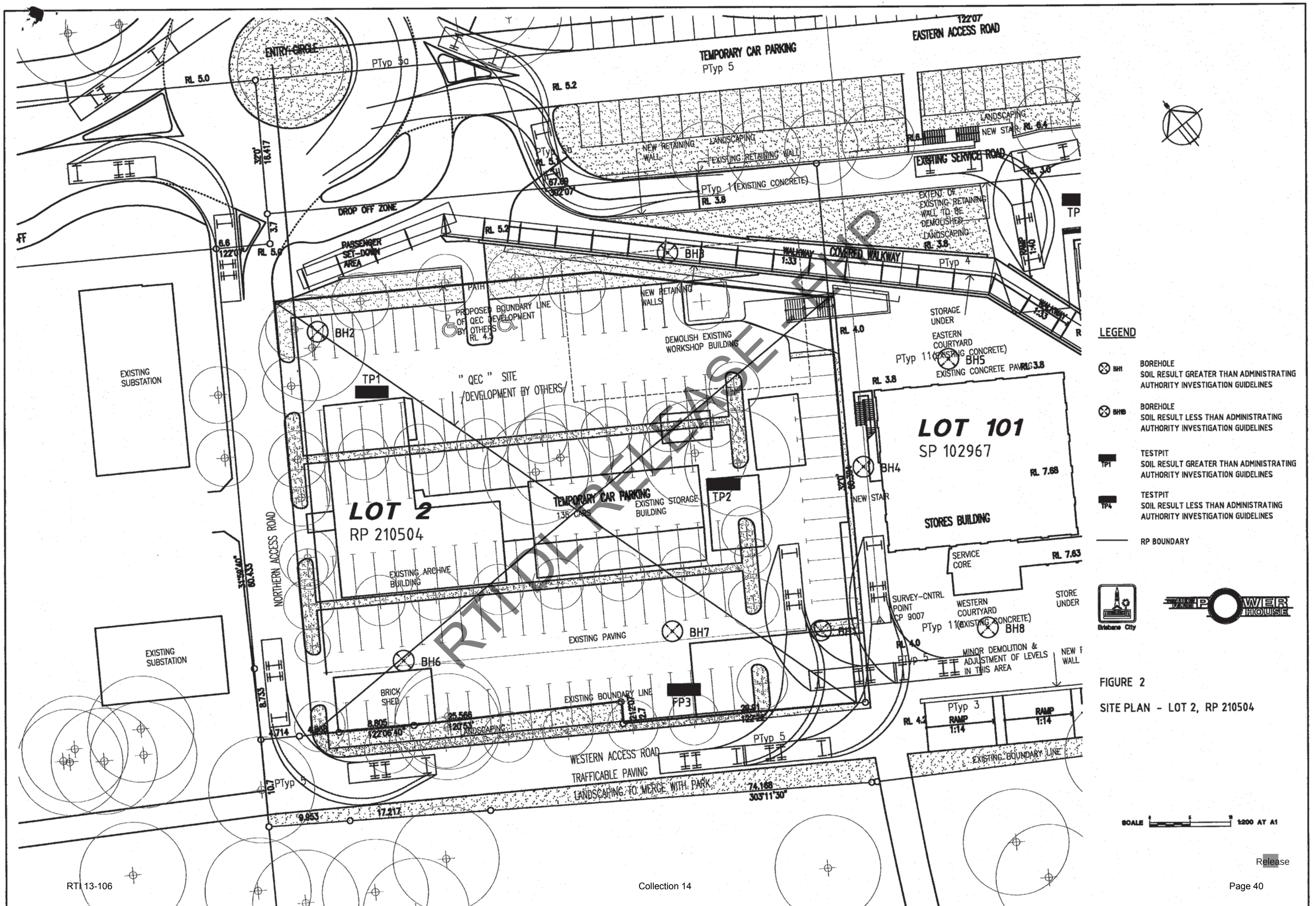
4.2.2 Written records of details of inspections, monitoring and maintenance programs, site excavations, soil movements and soil disposals are to be documented and a available to the Administering Authority on request.

4.2.3 A round of groundwater sampling is to be undertaken from on-site groundwater monitoring wells (denoted as BH3 and BH6) prior to 30 November 1999 (Note BH 8 on Lot 101 on SP 102967 should be sampled at the same time - see SMP for Lot 101 on SP 102967). Samples collected from this initial round of sampling shall be submitted for analysis of TPH, phenols, PAHs and selected heavy metals (ie. As, Cd, Cr, Cu, Hg, Ni, Pb and Zn). The groundwater monitoring event shall include gauging of the wells (including BH 8 - see SMP Lot 101 on SP102967) and recalculation of the local groundwater flow direction to confirm previous monitoring results. The results shall be provided in a written report to the Administating Authority by 31 December 1999. Based on this round of sampling, subsequent groundwater monitoring and reporting requirements (and the SMP conditions) are to be reassessed by the Administering Authority.

This Site Management Plan makes reference to a plan attachments which are available from the administering authority if required.

NOTE: This Site Management Plan has been developed to manage site contamination present at the issue date. Subsequent uses of the site may result in the need to review this plan.

RTI DL RELEASE EHP



Site Id: 140-036176

Site Name: FUEL STORAGE, NEW FARM

Official Authorisation for CSR Site: Y

Local Government: BRISBANE CITY

Category: PRO

Entry Date: 09/10/95

Last Altered: 09/06/1998

Location: 78 LAMINGTON STREET
NEW FARM
4005

Lot: 2 on Plan RP53157

Tenure:

Owner: COLONIAL SUGAR REFINING CO LTD
GPO BOX 54
BRISBANEQLD
4001Zoning: IND
Current Use: 117
Prescribed Purpose: 3517
File: 902196Area: 51530 ha/s
Past Use: 117

UXO region:

Contaminants:

Action Officer:

Vol:

Comments:

UNK
NILStatus: A
Folio: 0000NOTIFICATION BY CSR LIMITED - NEW FARM RECEIVED
04.09.95. FUEL STORAGE ON THIS LOT CONFIRMED BY
FAX FROM CSR LIMITED ON 18.09.95. 2 ABOVEGROUND
20,000 LITRE LIGHT FUEL OIL TANKS; 1 ABOVEGROUND
4,000 LITRE DIESEL TANK AND 1 ABOVEGROUND 7,500
LITRE LPG TANK.-09.09.95-DOH.//

** END OF REPORT **



QUEENSLAND

Date 27/05/98

DEPARTMENT OF ENVIRONMENT

Receipt No. 54915

Received From .. PPK ENVIRONMENT & INFRASTRUCTU Amount.... 900.00
Cheque Details
Bank..... WBC Chq. No..... 403708
Place..... BRISBANE
Particulars..... CONTAM. SITE REPORT
4SRWM176 EH210 900.00

Cashier.... MER Per Authorised Accounting Officer sch4p4(6) Personal Information

Cheques or other negotiable instruments accepted subject to clearance

RTI DL RELEASE - EHP



CURRENT TITLE SEARCH

DEPT. OF NATURAL RESOURCES, QUEENSLAND

Request No: 543406
Search Date: 19/05/1998 4:12 pm

Title Reference: 12082184
Date Created: 28/08/1939

Previous Title: 11636018

REGISTERED OWNER

BRISBANE CITY COUNCIL

ESTATE AND LAND

Estate in Fee Simple

LOT 1 REGISTERED PLAN 53157
 County of STANLEY Parish of NORTH BRISBANE

EASEMENTS, ENCUMBRANCES AND INTERESTS

1. Rights and interests reserved to the Crown by
Deed of Grant No. 11503129 (POR 365)
Deed of Grant No. 11526173 (POR 366)
Deed of Grant No. 19549044 (ESA 30)
2. EASEMENT IN GROSS No 602041065 (K45786P) 20/09/1989
BURDENING THE LAND
TO THE SOUTH EAST QUEENSLAND ELECTRICITY BOARD
OVER EASEMENT B ON RP210500

ADMINISTRATIVE ADVICES - NIL
UNREGISTERED DEALINGS - NIL

CERTIFICATE OF TITLE ISSUED - Yes

Certificate No. 1

Caution - Charges do not necessarily appear in order of priority

** End of Current Title Search **

Requested By: External Token

COMPUTER FOLIO SEARCH

The Registrar of Titles hereby certifies that at the date and time specified in the statement of the computer folio search on the reverse side hereof -

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- 2 At the time of this Search Statement where the statement contains a section headed **REGISTERED OWNER** the person/corporation described in that section is the registered owner of an estate in fee simple [or such other estate or interest as is set forth in that section] in the land or lot so described, subject to such easements, encumbrances and interests as appear in the section headed **EASEMENTS, ENCUMBRANCES AND INTERESTS**.
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CURRENT TITLE SEARCH

DEPT. OF NATURAL RESOURCES, QUEENSLAND

Request No: 543406
Search Date: 19/05/1998 4:12 pm

Title Reference: 12082185
Date Created: 28/08/1939

Previous Title: 11636018

REGISTERED OWNER

THE COLONIAL SUGAR REFINING COMPANY LIMITED

ESTATE AND LAND

Estate in Fee Simple

LOT 2 REGISTERED PLAN 53157
County of STANLEY Parish of NORTH BRISBANE

EASEMENTS, ENCUMBRANCES AND INTERESTS

1. Rights and interests reserved to the Crown by
Deed of Grant No. 11503129 (POR 365)
Deed of Grant No. 19549044 (ESA 30)

ADMINISTRATIVE ADVICES

Dealing	Type	Lodgement Date	Status
AS14113N	HERITGE SITE	15/09/1993 00:00	CURRENT
	DEP EVR/HERITAGE		
	FILE NO 600261		

UNREGISTERED DEALINGS - NIL

CERTIFICATE OF TITLE ISSUED - Yes

Certificate No. 1

Caution - Charges do not necessarily appear in order of priority

** End of Current Title Search **

Requested By: External Token

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CURRENT TITLE SEARCH

DEPT. OF NATURAL RESOURCES, QUEENSLAND

Request No: 543406

Search Date: 19/05/1998 4:12 pm

Title Reference: 17403132

Date Created: 09/10/1989

Previous Title: 10739127
10739141
10798042
10839147
11636016
11732074
11740234
11823110

REGISTERED OWNER

Dealing No: 702029297 12/06/1997

BRISBANE CITY COUNCIL

ESTATE AND LAND

Estate in Fee Simple

LOT 2 REGISTERED PLAN 210504
County of STANLEY Parish of NORTH BRISBANE

EASEMENTS, ENCUMBRANCES AND INTERESTS

1. Rights and interests reserved to the Crown by
Deed of Grant No. 11526174 (POR 369)
Deed of Grant No. 11823110 (POR 395)
Deed of Grant No. 19549044 (ESA 30)
Deed of Grant No. 19549045 (ESA 29)
2. EASEMENT IN GROSS No 601899975 (K194951W) 28/02/1990
BURDENING THE LAND
TO THE SOUTH EAST QUEENSLAND ELECTRICITY BOARD
OVER EASEMENT A ON RP219754
3. LEASE No 601899976 (L347050T) 22/01/1993
OF PART OF THE LAND
TO BRISBANE CITY COUNCIL
ORIGINAL TERM: COMMENCING 01 JAN 1992
TERMINATING 31 DEC 1994
OR OPTIONS AS MAY BE STATED

ADMINISTRATIVE ADVICES - NIL

UNREGISTERED DEALINGS - NIL

CERTIFICATE OF TITLE ISSUED - No

COMPUTER FOLIO SEARCH

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CURRENT TITLE SEARCH

DEPT. OF NATURAL RESOURCES, QUEENSLAND

Request No: 543406

Search Date: 19/05/1998 4:12 pm

Title Reference: 17403132

Date Created: 09/10/1989

Caution - Charges do not necessarily appear in order of priority

** End of Current Title Search **

Requested By: External Token

RTI DL RELEASE - EHP

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DEPT. OF NATURAL RESOURCES, QUEENSLAND

Request No: 543406

Search Date: 19/05/1998 4:12 pm

Title Reference: 17403131

Date Created: 09/10/1989

Previous Title: 11636016
11740234
11823110

REGISTERED OWNER

BRISBANE CITY COUNCIL

ESTATE AND LAND

Estate in Fee Simple

LOT 3 REGISTERED PLAN 210504
County of STANLEY Parish of NORTH BRISBANE

EASEMENTS, ENCUMBRANCES AND INTERESTS

1. Rights and interests reserved to the Crown by
Deed of Grant No. 11526174 (POR 369)
Deed of Grant No. 11823110 (POR 395)
Deed of Grant No. 19549044 (ESA 30)
Deed of Grant No. 19549045 (ESA 29)
Deed of Grant No. 19549046 (ESA 28)
2. LEASE No 602204268 (JL55010M) 16/01/1987
OF PART OF THE LAND
TO EMMIE MARIE CORNELIUS, EDNA PEARL KARGER, ALAN STEWART
ORIGINAL TERM: COMMENCING 01 JAN 1987
TERMINATING 31 DEC 1991
OR OPTIONS AS MAY BE STATED
3. SURVEY PLAN No 602204269 (K45776G) 20/09/1989
THE WITHIN LAND IS SURVEYED INTO
EASEMENT B ON RP218281
4. EASEMENT IN GROSS No 602204270 (K45780Y) 20/09/1989
BURDENING THE LAND
TO THE SOUTH EAST QUEENSLAND ELECTRICITY BOARD
OVER EASEMENT A ON RP218281
5. LEASE No 602204271 (L407850B) 12/03/1993
OF PART OF THE LAND
TO JEAN GABRIEL HAMDAD
ORIGINAL TERM: COMMENCING 01 OCT 1991
TERMINATING 30 SEP 1996
OR OPTIONS AS MAY BE STATED

COMPUTER FOLIO SEARCH

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CURRENT TITLE SEARCH

DEPT. OF NATURAL RESOURCES, QUEENSLAND

Request No: 543406

Search Date: 19/05/1998 4:12 pm

Title Reference: 17403131

Date Created: 09/10/1989

EASEMENTS, ENCUMBRANCES AND INTERESTS (Continued)

6. LEASE No 701288688 01/05/1996 at 15:17
to
OPTUS MOBILE PTY LIMITED
Term commencing
15/04/1994
Terminating
14/04/1999
over part of the land
7. LEASE No 701288697 01/05/1996 at 15:18
to
OPTUS MOBILE PTY LIMITED
Term commencing
15/04/1999
Terminating
14/04/2004
over part of the land
8. LEASE No 701288703 01/05/1996 at 15:19
to
OPTUS MOBILE PTY LIMITED
Term commencing
15/04/2004
Terminating
14/04/2009
over part of the land
9. LEASE No 701288706 01/05/1996 at 15:20
to
OPTUS MOBILE PTY LIMITED
Term commencing
15/04/2009
Terminating
14/04/2014
over part of the land
10. LEASE No 701884252 26/03/1997 at 09:48
MERTHYR CROQUET CLUB INC
PART OF THE LAND,
LEASE NO.L96613W IS SURRENDERED BY OPERATION OF LAW.

ADMINISTRATIVE ADVICES - NIL
UNREGISTERED DEALINGS - NIL

CERTIFICATE OF TITLE ISSUED - No

COMPUTER FOLIO SEARCH

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CURRENT TITLE SEARCH

DEPT. OF NATURAL RESOURCES, QUEENSLAND

Request No: 543406

Search Date: 19/05/1998 4:12 pm

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Date Created: 09/10/1989

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Requested By: External Token

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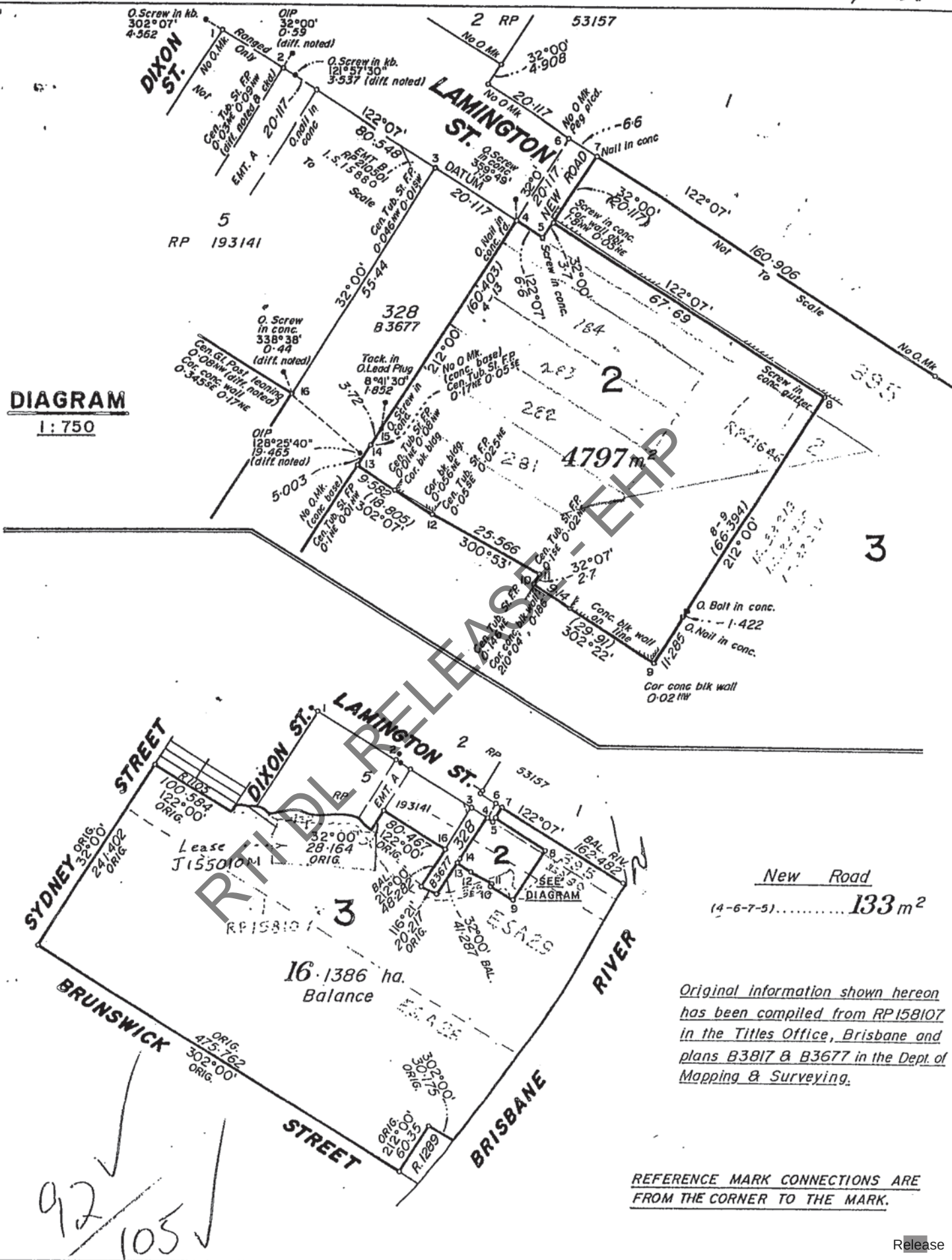


Registrar of Titles

PLAN MUST BE DRAWN WITHIN BLUE LINES

210504

DIAGRAM
1:750



Original information shown hereon
has been compiled from RP158107
in the Titles Office, Brisbane and
plans B3817 & B3677 in the Dept. of
Mapping & Surveying.

REFERENCE MARK CONNECTIONS ARE
FROM THE CORNER TO THE MARK.

Release

(NO. FIELD NOTES LODGED) ORIGINAL GRANT E.S.As 28-30(31/7/1844) 110664 (Per. 369) 117350 (Per. 395)		PLAN OF LOTS 2 & 3 Cancelling Lots 281-284 on RP 8740, Lots 1 & 2 on RP 41646, Lot 1 on RP 158107, and Lot 395 on RP 158107		ORIG. PORTIONS 369, 395. TOWN CITY OF BRISBANE PARISH NORTH BRISBANE COUNTY STANLEY	
MAP REF.		SURVEYED BY W. MITCHELL 28. 8. 87		SCALE 1:4000	
PROCLAIMED SURVEY AREA		MERIDIAN (m)		REGISTERED PLAN - 210504	

210504



PLANS AND DOCUMENTS
referred to in the
APPROVAL dated 8/5/98

Proposed Lot 1 1.0756 ha
Proposed Lot 2 15.063 ha
Original Lot 3 16.1386 ha

Title Ref - 17403131



Brisbane City
RTI 13-106

Project Name

PROPOSED SUBDIVISION

Lots 1 & 2 CANCELLING Lot 3 on RP.210504

Original Pors. 369 & 395, Original Suburban Allots. 28-30
Parish of North Brisbane



Scale 1 : 2500

Drawn by 6) Personal information

Search No. 1388

Instructions by: Susan Beale
City Design Architects

CADD Ref: 364.dra

SYMBOL FILE # L:\CITY_DES\SYM\CTDES98

CITY DESIGN TECHNICAL SERVICES

3rd Floor T.C. Beirne Centre
315 Brunswick St Mall. 4006.
N.Owen. ph.(07)34030452 fax.(07)34030438

Project / Plan No.

364-21

Amend.

A

19189

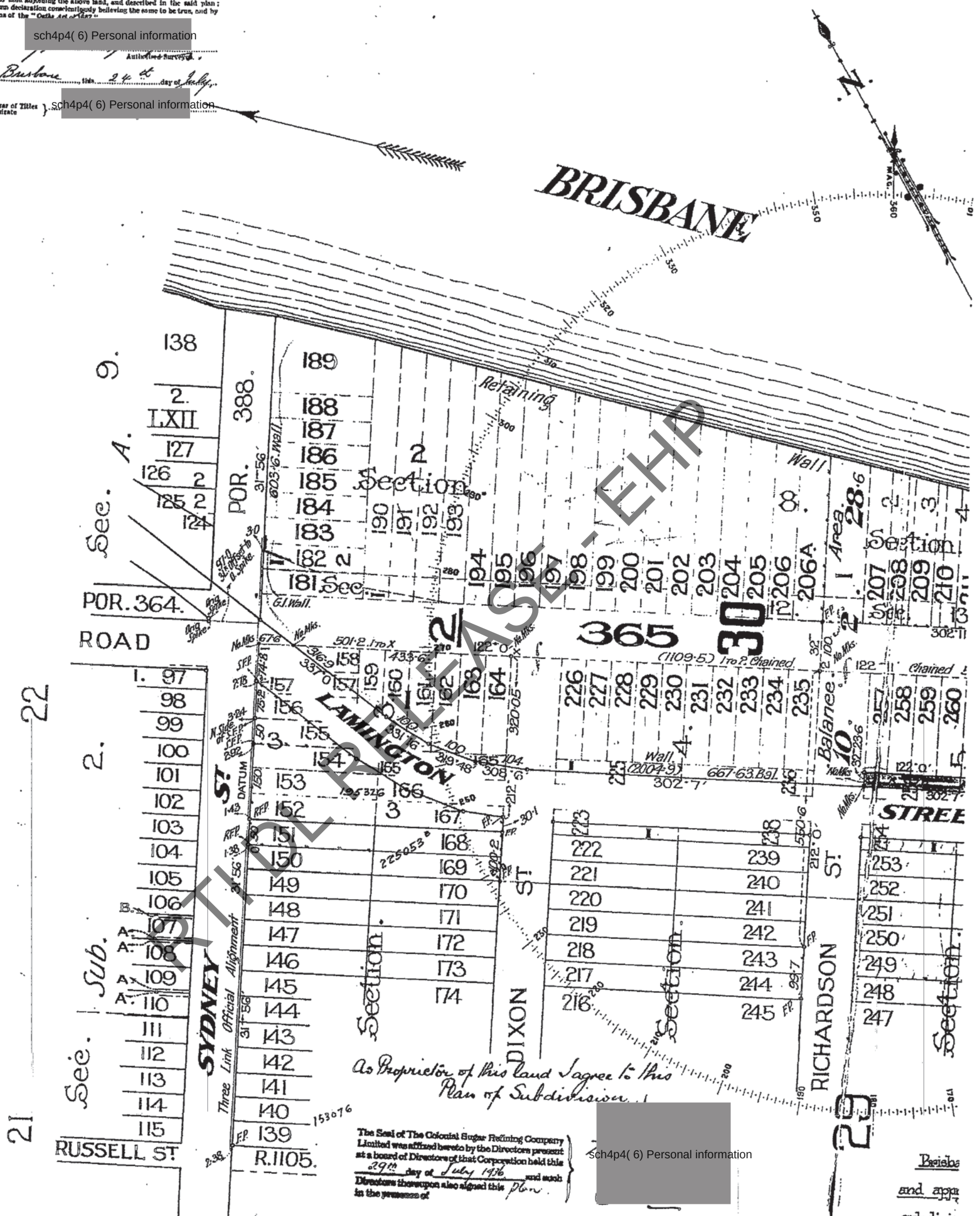
Thomas Sidney Moor of Brisbane.
Authorized Surveyor, do hereby solemnly and sincerely declare that I have faithfully and truly surveyed, measured, and marked on the ground the parcel of land herein referred to, and that the measurements and boundaries given in this plan are correct, and do not to the best of my belief in any way interfere with the rights or property of any person, owners, or occupiers of land adjoining the above land, and described in the said plan; and I make this solemn declaration conscientiously believing the same to be true, and by virtue of the provisions of the "Oaths Act of 1887".

sch4p4(6) Personal information

Authorized Surveyor

Made and Signed at Brisbane this 24th day of July, 1936, before me

Signature of Registrar of Titles or of a Magistrate } sch4p4(6) Personal information



As Proprietor of this land I agree to this Plan of Subdivision.

The Seal of The Colonial Sugar Refining Company Limited was affixed hereto by the Directors present at a board of Directors of that Corporation held this 29th day of July 1936 and each Directors thereupon also signed this plan.

sch4p4(6) Personal information

Brisbane and appa subdivis

sch4p4(6) Personal information

SCALE 150 Links. chain to an inch.

As Proprietor of this land, I agree to this Plan of subdivision, and dedicate the new roads shown hereon to public use.

Signature of Proprietor

53157

29189

THIS PLAN should be ROLLED not folded.
FOR OFFICE USE ONLY.

ET. 299278 1636-18 8740-
Lot 1 See also Emt 210500
No. A414698 Rd. Ded. over 15%opers. Res. of Subs. 2568 265.
Emt A 2104-26 merged in the fee simple vide A446163

I certify that this plan has been correctly copied & compiled,
from my survey as shown in black figures & from plan
Cat. No. 8740-3 in the Register of Titles Office Brisbane,
as shown in brown figures hereon.

Renumbered
158147 B

sch4p4(6) Personal information

Auth. Surveyor

NOTE!
Add 9'4'46" To bring to Official
Alignment of Sydney St

53157

AMENDED DESCRIPTION
Note: This description takes effect upon
approval of the current Title Deed
with the evidence by a further
notation
Survey of Lot (s) 1 and 2
on R.P. 53157.

CITY OF BRISBANE.

Por. 366 & Subs. 1 & 2 of Por. 365 & Subs. 1 to 9. 163. 164. 181. 193 to
189. 194 to 206. 206 & 226 to 235. 257 to 264. 288 to 295 & 300. Resub. 1 of
Subs. 157 to 162. 165. 225. 236. 256. 265 & 287. Resubs. 1 & 2 of Subs. 10. 132.
& 190 to 193. Resubs. 207 to 211. of Subs. 2 to 4. of Sections. 3 to 8. 10. 12 & 13
& Resub. 1 of Sub. C. of East. Sub. Allot. **SURVEY**
OF SUBDIVISIONS **30.**

OF ATTACHMENT OR PORTION NO.

COUNTY OF **Stanley**
PARISH OF **North Brisbane**

Cat. No. **53157**

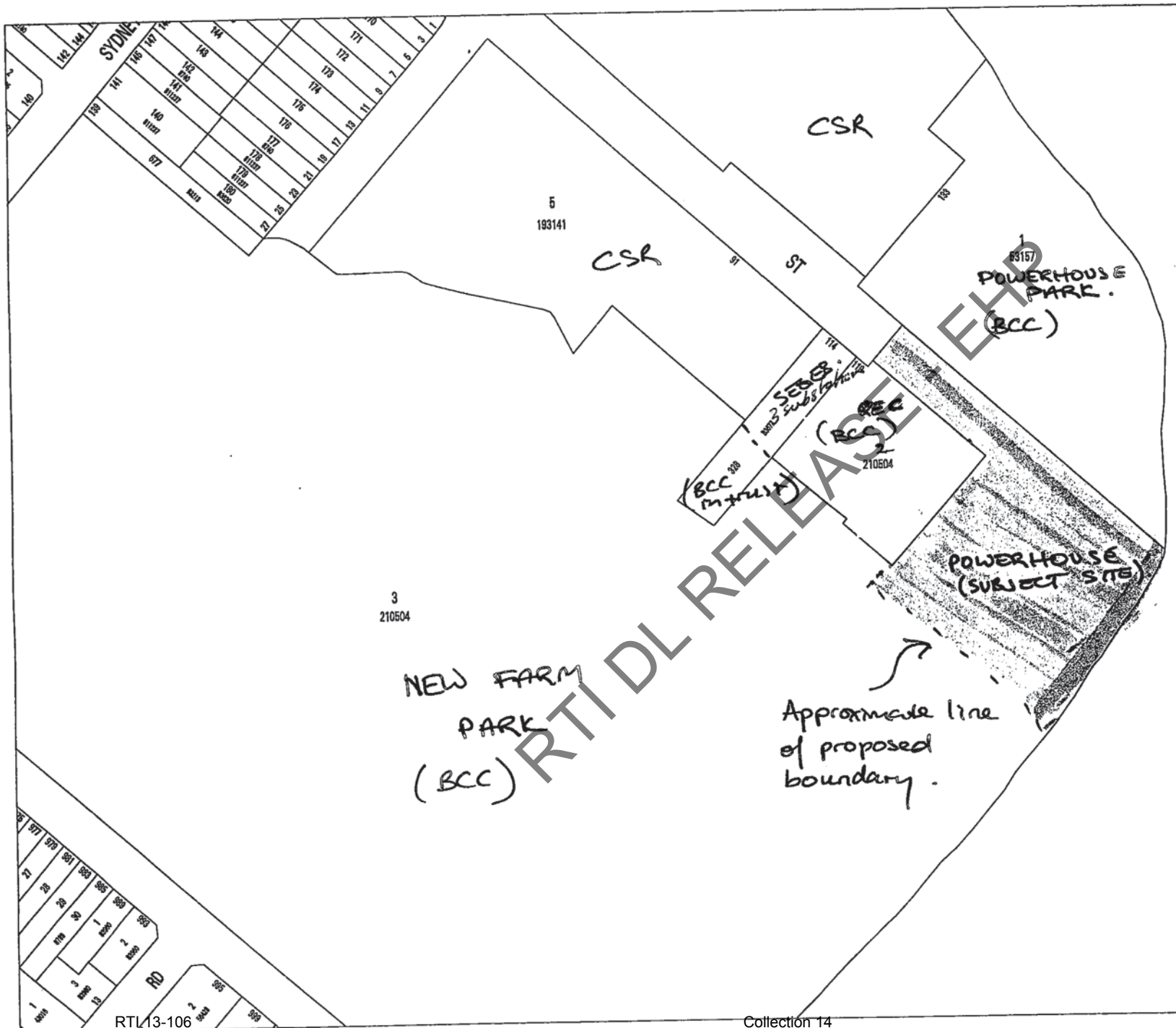
PLAN examined, passed, and registered
this 20th day of October 1938
sch4p4(6) Personal information

Brisbane City Council consents to
and approves of the within plan of
subdivision.

sch4p4(6) Personal information

Town Clerk

53157



Date: 17-Feb-98
 Time: 10:37:59
 Userid: adtp
 Username: SUSAN BEALE
 Job: Local
 Scale: 1: 2500

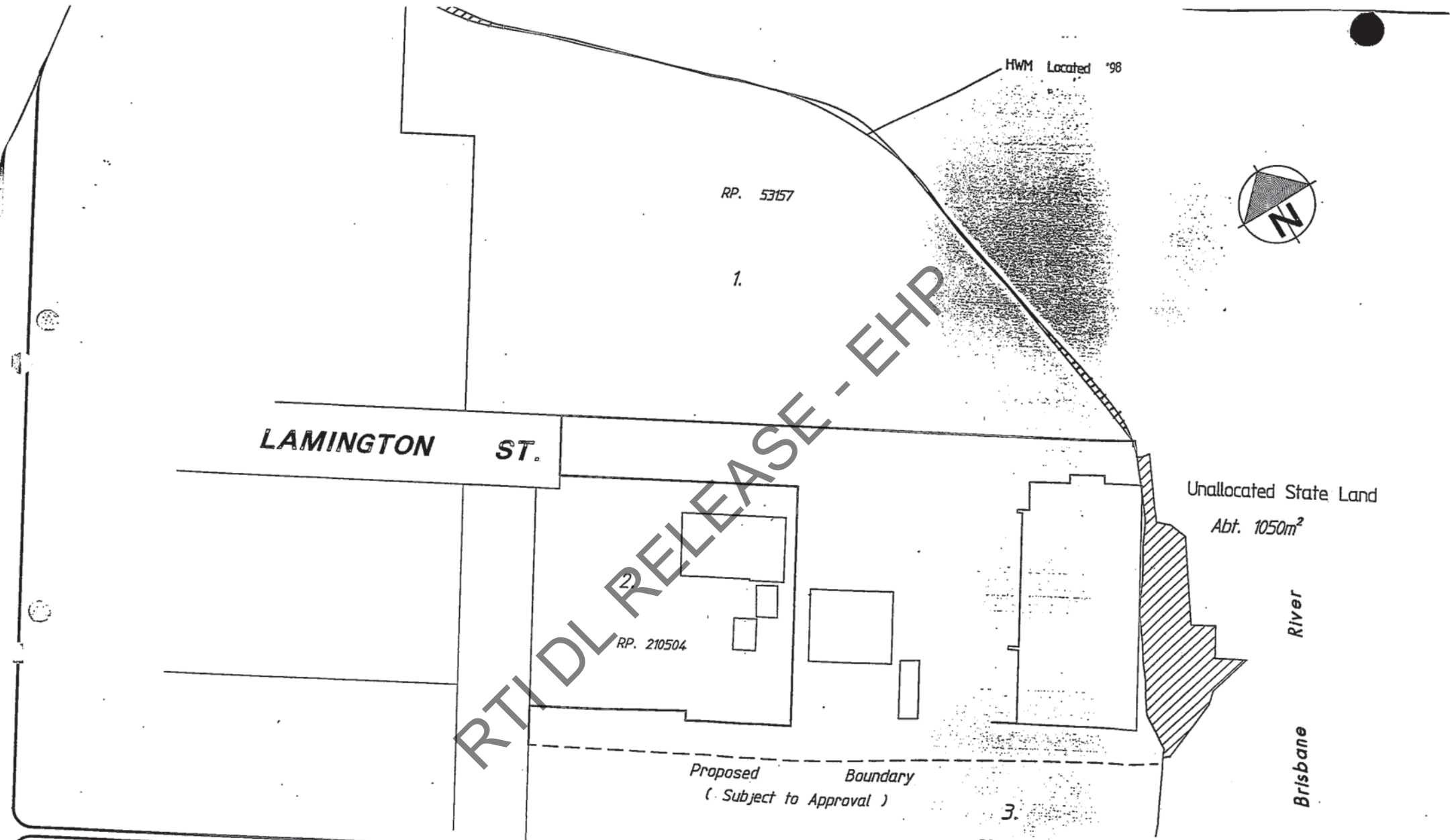
Location:
 505046 6961467

Themes:
 CADASTRE

Warnings:

While every endeavour has been made to ensure that the material here produced is as accurate as possible in what it conveys, the Council takes no responsibility for any errors therein, nor for any acts or omissions that may occur due to its use.

Surplus RP's and areas suppressed above 1:500
 Areas suppressed above 1:1000



Project Name

UNALLOCATED STATE LAND

Adjacent to Lot 3 on RP.210504 & Lot 1 on RP.53157
Original Pars. 369 & 395 .. Original Suburban Allots. 28-30

Parish of North Brisbane

Collection 14

ORIGINAL FILE # K:\A\SS\PLANFORM\COES_SUR\DATA



Scale 1 = 1000

Drawn by: Personal Information

Search No. 1388

Instructions by: Susan Beale
City Design Architects

CADD Ref: 364.dra

SYMBOL FILE # L:\CITY_DESIGN\COES_SUR

CITY DESIGN TECHNICAL SERVICE
3rd Floor T.C.Belme Centre
315 Brunswick St Mall. 4006.
N.Owen. ph.(07)34030432 fax.(07)34030438

Project / Plan No.	Amend
364-31	

Page 64

No. 1725

☐ **Adelaide**

101 Pirie Street
Adelaide, SA
GPO Box 398, Adelaide
SA 5001
Tel (08) 8405 4300
Fax (08) 8405 4301

☒ Brisbane

348 Edward Street
Brisbane, QLD
GPO Box 2907
QLD 4000
Tel (07) 3218 2222
Fax (07) 3831 4223

☐ Melbourne

6th Floor,
163 Eastern Road
South Melbourne, Vic 3205
Tel (03) 9686 1166
Fax (03) 9686 1110

☐ **Perth**

97 Broadway
Nedlands, WA
PO Box 654, Nedlands
WA 6009
Tel (08) 9389 8668
Fax (08) 9389 8447

To Mark Dreyer

From *CHRIS WOODFULL*

Client DEPARTMENT OF ENVIRONMENT

Address 160 ANN ST BRISBANE

Q4 4000

Date 26/5/98

Job No. 84 K043A

Project FORMER NEW FARM POWER STATION EIA

We enclose the following documents:

[illegible]

Please acknowledge receipt of documents by signing the green copy and returning to this office.

Reason

sch4p4(6) Personal information

Authorised by

Method of Delivery

Page 65

RTI 13-106

~~White-Client Copy~~

Green-Collection 14

Blue-File Copy

Yellow-Book Copy

Pages 66 through 152 redacted for the following reasons:

Consult Boulderstone



13 March 1997

Project No. A3200900\0001

Brisbane City Council
GPO Box 1434
BRISBANE QLD 4001

Attention: **Felicity Boevink**

Dear Felicity

RE: PRELIMINARY SITE ASSESSMENT ON QTSC SITE - NEW FARM

We are pleased to provide this brief report on the findings of the preliminary site assessment investigation at the portion of the former New Farm power station which is planned to be returned to the Brisbane City Council (BCC) in the near future.

1.0 INTRODUCTION

The purpose of the assessment was to determine whether significant areas of contamination exist which may need to be considered in transferring the property to the BCC.

2.0 SCOPE OF WORKS

The scope of works undertaken included the following:

Site History Review

The site history review which was fairly limited due to the time constraints presented, included the following:

- Review of Preliminary Site Investigation Report on the New Farm Powerhouse completed by BCC in 1993;
- Review of relevant aerial photographs;
- Review council records for the presence of an underground storage tank on site.

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Felicity Boevink
Brisbane City Council
13 March 1997
Page 2 of 6

Sampling Program

Prior to undertaking the sampling program on 6 March 1997, it was necessary to review SEQEB plans to determine the extent of underground power cables in the vicinity of the proposed testing area. The sampling programme set out in our proposal was slightly adjusted to allow for the conditions encountered onsite as follows:

- Three test pits to approximately 2-3 metres using a backhoe. TP1 located to the north of the QEC Archive building and TP2 between the Joinery Shop and what was known as the Office and Workshop. Due to the presence of a concrete apron around the transformer bays, the testpit originally planned in this area was not possible and consequently, no samples were tested for PCBs. Therefore, this testpit (FP3) was relocated to an adjacent gravel bay as discussed below;
- Log and photograph each pit; and
- Collect soil samples in each pit at each change in the soil profile.

Additional Site Inspection

Additional closer inspection of the site carried out during the fieldwork phase of this assessment revealed a gravel bay located immediately to the west of the former transformer area. This pit is overgrown with bracken and weeds and also contains amounts of building waste that would tend to suggest potential contamination. Therefore, our testing programme was modified to include sampling from this area rather than next to the former transformer.

As outlined in our proposal, there was no requirement to carry out an additional inspection of the inside of the buildings. However, we did inspect the inside of the Joinery Shop building which had not been open during the initial site visit on 27 February 1997.

3.0 SITE DESCRIPTION AND HISTORY

The majority of the site history has been summarised from the Preliminary Site Investigation Report on the New Farm Powerhouse completed by BCC in 1993, with back-up information obtained during Woodward-Clyde site visits and searches.

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Felicity Boevink
Brisbane City Council
13 March 1997
Page 3 of 6

The 2.6 hectares of land on which the former power station is located is made up of a portion of Lot 3 on RP 210504 and the whole of Lot 4 on RP 210504.

The area being investigated in this report is approximately 1.2 acres of this property located at the north-west boundary adjacent to the end of Lamington Street.

Currently this portion of the site is occupied by numerous buildings which include the former Office and Workshop, the former Joinery and Carpenter's Shops, the QEC Archive and the former transformer locations. The majority of the remainder of the area is either concrete or bitumen paved with the exception of small grassed areas adjacent to the Archive building and between the Joinery Shop and the Office and Workshop.

The Office and various workshops were constructed in the 1940's and are currently unoccupied. The aerial photograph from 1946 was examined which showed that the buildings known as the QEC Archive, the Carpenter's Shop and the Joinery Shop were not constructed until after 1946.

The transformers were removed from the site during the plant removal phase in 1977, and our site inspection revealed that the bays, fencing, and concrete foundations filled over with ballast are still undisturbed. Minor staining was evident on the surface of the ballast located immediately adjacent to the former transformer locations, however the entire surrounds of the transformer bays are sealed with concrete paving which appears to be in good order.

There were apparently no known coal-stockpiling areas located within the boundary of the area being investigated.

A search of the council records by the BCC revealed no history of an underground storage tank existing in this area of the power station property.

4.0 SITE INVESTIGATION PROGRAM

Soil samples were collected at changes in the soil profile in each of the testpits, which are located on Figure 1 attached.

A geotechnical description of the soil profile is given for each testpit in the testpit logs in Appendix 3 attached.

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Felicity Boevink
Brisbane City Council
13 March 1997
Page 4 of 6

As the testpit logs and photographs in Appendix 3 show, only limited depths of power station by-products ie. ash, coke, cinders etc, have been used for filling purposes in the area being investigated. Approximately 0.9m of varying layers of coke and ash were encountered in TP1, while only surface ash to 0.1m depth was found in TP2.

As discussed earlier, a third testpit, FP3, was excavated in what appears to be the former gravel bay. This testpit revealed metal pieces and general rubbish articles amongst bracken and weeds on the surface of the remaining gravel pile. This gravel pile is approximately 0.3-0.5m deep and is situated on natural silty sand. A sample of the silty sand was taken for analysis.

Analytical Testing

In TP1 and TP2, surface samples only were analysed at this stage. Analyses included testing for eight metals (copper, lead, zinc, chromium, nickel, arsenic, cadmium and mercury). As indicated on the attached testpit logs, ash was encountered in testpits TP1 and TP2. After consultation with Felicity Boevink, a sample of the ash from TP1 was also tested for polycyclic aromatic hydrocarbons (PAH's). As soil sampling in the transformer area was not possible, testing for PCB's was not carried out.

5.0 RESULTS AND DISCUSSIONS

Analytical results are presented in Table 1 below:

TABLE 1
Summary of Analytical Results, NEW FARM

Analyte	Level of Reporting (mg/kg)	Investigation Threshold* (mg/kg)	TP1 (0.0-0.2)	TP2 (0.0-0.1)	FP3 (0.2-0.5)
Inorganics:					
Arsenic	1	20	2	6	35
Cadmium	1	3	<1	<1	3
Chromium	1	50	10	17	51
Copper	1	60	69	54	440
Lead	1	300	75	10	1670

TABLE 1 (Cont'd)
Summary of Analytical Results, NEW FARM

Analyte	Level of Reporting (mg/kg)	Investigation Threshold* (mg/kg)	TP1 (0.0-0.2)	TP2 (0.0-0.1)	FP3 (0.2-0.5)
Mercury	0.1	1.0	0.1	0.3	0.3
Nickel	1	60	9	12	33
Zinc	1	200	126	20	10
Organics:					
**Total PAH's	0.5	20	0	-	-

Notes:

LOR = limit of reporting

* - Environmental Investigation Threshold. Source: Draft Aust. and N.Z. Guidelines for Assessment of Contaminated Sites, Jan. '92 (ANZECC/NHMRC)

** - Total PAH concentrations determined by summing individual compound levels; totals reported as < are recorded as 0

Shaded cells indicate Threshold exceedance Concentrations in mg/kg

The analytical results from the ash and coke fill material in TP1, adjacent to the QEC Archive building, showed that Copper at 69 mg/kg was the only metal to slightly exceed the DoE threshold of 60 mg/kg in the area of this testpit.

Slightly elevated levels of both lead and zinc were reported for the sample taken from the ash fill in TP2, lead at 410 mg/kg and zinc at 520 mg/kg, again slightly exceeding the DoE thresholds of 300mg/kg and 200 mg/kg respectively.

The sample taken at FP3 of the natural silty sand immediately beneath the gravel and rubbish pile in the former gravel bay reported levels of arsenic, chromium, copper, lead and zinc all slightly exceeding their relative DoE thresholds as shown in Table 1.

6.0 CONCLUSIONS

The history did not reveal any past site activities which are of concern with regards to potential contamination other than using power station wastes for fill material.



Felicity Boevink
Brisbane City Council
13 March 1997
Page 6 of 6

Although heavy metals were detected at levels marginally exceeding the DoE investigative and health-based thresholds, the contamination appears to be confined to the relatively shallow depths of ash and coke fill encountered across the site.

We believe that remediation of the site is not required for the following reasons:

- the majority of the area is either bitumen or concrete paved;
- the relatively low nature of the levels of heavy metal concentrations encountered; and
- the intended use of the site does not include re-zoning for residential development.

The lead level in FP3 at 1670 mg/kg is the only result which exceeds the draft National Environmental Health Forum health based soil guidelines for commercial / industrial properties of 1500 mg/kg.

If it were deemed necessary to carry out remediation of these areas, it's likely that this would involve a relatively small scale excavation exercise to remove the various areas of ash, coke and gravel fill to a Brisbane City Council landfill as low level contamination at less than \$20 / tonne including disposal fees and transport.

Please contact the undersigned urgently should you have any questions.

Yours faithfully
WOODWARD-CLYDE

[Redacted]
sch4p4(6) Personal information

JIM SOLTAU
Principal - Site Remediation Services

[Redacted]
sch4p4(6) Personal information

LUKE HOVE
Environmental Technician

Attachments: Appendix 1 - Figure
 Appendix 2 - Testpit Logs
 Appendix 3 - Plates
 Appendix 4 - Laboratory Reports

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APPENDIX 1

FIGURE

RTI DL RELEASE - EHP

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APPENDIX 2

TESTPIT LOGS

RTI DL RELEASE - EHP



Testpit Number TP1		Location Former New Farm Powerhouse Site - BCC		Project No. A3200900/0001		
Date Completed 4/3/97		Excavation Equipment Backhoe		Completion Depth 2.2m		
Depth (m)		Material Description material type, colour, plasticity/particle size, secondary/ minor components		Sample Record	Water	Field Records/Comments testing, soil structure, soil origin, odours,etc
0.00		FILL - ash, silty sand, some brick rubble, grey/brown		0.0 - 0.2		
0.50		FILL - coke, ash, very dark grey		0.4 - 0.5		
		FILL - sandy clay, mottled orange/brown and light grey		0.5 - 0.6		
		FILL - ash, silty sand, some brick rubble, grey/brown				
1.00		NATURAL - silty CLAY, mottled orange/brown and light grey, slightly moist, very stiff		1.4 - 1.5		
1.50						
2.00						
2.50		End of Pit at 2.2m				

TEST PIT LOG

Testpit Number TP2	Location Former New Farm Powerhouse Site - BCC	Project No. A3200900/0001		
Date Completed 4/3/97	Excavation Equipment Backhoe	Completion Depth 2.0m		
Depth (m)	Material Description material type, colour, plasticity/particle size, secondary/ minor components	Sample Record	Water	Field Records/Comments testing, soil structure, soil origin, odours,etc
	FILL - ash, silty sand, some coke also, very dark grey/brown	0.0 - 0.1		
0.50	NATURAL - silty CLAY, brown, moist, firm	0.5 - 0.6		
1.00				
1.50	silty sandy CLAY, mottled orange/brown and light grey, moist, firm	1.0-1.1		
	- sand and moisture content increasing with depth			
2.00	End of Pit at 2.0m			
2.50				



Testpit Number FP3	Location Former New Farm Powerhouse Site - BCC	Project No. A3200900/0001		
Date Completed 4/3/97	Excavation Equipment Backhoe	Completion Depth 0.50m		
Depth (m)	Material Description material type, colour, plasticity/particle size, secondary/ minor components	Sample Record	Water	Field Records/Comments testing, soil structure, soil origin, odours,etc
0.25	FILL - silty clayey sand, orange/brown, and medium-sized gravels, dry	0.0 - 0.2		
0.50	NATURAL - silty SAND, grey/brown, slightly moist	0.2 - 0.5		
0.75	End of Pit at 0.5m			
1.00				
1.25				



APPENDIX 3

PLATES

RTI DL RELEASE - EHP

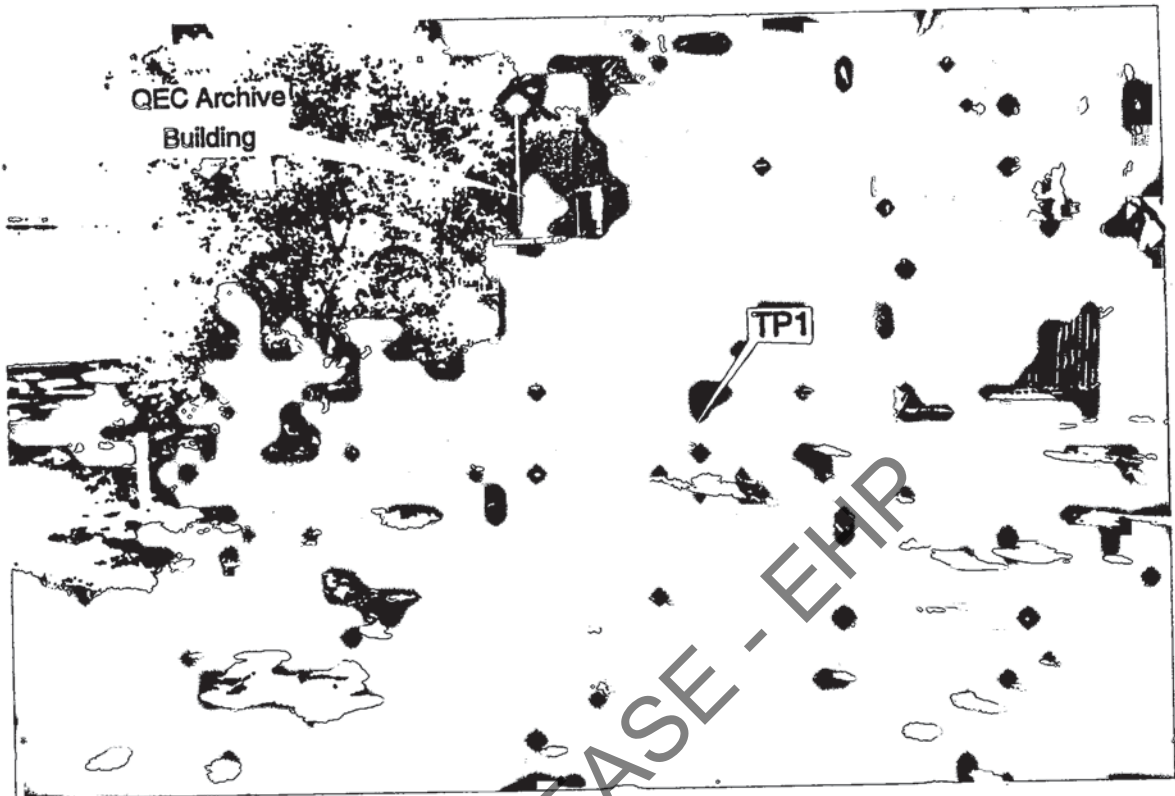


Plate 1: Location of TP1.

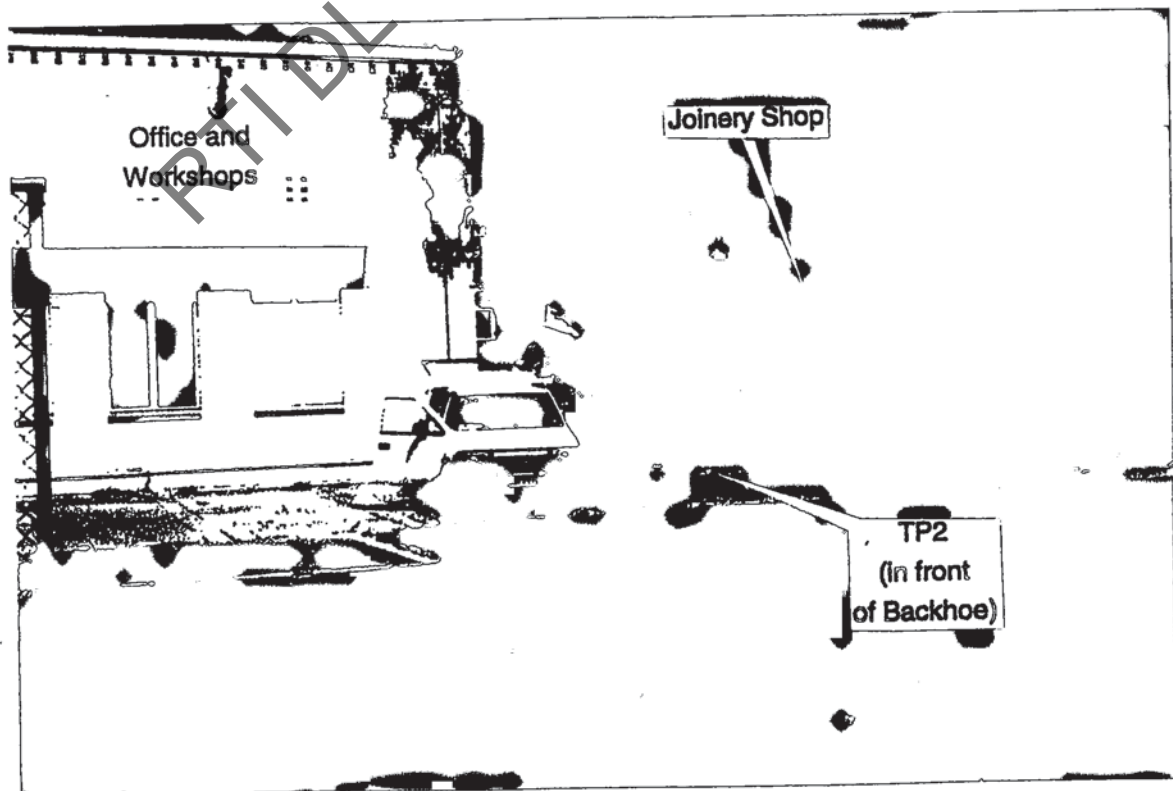


Plate 2: Location of TP2.

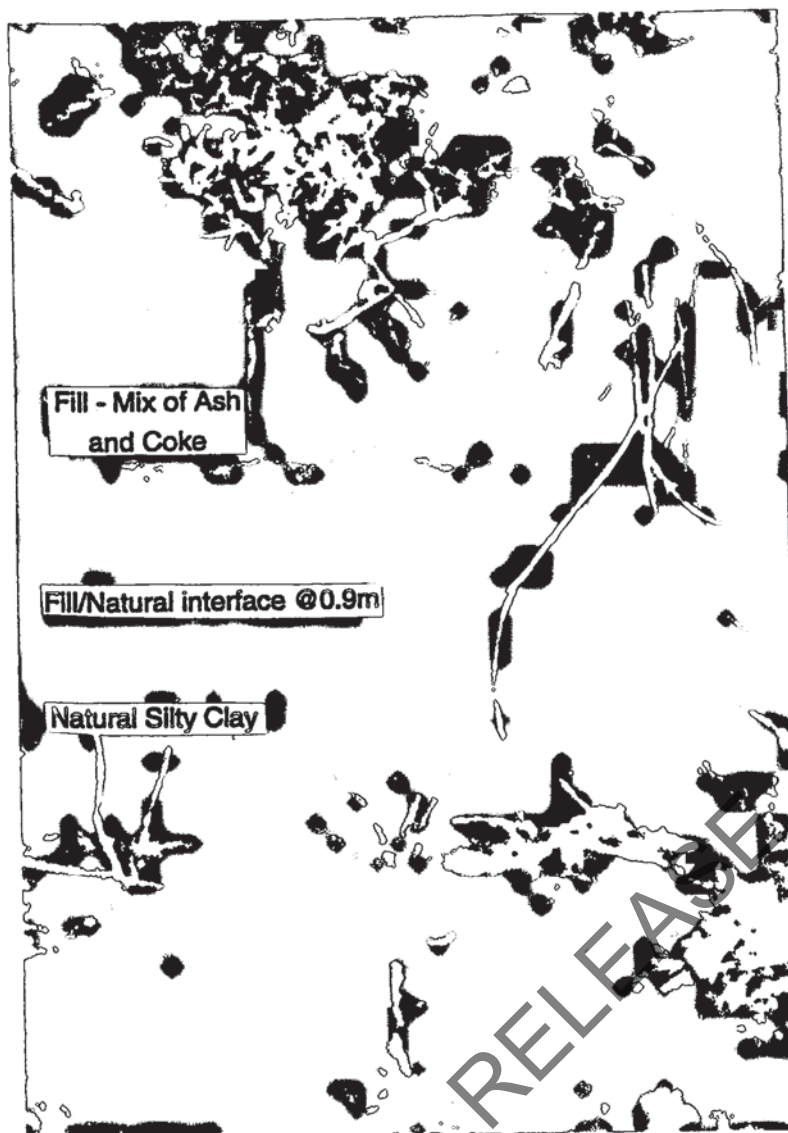


Plate 3: TP1 Profile.

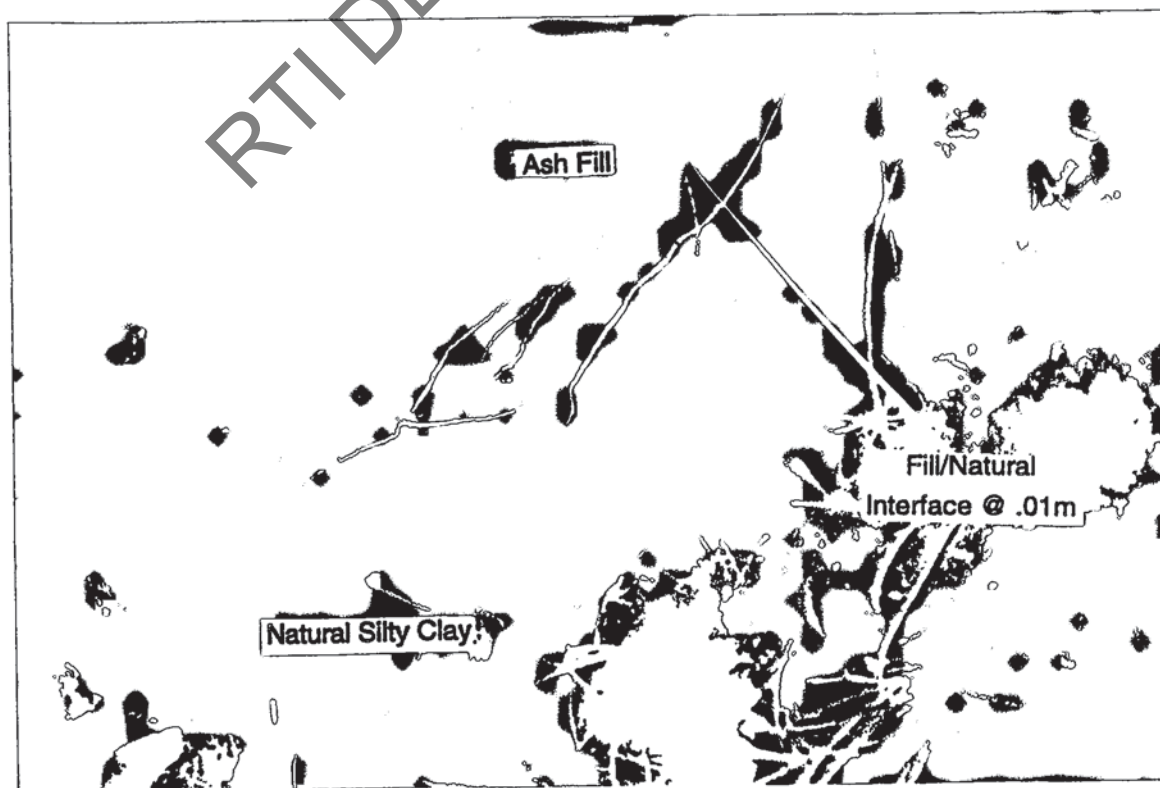


Plate 4: TP2 Profile.

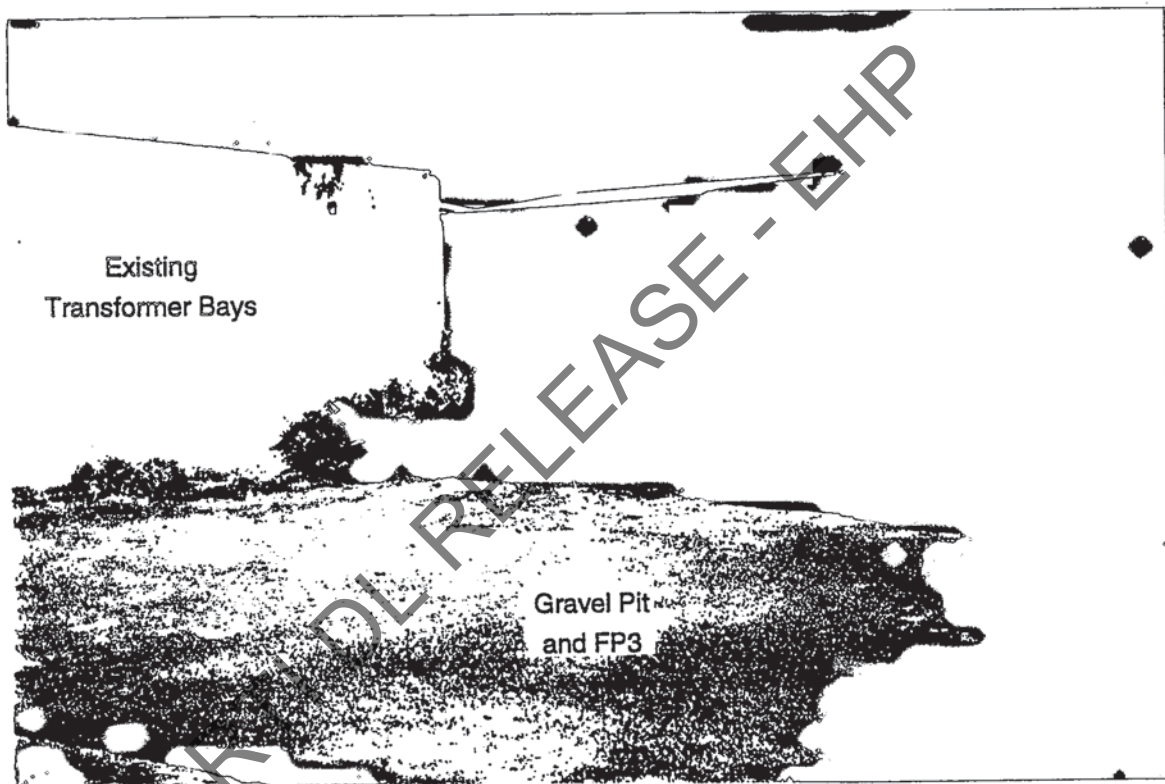


Plate 5: Location of Gravel Pit and FP3.



RTI DL RELEASE - EHP

APPENDIX 4

LABORATORY REPORTS



W. WOODWARD-CLYDE (OLD)

Attention: MR T ELLIS
 Order: A32/00900/0001
 SampleType: SOIL
 Project: NEW FARM P.S. (BCC)

Page-no: 1
 ENV BRISBANE
 Batch-no: 8203
 Sub-batch: 0
 No-samples: 3
 Received: 04/03/97
 Checked:

Code	Analysis description	Units	LOR	TF1 0.0-0.2 04/03/97	TF2 0-0.1 04/03/97	TF3 0.2-0.5 04/03/97
055	Moisture Content (dried @ 103° C)	%	0.1	7.8	7.1	8.0
K 005T	Arsenic - Total	mg/kg	1	2	6	35
K 005T	Cadmium - Total	mg/kg	1	<1	<1	3
K 005T	Chromium - Total	mg/kg	1	10	17	51
K 005T	Copper - Total	mg/kg	1	69	54	440
K 005T	Nickel - Total	mg/kg	1	9	12	33
K 005T	Lead - Total	mg/kg	1	75	410	1670
K 005T	Zinc - Total	mg/kg	1	126	520	1570
K 020T	Mercury - Total	mg/kg	0.1	0.1	0.3	0.3

Samples as received digested by USEPA method 3051 prior to the determination of metals. Results reported on a dry weight basis. The presence of coarse material may result in low precision for sample duplicate. This report supersedes any previous preliminary reports of the same batch number.

*** FINAL RESULTS REPORT ***
AGC WOODWARD-CLYDE (QLD)

Lab: ENV BRISBANE
 Batch-no: EB8203
 Sub-batch: 1
 No. samples: 1
 Received: 04/03/97
 Checked:

O'no: A32/00900/0001 S'type: SOIL

Project: NEW FARM P.S. (BCC)

Method	Analysis description	Units	LOE	TP1
				1 0.0-0.2 04/03/97
JA-055	Moisture Content (dried @ 103°C)	%	0.1	7.8
JP 13	POLYNUCLEAR AROMATICS			
	Naphthalene	ug/kg	0.5	<0.5
	2-Methylnaphthalene	ug/kg	0.5	<0.5
	2-Chloronaphthalene	ug/kg	0.5	<0.5
	Acenaphthylene	ug/kg	0.5	<0.5
	Acenaphthene	ug/kg	0.5	<0.5
	Fluorene	ug/kg	0.5	<0.5
	Phenanthrene	ug/kg	0.5	<0.5
	Anthracene	ug/kg	0.5	<0.5
	Fluoranthene	ug/kg	0.5	<0.5
	Pyrene	ug/kg	0.5	<0.5
	N-2-Fluorenylacetanilide	ug/kg	0.5	<0.5
	Benz(a)anthracene	ug/kg	0.5	<0.5
	Chrysene	ug/kg	1.5	<0.5
	Benzo(b) & (k)fluoranthene	ug/kg	1	<1
	7,12-Dimethylbenz(a)anthracene	ug/kg	0.5	<0.5
	Benzo(a)pyrene	ug/kg	0.5	<0.5
	3-Methylcholanthrene	ug/kg	1.5	<0.5
	Indeno(1,2,3-cd)pyrene	ug/kg	1.5	<0.5
	Dibenz(a,h)anthracene	ug/kg	1.5	<0.5
	Benzo(g,h,i)perylene	ug/kg	1.5	<0.5

Wet to Dry Calc Performed.

Samples analysed on an as received basis. Results reported on a dry weight basis.

SRAEB08203



ENVIRONMENTAL GUARANTEED TESTING

SAMPLE RECEIPT ADVICE

COMPANY: AGC WOODWARD-CLYDE (OLD)
 ATTENTION: MR T ELLIS
 DATE: Mar. 05, 1997
 FROM: Sharon DAVIDSON, ENV BRISBANE

ALS has received samples pertaining to your reference: A32/00900/0001

For future reference the batch number on this order is: EB08203

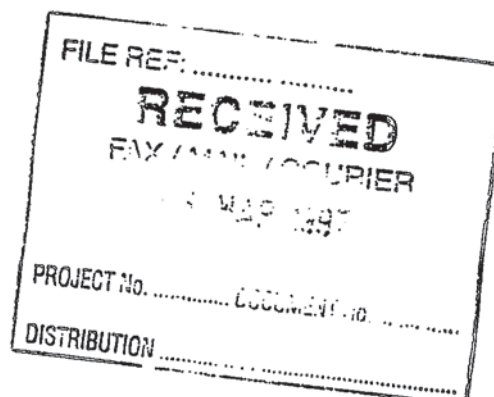
All samples and paper work were received in good order.
 Samples were damaged during transit. Please contact us.
 Samples chilled when received.
 Samples received in appropriately pretreated and preserved containers.
 Please direct any turnaround/technical queries to Paul VOGEL.
 Any queries relating to sample condition/numbering/breakages should
 be directed to Sharon Davidson.

You can expect results to be reported as detailed below:

All Environmental Results Mar. 06, 1997

Comments: Mercury results may not be available by 6/3/97

ALS - SERVICING YOUR NEEDS BETTER

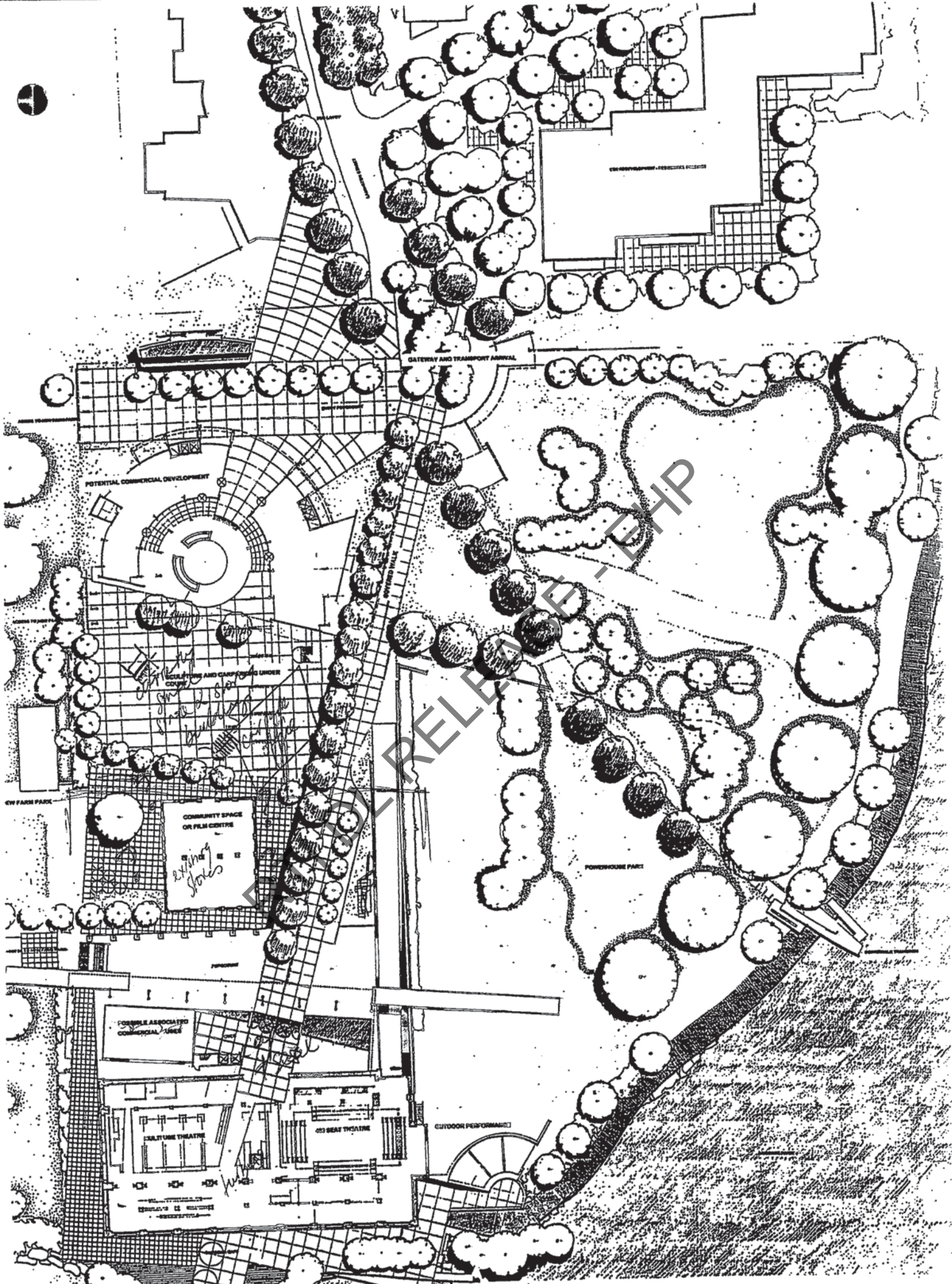


AUSTRALIAN LABORATORY SERVICES P/L
 A.C.N. 009 936 029

Brisbane
 Phone (07) 3243 7222
 Fax (07) 3243 7218

Sydney
 Phone (02) 9841 9500
 Fax (02) 9841 9530

Melbourne
 Phone (03) 9853 5299
 Fax (03) 9853 0730



R11/46/06

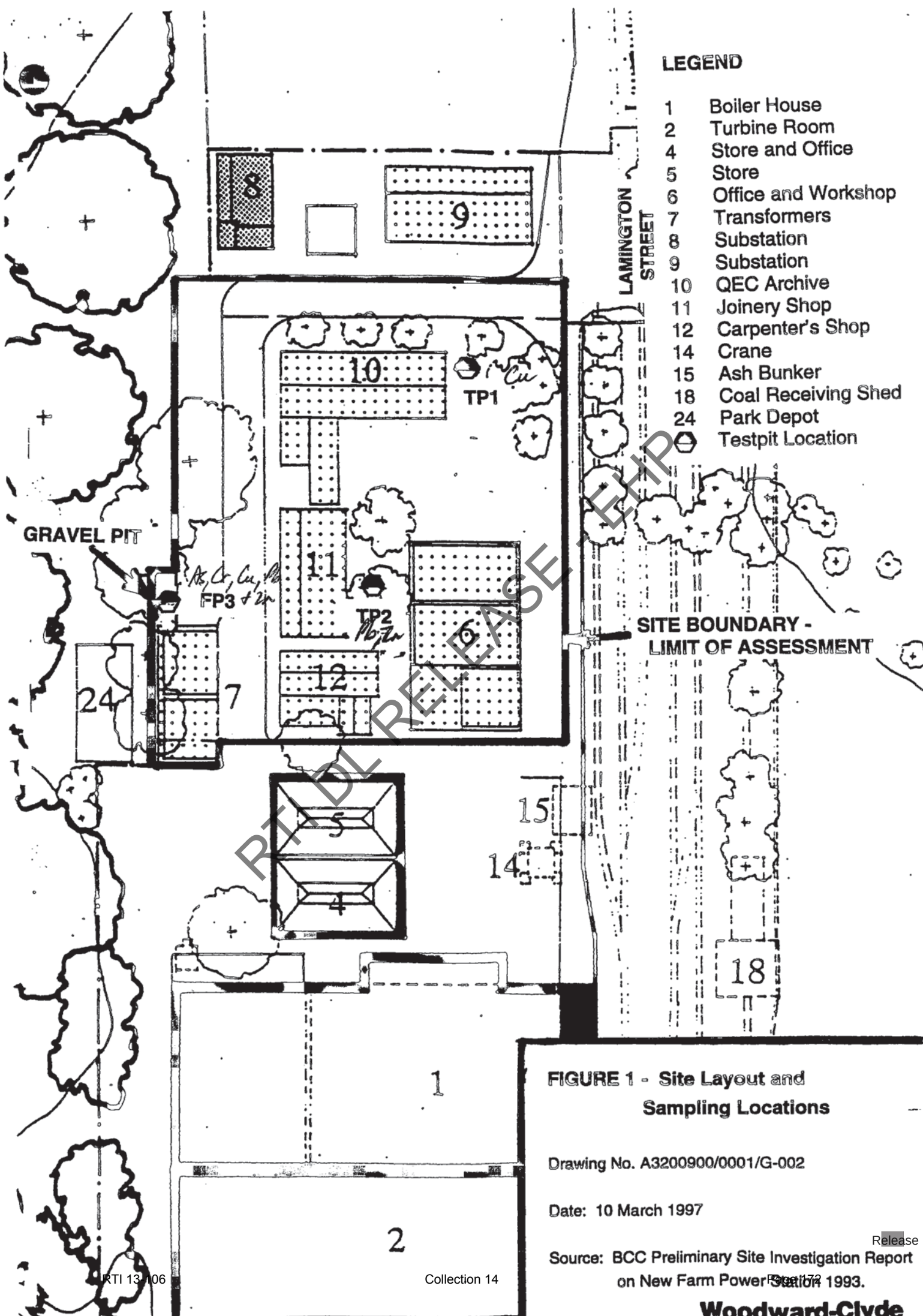
Collection 14

BRISBANE CITY COUNCIL
CITY DESIGN
COX

NEW FARM POWERHOUSE
CONCEPT DESIGN POWERHOUSE BUILDING
MASTER PLAN

Page 171

Release



1.0 INTRODUCTION

In March of 1993, Scientific Services Branch of the Brisbane City Council was commissioned to undertake a stage 1, Preliminary Site Investigation to determine the extent of contamination at the site known as "The New Farm Powerhouse".

The site is located at the tip of the New Farm peninsula. The area investigated comprises the former Powerhouse, associated buildings and approximately 2.9 hectares of adjoining land. The site borders New Farm Park to the south-west, the Colonial Sugar Refinery (CSR) to the north-west, and the Brisbane River to the north-east.

The New Farm Powerhouse site investigation is being carried out as part of the urban renewal program for the inner north-eastern suburbs of Brisbane by the Brisbane City Council. The urban renewal program is investigating the feasibility of the potential for reuse of the Powerhouse building and its surrounds for a range of purposes. These include:

- 1) Adaptation for arts/cultural use
- 2) Adaptation for sports/recreation use
- 3) Adaptation for housing
- 4) Open space adaptation

All sampling, data reduction, interpretation and report presentation has been undertaken by the Brisbane City Council, Scientific Services Branch. Chemical analysis was undertaken by Australian Laboratory Services Limited (ALS, Brisbane), Safety in Mines Testing and Research Station (Simtars, Brisbane) and the Institute of Environmental Health and Forensic Services (New Zealand).

2.0 EXECUTIVE SUMMARY

The site forming the study area was located at the tip of the New Farm peninsula, Lamington Street, New Farm and comprises the powerhouse itself, associated buildings, and open space. The site borders New Farm Park to the south-west, the CSR refinery to the north-west, and the Brisbane River to the north-east. It covers a total area of 2.5959 hectares. Figure 1, in appendix 1, depicts the site location.

The sampling plan developed for the New Farm powerhouse site had two distinct functional components. A triangular grid pattern of boreholes with 50 m spacing over the open space, and judgemental sampling of areas around the existing buildings on site.

The results of the preliminary site investigation indicated that there was no evidence of any significant levels of contamination which would restrict the development of the site for the end uses proposed by the Brisbane City Council. However, If significant excavation was to be carried out on site, as part of a redevelopment plan, further site investigation may be necessary.

Contamination at the site was primarily physical. Large amounts of imported soils, mixed in some cases with building rubble were found. Chemical contamination by phenols, polynuclear aromatic hydrocarbons, petroleum hydrocarbons, heavy metals, PCB's and dioxins was not significant across the site. No evidence of significant asbestos contamination was found during the preliminary site investigation.

3.0 SITE LOCATION AND DESCRIPTION

The prescribed land is located at Lamington Street, New Farm. It covers a portion of Lot 3 (1.1036 ha) on RP 210504, and Lot 4 (1.4923 ha) on RP 210504. New Farm park covers the remainder of Lot 3 RP 210504. Figure 1, in appendix 1, depicts the site location.

The site forming the study area is located at the tip of the New Farm peninsula and comprises the powerhouse itself, associated buildings, and open space. The site borders New Farm Park to the south-west, the CSR refinery to the north-west, and the Brisbane River to the north-east. It covers a total area of 2.5959 hectares. Figure 2 in appendix 1 depicts the current site features.

The New Farm Powerhouse site divides itself into several distinct zones that relate directly to the manner in which it was developed and utilised. That is ;

- . The powerhouse
- . The stores buildings
- . The offices and workshops
- . The boilerhouse
- . Open space
- . The transformers
- . Former coal stockpiling areas

All of the area surrounding the remaining on-site structures (excepting the open space) is sealed and concreted.

3.1 The Powerhouse

The powerhouse is located close to the Brisbane river on the southern most portion of the site. As it is adjacent to the Brisbane river , substantial ground preparation was necessary to provide a stable foundation for construction of the buildings.

The powerhouse was founded on concrete footings and hardwood piles, and the main floor level was raised some 2 to 3 metres above natural ground height. A retaining wall varying from 2 to 3 metres in height, was constructed along the extension of Lamington street, on the eastern side of the buildings, past the old boilerhouse, to the main floor level of the powerhouse. This wall also extends around the boilerhouse. On the western side of the powerhouse a 2 to 3 metre grass-covered embankment slopes towards New Farm park, and on the southern side a two to three metre grassed embankment slopes towards the Brisbane river.

The powerhouse is a substantial structure, that was built in several stages, comprising three sections, the switch house, turbine room and boilerhouse. The boilerhouse will be examined separately in section 3.4. Appendix 1, figure 3 shows details of the powerhouse.

The physical state of the of the turbine room and switch house appears to be generally sound, although the roofing, guttering and windows of the powerhouse are suffering from neglect and vandalism. All plant machinery was removed from the powerhouse structure in the 1970's. Inlets for cooling water from the Brisbane river have been sealed.

Council rehabilitation plans centre on the retention and refurbishment of the remaining powerhouse buildings on site to contain either, arts, sporting or housing facilities. The open space plan would see the remaining structures either demolished, or secured after building defects are rectified.

Appendix 1, figure 3 contains illustrations of the remaining stores buildings at the site. The stores were once connected by a timber framed walkway to the powerhouse buildings, but this was removed when the boilerhouse was demolished. These buildings were used as stores for powerhouse needs during its operating period.

The buildings are apparently sound, and are currently occupied by the Electrical Services Section of the Brisbane City Council, Corporate Services Division.

Council rehabilitation plans support the retention and refurbishment of these buildings as they form an integral part of the original powerhouse complex.

This study did not examine these buildings as they are currently occupied by the Electrical Services Section of the Brisbane City Council, the area around these buildings is fully sealed by concreting, and historical records show that they have been only used for storage of equipment.

3.2 The Offices and Workshops

These buildings were constructed in the 1940's to provide additional space for the powerhouse operations. They have been fully renovated and are currently occupied for office use, by the Electrical Services Section of the Brisbane City Council. Appendix 1, figures 2 and 3 show the location of these buildings. The office workshop area of the site is viewed as non-essential to the redevelopment of the site.

3.3 The Boilerhouse

The boilerhouse structure was demolished in May 1984. Rubble from the demolition was placed in the basement section of the building and the debris covered with dirt to make a smooth surface. As the original boilerhouse

The open space is completely grassed with a some established larger vegetation such as Poinciana and Acacia along the river bank, and various other tree species such as Mangos, Figs, Eucalypts and Callistemans dotted around the open space. Figure 4 in appendix 1 shows the existing vegetation.

A former coal handling wharf in a poor state of repair, survives on the north-eastern side of the open space. This wharf is still being used commercially by a barge operator. The upper most southern section of the open space area is being used as a car parking facility by Brisbane City Council staff.

The north-west corner of the open space is being used as an additional storage area for large piles of mulch and bark chips for New Farm park.

3.5 The Transformers

The transformers were originally located on the western boundary of the powerhouse site, behind the carpenter's shop. Appendix 1, Figure 2 shows the former location of the transformer housings. These have been removed from the site. Mesh fencing encircles the former location of the transformers. All that remains is the concrete foundations for these structures. Gravel covers the concrete base.

3.6 Coal Stockpiling Areas

Several former coal stockpiling areas are illustrated in figure 5, appendix 1. A gypsum store for CSR has been constructed over the northern most area illustrated. The stockpiling area adjacent to the powerhouse has been covered with concrete. The area in the remaining open space has been covered with fill.

4.0 SITE HISTORY

Prior to the construction of the powerhouse the property is thought to have supported a racecourse for the Moreton Bay Racing Club in 1846, and grazing/park activities from the 1880's to the 1920's. The Colonial Sugar Refinery (CSR) purchased land adjacent to the New Farm powerhouse site in 1885, and established a sugar refinery in 1893.

The land on the New Farm peninsula, which the powerhouse now occupies, was partially resumed from private owners and New Farm park and combined with unoccupied allotments by the Brisbane City Council in 1926. Brisbane City Council records show that "Small Creek" meandered from the north-west corner of the property before entering the Brisbane River from the south-east corner. Figure 6, appendix 1 shows the location of this creek. The main powerhouse buildings, the boilerhouse and the stores, were built over this creek which then cut through the southern corner of the open space at the site. As there is no evidence of this water course today, it can be assumed that it was drained and filled during the construction of the powerhouse foundations in the 1920's.

Construction of the first stage of the New Farm powerhouse by the Brisbane City Council, commenced under the supervision of Mr. R.R.Ogg, the designer of the buildings, in 1926. The turbine room and boiler house were in the first phase developed, and operation of the powerhouse began in 1928. The Architects and Builders Journal of Queensland, May 1928, detailed the construction of the powerhouse and stated, "The workmanship through out is of the best, and reflects great credit on those concerned". The turbine room and switch house were expanded in 1934, the boiler house and staff accommodation in 1936, and further extensions to the boiler house were completed in 1940.

Coal was originally transported by rail to the boilers, via an extension from Lamington street of the existing rail services to the CSR refinery. During the 1950's a coal handling wharf on the Brisbane river was constructed. Coal was then shipped to the powerhouse and stockpiled adjacent to the river and behind the boiler house. Figure 5, appendix 1 shows the location of all former coal stockpiling areas.

In 1963 operation of the powerhouse and surrounding land was passed over to the Southern Electric Authority, and in 1967 from the Southern Electric Authority to the State Electricity Commission of Queensland (now SEQEB).

The powerhouse was decommissioned by SEQEB in 1968. Under the original terms of contract between SEQEB, the Southern Electric Authority and the Brisbane City Council, Clause 39 (5) provided for the repurchase of the powerhouse and associated buildings by the Brisbane City Council. Negotiations began in 1973 between SEQEB and the Brisbane City Council for the repurchase of the powerhouse and associated buildings only, by the council. The council approved the transaction and repurchased these buildings in 1973. The remainder of the site, e.g the majority of the unimproved land, remained under SEQEB control. SEQEB maintained two substations and a works depot at the remainder of the site under their control.

Contracts for the removal of plant and ancillary structures from the powerhouse buildings were issued by the Brisbane City Council in 1976. Items to be removed included the Boilers, Turbo Alternators, Pumps, Coal Handling Facilities, Smoke Stacks and Reactors. Conditions of the contract encompassed the cleaning of the entire site by the contractors and removal of all waste and scrap to be disposed of in accordance with Brisbane City Council regulations.

A Sydney firm was granted the contract for the removal of plant machinery in July 1977. This contract included the removal of asbestos from the powerhouse buildings. Although government regulations regarding asbestos handling and

removal were not as stringent in the 1970's as in the 1990's, the SEQEB manager who was on site at this time, recalled that management and staff responsible for removing the asbestos material were aware of the dangers of the material and rigorous procedures were employed to remove all residues from the site. There appears to be no assessment documentation of the relative success or failure of this clean-up. The powerhouse buildings were then recommended for use as storage facilities by the council.

After decommissioning of the powerhouse, parts of the site continued as a works depot for SEQEB. Large amounts of material, consisting of concrete, soil, and general fill were imported to the open space of the site by SEQEB during the 1980's. The SEQEB manager of the site at this time, recalled that the material originated from SEQEB cable excavations from around the city. Imported materials were primarily soil and building rubble from excavation activities. There is no documentation about these earth moving activities. These activities resulted in an increase of the ground level, up to 4.5m above natural height, in some areas around the powerhouse.

In the early 1980's the old boilerhouse building was deemed to be unsafe by the Brisbane City Council, and tenders for its demolition were called. The contract was granted to Denviel Demolitions Pty. Ltd. in 1984. The contractors were required to undertake the demolition, in-fill construction, and cleaning of the boilerhouse building. All walls of the boilerhouse, excepting the common wall with the turbine bay, and the boilerhouse ground floor slab were demolished. Fill material was then placed in the basement section of the building. The contract specified that this material was to be clean broken masonry reduced to single brick size. Asbestos residues were not specifically mentioned in the contract. Council staff were then responsible for the top-soiling and turfing of this area. All demolished debris and materials, except for the demolished masonry used for filling, were removed from the site.

In 1989 land exchanges occurred between SEQEB and the Brisbane City Council. These land dealings between QEC, SEQEB and the Brisbane City Council were gazetted in January 1990, and the ownership of the majority of the site which had been under SEQEB management, was transferred to the Brisbane City Council.

The old store building is currently being used as council stores and offices, and parts of the powerhouse land are used for stockpiling compost and bark chips for New Farm park operations. The New Farm Powerhouse site is now targeted for restoration as part of the urban renewal program of the Brisbane City Council.

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5.0 INITIAL SITE INSPECTION REPORT

An initial site inspection was carried out by officers of Scientific Services Branch, Brisbane City Council. This inspection was carried out by Felicity Boevink, Ken Giess, and Allan Kleinschmidt of the Scientific Services Branch of the Brisbane City Council in April 1993.

Observations made during this inspection are included in section 3.0 Site Location and Description.

Points of interest noted during this inspection were that:

- . The area around the buildings was sealed by concreting.
- . All buildings except for the powerhouse itself were renovated and contained modern office and store facilities.
- . There appeared to be no evidence of vegetation affected by underlying contamination in the open space.
- . The transformers have been removed. A concrete base covered by gravel remains.
- . The basement of the boilerhouse was open to the environment through breaches in the original entrance ways.
- . There was a small area of exposed coal fines along the embankment which runs next to the south-west wall of the powerhouse facing New Farm Park.
- . Large mounds of compost and bark chips are stored for New Farm park activities on the levelled basement area of the boilerhouse and in the north-west corner of the open space.
- . There are no visible areas of coal where it was formerly stockpiled for powerhouse operation.

6.0 SAMPLING PLAN

The sampling plan developed for the New Farm powerhouse site had two distinct functional components. A triangular grid pattern of boreholes over the open space area, and judgemental sampling based on site history of areas around the existing buildings on site.

6.1 Sample Locations

Historical records indicated that the area of open space contained large amounts of imported fill. Boreholes in a triangular grid pattern, with 50 m spacing between each bore, was judged to be the most effective method for developing a profile for this area. Bores were drilled to the natural ground level in all cases. Samples were collected from each discrete layer in each bore, by auguring. The borelogs provide a detailed description of the layers of fill over the open space area. Appendix 4 contains the detailed locations of each sampling point, sample depth and bore log.

Two bores based on estimates made from consulting historical records were drilled in an attempt to find any discharge of water through the site to the Brisbane River from "Small Creek". Appendix 4 contains the detailed locations of these sampling points, sample depths and bore logs.

Judgemental sampling targeted the boilerhouse rubble, drains, transformers, and areas of exposed ash adjacent to the powerhouse building. Bores were drilled to the concrete basement of the boilerhouse and composite samples taken by auger of the rubble. Drain sediments were sampled by lowering a sample container to grab samples from the deep drains, and surface drain samples were collected with a sampling trowel. Some gravel was collected from the sites of the transformers. Samples of the exposed ash were collected by surface

sampling with a sampling trowel to a depth of 150mm. Appendix 4 contains the detailed locations of these sampling points.

6.2 Analysis parameters

The New Farm Powerhouse site had the potential to be contaminated from a wide range of substances originating from construction, operation and maintenance activities.

Likely contaminants are :

. **Asbestos** - Used in lagging and coating activities through out the powerhouse. Land and structures surrounding areas where asbestos coatings have been used may be contaminated by overspray. The removal of plant and ancillary structures in the 1970's was likely to have removed the bulk of the asbestos material, however the potential for contamination of buildings, surrounding soils and drains by dusts remained possible. The demolition materials in the basement of the boiler house was expected to contain high quantities of asbestos fibres.

. **Coal and Coal Fines** - The structures, and land adjacent to, coal handling or storage facilities are most likely to be contaminated by coal and coal leachates. Under normal rainfall conditions coal produces a highly acidic, metal-rich leachate. Sulphur complexes and heavy metal precipitates often result after contact with the more alkaline surface soils and waters. The complex organic structure of coals leaches a complex mixture of aliphatic and aromatic hydrocarbons, including a wide variety of polynuclear aromatic hydrocarbons. Phenolic and other oxygen-containing organic compounds also leach from coal piles. Leachates generally have high conductivities and concentrations of suspended materials.

. **Petroleum Hydrocarbons** - Resulting from general operation and maintenance practices, spillages of lubricating oils and greases as well as a variety of other

petroleum products are likely to have occurred. Centralised around plant and other mechanical equipment, and possibly storehouses, these contaminants, though biodegradable may still be present.

. **Polychlorinated Biphenyls** - Used for cooling oils in transformers these compounds are highly persistent and toxic contaminants. PCB's may be present near former transformer and storage sites.

. **Ash** - Partially combusted materials and ash from coal firing, boiler ash and flue dust fallout may be distributed across the entire site as well as concentrated in the regions built-up with imported fill. Ash typically contains high concentrations of polycyclic aromatic hydrocarbons, phenols, halogenated hydrocarbons, and other aliphatic and aromatic compounds as well as dioxins, furans, cyanide, metal and sulfur compounds.

6.3 Sample collection protocol

Samples for analysis were collected in the appropriately solvent or acid washed container in all cases.

Samples for metals analysis were collected in acid washed, glass bottles or plastic bags manufactured for soil sampling.

Samples for organics analysis were collected in solvent washed glass bottles with solvent washed teflon cap-liners.

Samples for asbestos analysis were collected in plastic bags manufactured for soil sampling.

Samples for dioxin analysis were collected in glass bottles with teflon cap liners. The bottles were washed with phosphate free detergent, rinsed with water, methanol, acetone, hexane, and methylene chloride.

The sampling auger and drill bits were steamed cleaned before drilling each bore. The sampling trowel was cleaned by rinsing with distilled water and acetone before the collection of each new sample.

6.4 Bore Logs

Bore logs were kept for all bores drilled on the site, by David Stewart of the Geotechnical section of the Brisbane City Council. These revealed the stratification of fill that had been placed over the open space and the nature of the rubble in the boilerhouse basement.

6.4.1 Bores in the open space

The natural ground level of the open space sloped gradually downwards from its north western boundary (Alluvial soils approximately 0.6 m under the existing surface) to the southern corner (Alluvial soils approximately 5.8 m under the existing surface), at the edge of the Brisbane River. The depth and variety of fill changed with the alluvial depth of the open space land. More fill had been placed in a variety of layers over the southern and south-eastern corners of the open space than in the northern and western corners of the open space. The fill which was characterised at the site was mainly sand, gravel and clay mixes that had been placed over the natural topsoil. There were also layers of coal dust and ash over this area. The complete borelogs are contained in appendix 4.

Bores 6,7,8,9,10 and Creek1 had the greatest depth to alluvial soils (3.2 to 5.8 m). They were exclusively located in the southern half of the open space area. The majority of fill was placed over this portion of the open space area. There were a variety of layers of sandy, gravelly, clayey mixes with some building rubble detected in the bores. Ash and coal dust layers in these bores were located at depths of 2.9 to 5.1 m. The bore profiles for this area correspond with recollections of the SEQEB manager of the site at the time, that the

majority of fill imported to the site was soil and building materials from SEQEB cable excavations from around Brisbane.

Bores 4 and 5 were located on the edge of the drop in the alluvial soil level. Alluvial soils were located 2.2 and 2.1 m under the imported fill. The profiles of these two bores were very similar. An ash layer was detected just below the surface at a depth of 0.2 to 0.9 m, and a second layer of ash, coal, and coal dust was found at a depth of 1.3 to 2.2 m. Layers of sandy clay and sandy gravel fill were also found in these bores. No building rubble was detected in these bores.

Bores 1A, 1B, 2 and 3 were drilled in the northern section of the open space area. Alluvial soils were found 1 m below the surface. Little fill was imported to this area. A layer of ash was detected immediately below the surface in bores 1A, 2 and 3. This layer appeared to be the only imported material over the northern portion of the open space area.

6.5 The Boilerhouse

Two bores were drilled through the rubble in the boilerhouse basement. These bores contained building rubble, cobbles and timber over a concrete floor 3.95 m under the surface. A sandy gravel surface had been compacted over this building rubble.

7.0 CHEMICAL ANALYSES

Samples were submitted to Australian Laboratory Services Limited (ALS, Brisbane), Safety in Mines Testing and Research Station (Simtars, Brisbane) and the Institute of Environmental Health and Forensic Services (New Zealand).

Australian Laboratory Services Limited performed analyses for polynuclear aromatic hydrocarbons, phenols, total petroleum hydrocarbon, sulfur, cyanide and selected metals. ALS is a NATA registered laboratory. Quality control spikes and replicate samples were analysed by ALS.

All samples for metals analysis were prepared in accordance with USEPA Method 3051 (microwave digestion for metals). Analysis was carried out by inductively coupled plasma atomic emission spectroscopy (ICPAES) or cold vapour atomic absorption spectroscopy (CVAAS) as appropriate.

Samples for polynuclear aromatic hydrocarbons and phenols were extracted by ultrasonication, and analysed by gas chromatography - mass spectrometry. Samples for total petroleum hydrocarbons were extracted by ultrasonication, and analysed by gas chromatography - mass spectrometry (GCMS) and gas chromatography - Flame Ionisation Detector (GCFID).

SIMTARS carried out asbestos testing. Tests were carried out using polarising light microscopy techniques. Samples were sent to the Electron Microscope Centre at the Queensland University of Technology for confirmation of results.

The Institute of Environmental Health and Forensic Services, New Zealand, conducted testing for dioxins in the submitted samples. A travel blank, the samples and quality control samples were all processed by the Institute of

Environmental Health and Forensic Services. The Institute is registered by the Testing Laboratory Registration Council of New Zealand (NATA equivalent).

7.1 Heavy Metal Contamination

Samples from the boilerhouse fill, and bores 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 were analysed for levels of heavy metal concentration. The analytes selected were arsenic, cadmium, cobalt, chromium, copper, manganese, nickel, lead, zinc, and mercury. Samples were selected from all levels of fill in the bores, including the surface soils, ash layers, imported soils and building materials.

All levels of analytes in these samples were below the thresholds for environmental investigation as specified by A Guide to the Contaminated Land Act 1991 (Chemical Hazards and Emergency Unit (Chem. Unit), 1992) except for those samples listed in Table I. The original analytical reports are contained in Appendix 6.

Samples with heavy metal concentration above threshold levels for environmental investigation were in layers of subsurface, imported fill in all cases. The soil/building rubble matrix 2.0 m below the surface in borehole 10, and 2.5-3.0m below the surface in borehole 6 contained levels of copper above the threshold environmental investigation level. The ash layer 1.0 m below the surface in bore 3 contained levels of manganese above the threshold environmental investigation level. The surface material across the site did not appear to be contaminated with heavy metals.

The results of the preliminary site investigation indicated that there is no evidence of any significant metal contamination across the site. As the site was filled with large amounts of imported material from construction activities, isolated pockets of contamination could exist.

Table I
Metal Concentration At The Powerhouse Site

Sample	Analyte	Concentration mg/kg	Environmental Threshold mg/kg (Chem. Unit, 1992)
Borehole #3 1.0 - 1.5m Ash layer	Manganese	854	500
Borehole #10 2.0 -2.5m Gravelly sand and building rubble	Copper	98	60
Borehole #6 2.5 -3.0m Sandy gravelly clay	Copper	68	60

7.2 Organic Contamination

Samples from boreholes 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 were analysed for levels of concentration of possible organic contaminants. The analytes selected were polynuclear aromatic hydrocarbons, phenols and petroleum hydrocarbons. Samples were selected from all levels of fill in the bores, including the surface soils, ash layers, imported soils and building materials.

All levels of analytes in these samples were below the thresholds for environmental investigation as specified by A Guide to the Contaminated Land Act 1991 (Chem. Unit, 1992) except for those samples listed in Table II. The original analytical reports are contained in Appendix 6.

Petroleum hydrocarbons were detected in the surface soil of borehole 1B. The bore was adjacent to the old coal-handling wharf now used by a commercial barge operator. This contamination was likely to have been caused by fuelling operations or spillages associated with wharf activities.

Table II
Organic contaminants at the site

Sample	Analyte	Concentration mg/kg	Threshold level for health based investigation mg/kg (Chem. Unit, 1992)
Bore #1 0 - 0.25m Surface soil	Total petroleum hydrocarbon	1540	_____
Bore #3 0 - 0.25m Surface soil	PAH	23.6	20
Bore #5 2.0 - 2.5 m Alluvial soils	PAH	20.0	20

Polynuclear aromatic hydrocarbons are generated by the combustion of fossil fuels. High levels of these contaminants were expected at the powerhouse site. PAH's were detected in the surface soils of bores 3,4 and 9, the alluvial soil of borehole 5 and in the ash layers of bores 6 and 8. Levels of PAH's at borehole 3 exceed threshold limits for a health based investigation. Despite the levels detected at borehole 3, PAH levels did not appear to be excessive in the surface soils across the site. Sub-surface levels of PAH's did not appear to pose a health or environmental risk in relation to future use of the site.

There does not appear to be any significant contamination by phenols or petroleum hydrocarbons at the New Farm powerhouse site.

7.3 Asbestos Contamination

Samples from the Boilerhouse rubble and the northern and southern sections of the open space, and drain sediments were tested for asbestos contamination by polarising light microscopy and scanning electron microscopy. The original analytical reports are contained in Appendix 6.

The results for the asbestos testing for these samples are shown in Table I. Results for the drain sediment sample were still outstanding at the time that this report was completed.

Table III
Asbestos Concentrations At The New Farm Powerhouse

Sample	Results by Polarising Light Microscopy	Results by Scanning Electron Microscopy
Boilerhouse #1	Organic Fibre < 1% Particulate Matter > 99% No asbestos detected	No asbestos detected
Boilerhouse #2	Organic Fibre < 1% Particulate Matter > 99% No asbestos detected	No asbestos detected
Bore #3	Particulate matter 100 % No asbestos detected	Some crocidolite fibre in a subsample, no asbestos in the remainder of the sample

Sample	Results by Polarising Light Microscopy	Results by Scanning Electron Microscopy
Bore #7	Particulate matter 100 % No asbestos detected	No asbestos detected

The scanning electron microscopy report for borehole 3 detected some crocidolite fibres in the sample. These results when compared with results by polarising light microscopy indicated that the bulk of the sample did not contain asbestos.

There does not appear to be wide spread asbestos contamination at the New Farm Powerhouse site.

7.4 Dioxin Contamination

A composite sample from the open space area, a sample of the exposed ash along the embankment which runs next to the south-west wall of the powerhouse facing New Farm Park, and a travel blank were sent to the Institute of Environmental Health and Forensic Services, New Zealand.

Results for these samples are presented in Table IV. The original sample reports are contained in appendix 5.

Table IV
Dioxin contamination at the site

Sample	Dioxin Concentration pg g^{-1} Total toxic equivalents
Blank	0.21
Exposed ash	33.4
Composite cleared area	260

The principle environmental sources of dioxins are suspected to be of industrial origin. Sources of dioxins include incineration processes, motor vehicles, residential burning, and forest fires. Dioxin contamination at the site may have been generated by the coal firing processes used for power generation. Travis *et.al.* (1989) reported average dioxin concentrations of 1405 pg g^{-1} for urban sites in the United States of America with a previously known source of contamination, and 1819 pg g^{-1} for Canadian urban soils. Berry *et.al.* (1993) concluded that dioxins are common by-products of human society and are widely dispersed in the ambient environment.

The concentration of dioxin over the open space area was greater than that found in the exposed ash along the embankment which runs next to the south-west wall of the powerhouse facing New Farm Park.

7.5 Sulphur And Cyanide Contamination

Samples from bores 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 were analysed for levels of sulphate and cyanide concentration. Samples were selected from all levels of fill in the bores, including the surface soils, ash layers, imported soils and building materials.

All levels of analytes in these samples were below the thresholds for environmental investigation as specified by A Guide to the Contaminated Land Act 1991 (Chem. Unit, 1992) except for those sample 1B. The original analytical reports are contained in Appendix 5.

Sulphur levels of 8700 mg/kg as sulphate, were measured in the sample of borehole 1B. This exceeds the threshold environmental investigation level of 2000 mg/kg for sulphates.

There appeared to be no extensive sulphate or cyanide contamination across the site.

7.6 PCB Contamination

Samples collected from the former transformer sites were found to be unsuitable for analysis. As this area was fully concreted, it was concluded that any possible PCB contamination would be localised. If redevelopment plans include the disturbance or use of this area of the site, further investigation of possible PCB contamination may be necessary.

8.0 SUMMARY OF RESULTS

The results for each borehole are summarised in the following tables. All results are in mg/kg unless otherwise indicated.

Table V
Boreholes 1 - 4

Analyte	Borehole 1B 0.0 - 0.25 m	Borehole 2 1.5 - 2.0 m	Borehole 3 0.0 - 0.25 m	Borehole 3 1.0 - 1.5 m
% Moisture	11.1	15.1	8.5	13.2
% Sulphur	0.29	0.01	0.05	0.05
Arsenic	4	5	10	3
Cadmium	<1	<1	<1	<1
Cobalt	6	11	4	13
Chromium	6	24	13	22
Copper	21	15	13	13
Manganese	124	391	172	854
Nickel	6	15	8	16
Lead	19	25	25	12
Zinc	43	52	48	42
Mercury	<0.1	0.1	<0.1	0.1
Cyanide	0.2	0.1	0.1	<0.1
Phenol	<0.67	<0.67	<0.67	<0.67

Analyte	Borehole 1B 0.0 - 0.25 m	Borehole 2 1.5 - 2.0 m	Borehole 3 0.0 - 0.25 m	Borehole 3 1.0 - 1.5 m
PAH	<0.67	<0.67	NA	23.63
Petroleum Hydrocarbon	1540	<100	NA	<100

Table VI
Boreholes 4 - 7

Analyte	Borehole 4 0.5 - 1.5 m	Borehole 5 2.0 - 2.5 m	Borehole 6 2.5 - 3.0 m	Borehole 7 0.0 - 0.25m
% Moisture	14.9	16.9	17.6	10.8
% Sulphur	0.11	0.01	0.04	0.01
Arsenic	4	3	5	8
Cadmium	<1	<1	<1	<1
Cobalt	8	8	5	8
Chromium	15	22	20	7
Copper	21	11	68	22
Manganese	189	242	206	424
Nickel	9	14	11	13
Lead	31	7	109	50
Zinc	56	33	170	88
Mercury	0.1	0.1	0.4	0.4
Cyanide	0.1	<0.1	0.1	<0.1

Analyte	Borehole 4 0.5 - 1.5 m	Borehole 5 2.0 - 2.5 m	Borehole 6 2.5 - 3.0 m	Borehole 7 0.0 - 0.25m
Phenol	<0.67	<0.67	<0.67	<0.67
PAH	10.88	20.04	1.45	<0.67
Petroleum Hydrocarbon	<100	<100	<100	<100

Table VII
Boreholes 8 - 10

Analyte	Borehole 8 3.0 - 3.5 m	Borehole 9 0.0 - 0.25m	Borehole 10 2.0 - 2.5m
% Moisture	12.7	12.3	7.2
% Sulphur	0.05	0.03	0.07
Arsenic	6	2	10
Cadmium	<1	<1	<1
Cobalt	5	1	6
Chromium	31	11	20
Copper	54	11	98
Manganese	97	53	189
Nickel	11	3	9
Lead	71	84	139
Zinc	75	111	119
Mercury	0.2	<0.1	0.3

Analyte	Borehole 8 3.0 - 3.5 m	Borehole 9 0.0 - 0.25m	Borehole 10 2.0 - 2.5m
Cyanide	0.2	0.1	<0.1
Phenol	<0.67	<0.67	<0.67
PAH	12.28	<0.67	<0.67
Petroleum Hydrocarbon	<100	<100	<100

Table VIII
Boreholes on boilerhouse

Analyte	Borehole Boilerhouse #1	Borehole Boilerhouse #2
% Moisture	9.8	12.9
% Sulphur	0.05	0.08
Arsenic	10	5
Cadmium	<1	<1
Cobalt	4	2
Chromium	14	5
Copper	27	13
Manganese	183	90
Nickel	9	7
Lead	119	61
Zinc	109	51

Analyte	Borehole Boilerhouse #1	Borehole Boilerhouse #2
Mercury	0.1	0.2
Cyanide	0.4	0.1
Asbestos	None detected	None detected

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9.0 CONCLUSION

Based on the findings of the preliminary site investigation, there is no evidence of any significant level of contaminants which would restrict a proposed end-use of the site for the following purposes :

- 1) Adaptation for arts/cultural use
- 2) Adaptation for sports/recreation use
- 3) Adaptation for housing
- 4) Open space adaptation

If the proposed end-use of the New Farm Powerhouse site is for residential housing, or if significant excavation operations are proposed, it would be necessary to conduct a more detailed investigation targeting those areas which exceed threshold levels of contamination for environmental investigation as determined by Chem. Unit (1992).

It will be necessary to instigate discussions with the Department of Environment and Heritage (Qld.), Contaminated Land Unit in regard to the following:

- . The proposed development of the site
- . Results of the preliminary site investigation
- . The need for further site assessment

10.0 References

Allom Lovell Marquis-Kyle (1992) *New Farm Powerhouse Assessment : A Study for the Urban Renewal Task Force Brisbane City Council* (unpublished)

Anderson M., Bertsch P., et.al., (1991) *Interactions of Acidic Metal-Rich Coal Pile Runoff with a Subsoil*, *Enviro.Sci.Technol.*, Vol.25, No.12.

Australian and New Zealand Environment and Conservation Council and National Health and Medical Research Council (1992) *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*

Berry R., Luthe C., Voss R., (1993) *Ubiquitous Nature of Dioxins*, *Enviro.Sci.Technol.*, Vol.27, No.6.

Buser H. (1991) *Polychlorodibenzothiophenes, the Sulfur Analogues of the Polychlorodibenzofurans Identified in Incineration Samples*, *Enviro.Sci.Technol.*, Vol.25, No.9.

Chemical Hazards and Emergency Unit (1992) *A Guide to the Contaminated Land Act 1991*, Queensland Government Printers, Brisbane.

Fendinger N., Radway J., et.al., (1989) *Characterisation of Organic Matter Leached from Coal by Simulated Rainfall*, *Enviro.Sci.Technol.*, Vol.23, No.2.

Travis C., Hattermer-Frey H., Sildergeld E., (1989) *Dioxin, Dioxin Everywhere*, *Enviro.Sci.Technol.*, Vol.23, No.9.

APPENDIX 1

Site Details

RTI DL RELEASE - EHP

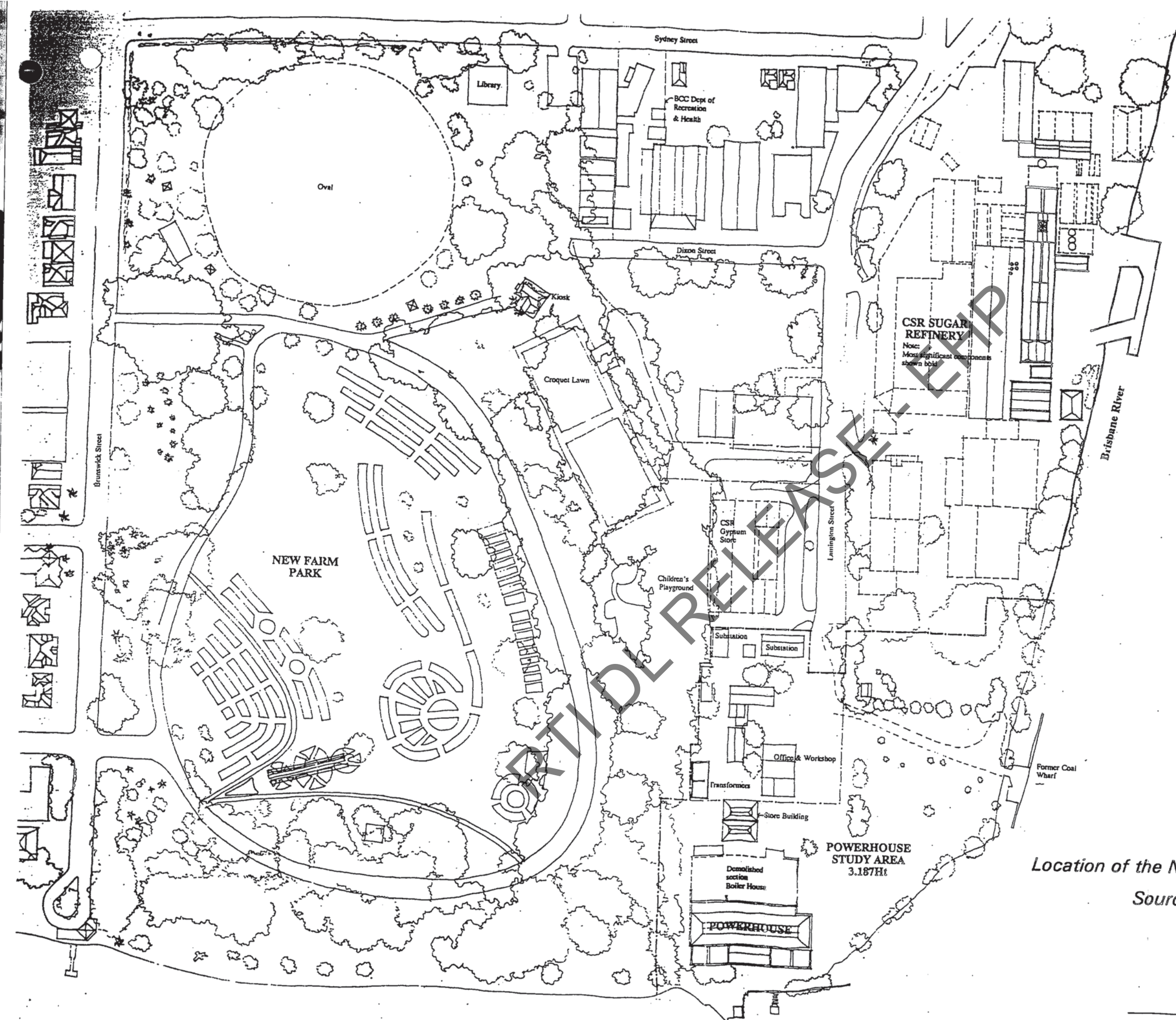


FIGURE 1

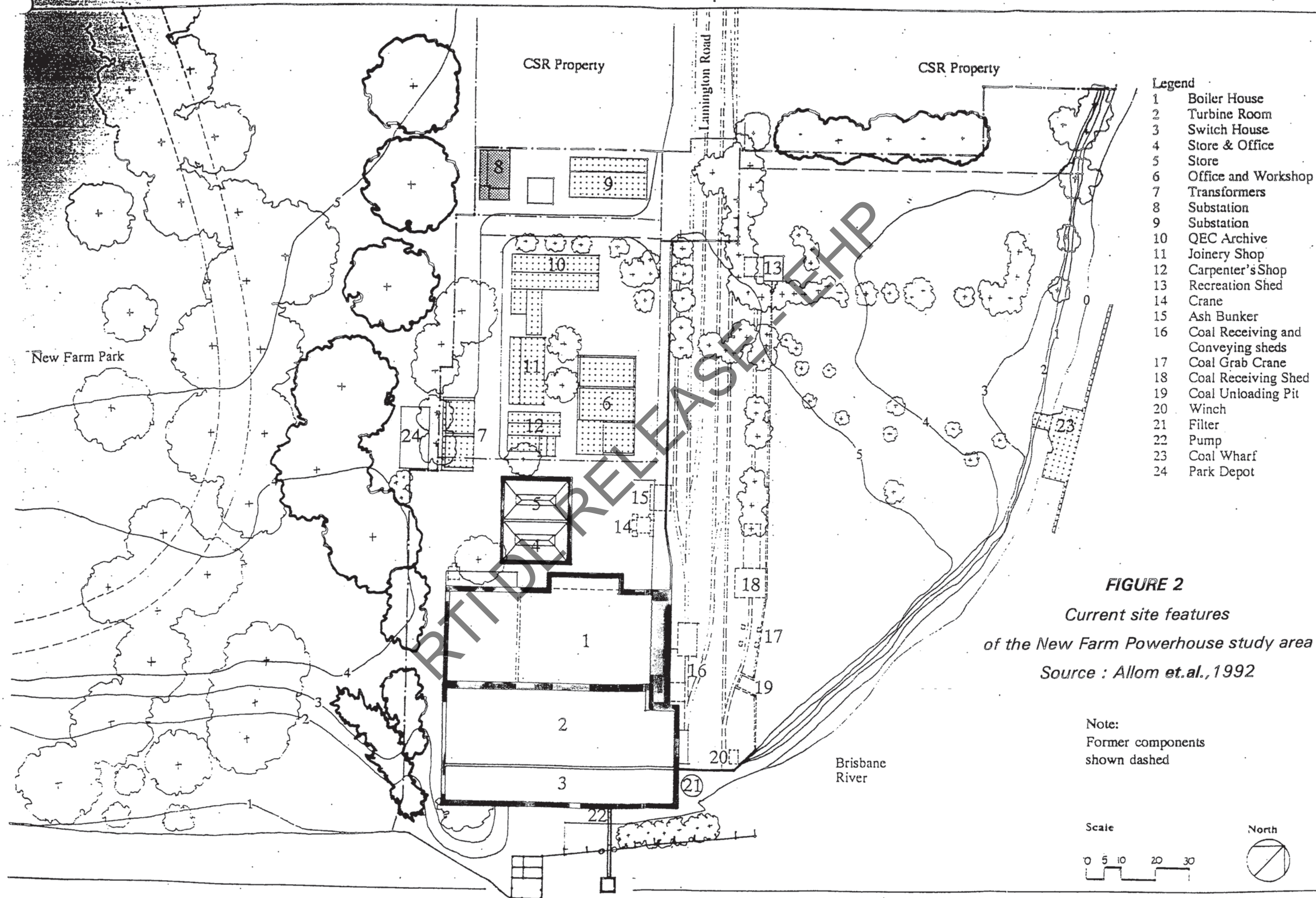
Location of the New Farm Powerhouse study area

Source : Allom et.al., 1992

Scale

0 20 40 60m





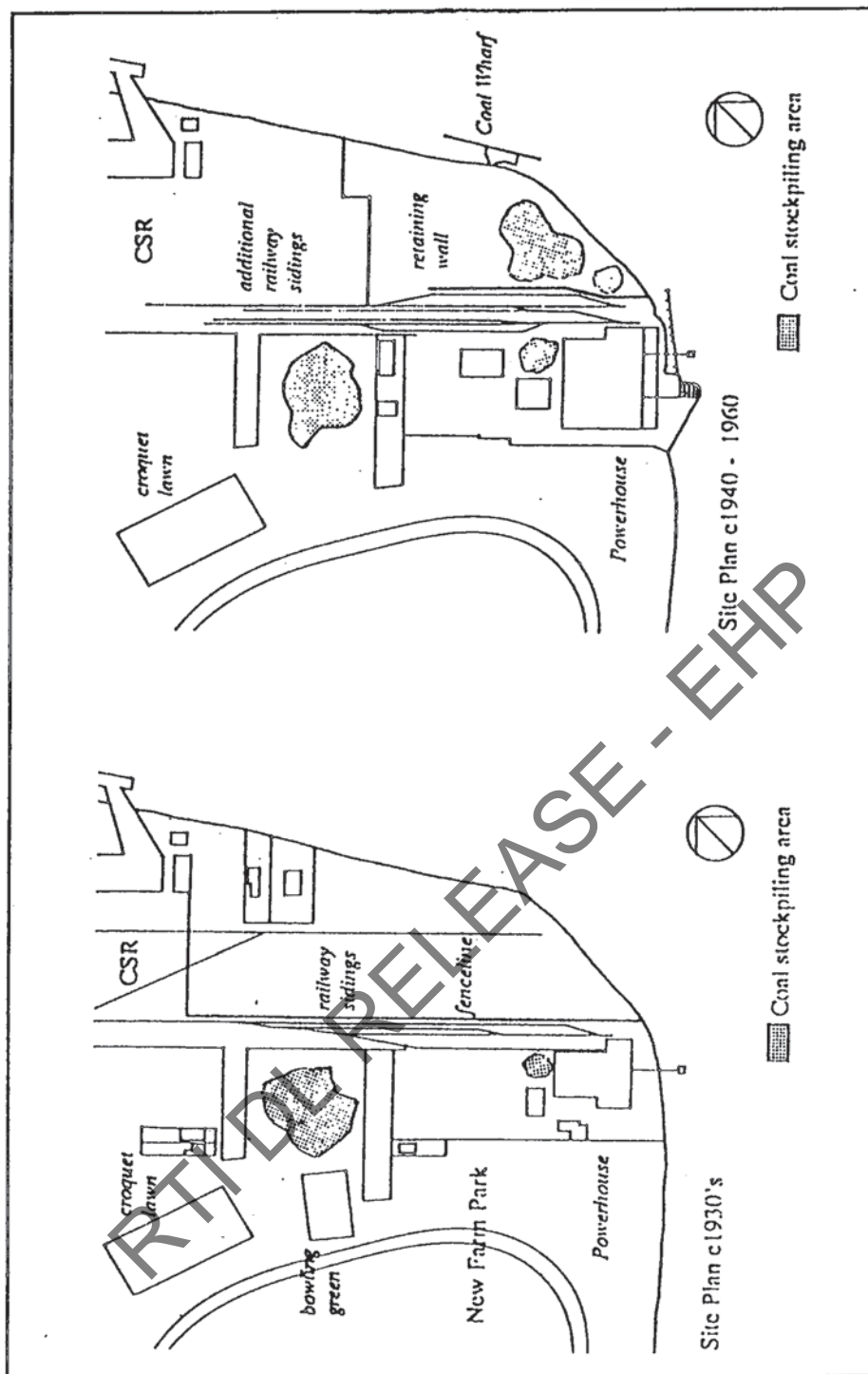


FIGURE 5
*Former coal stockpiling areas
 at the New Farm Powerhouse study area
 Source : Allom et.al., 1992*

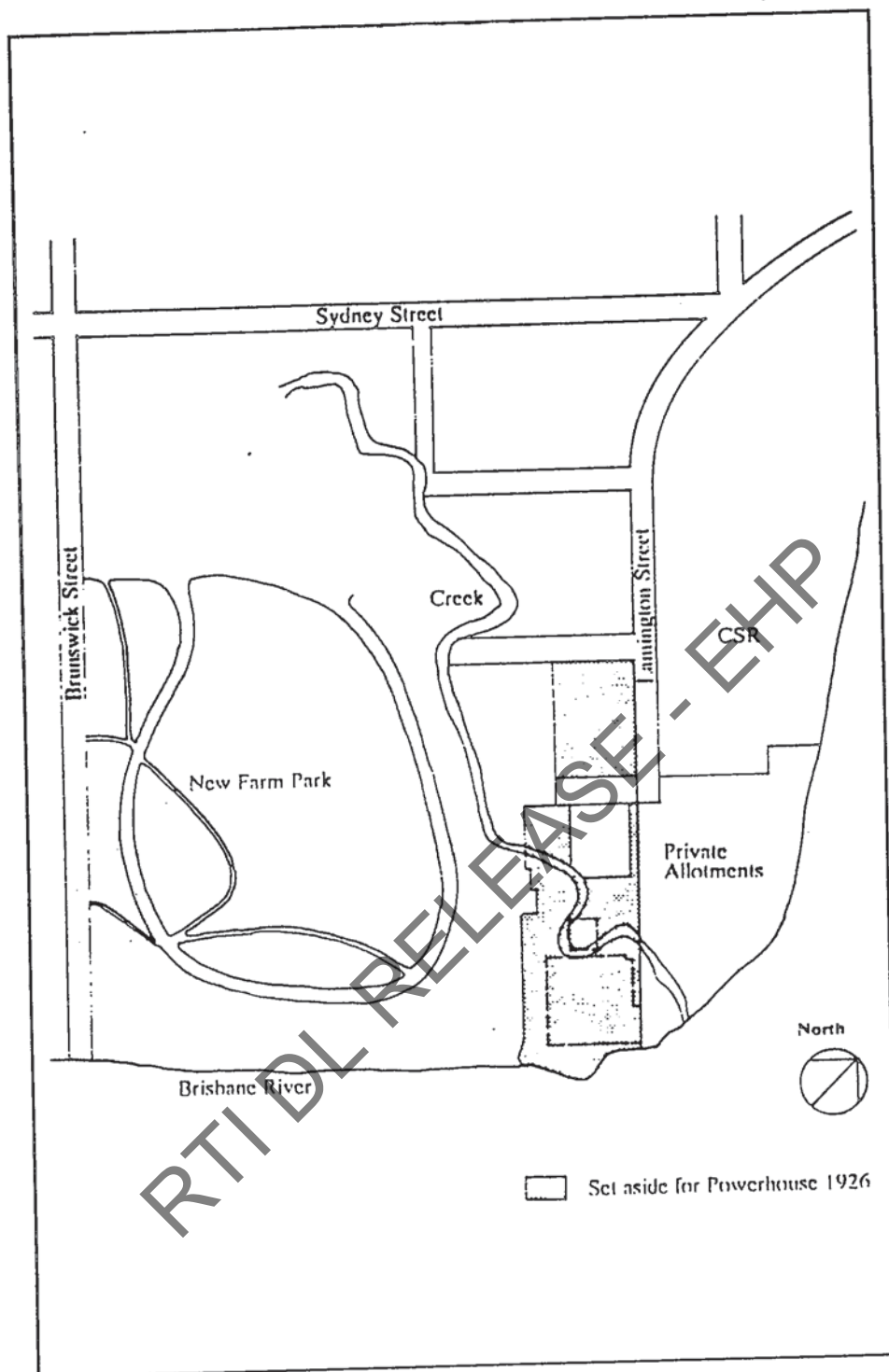


FIGURE 6
*Former location of Small Creek
 at the New Farm Powerhouse study area*
Source : Allom et.al., 1992

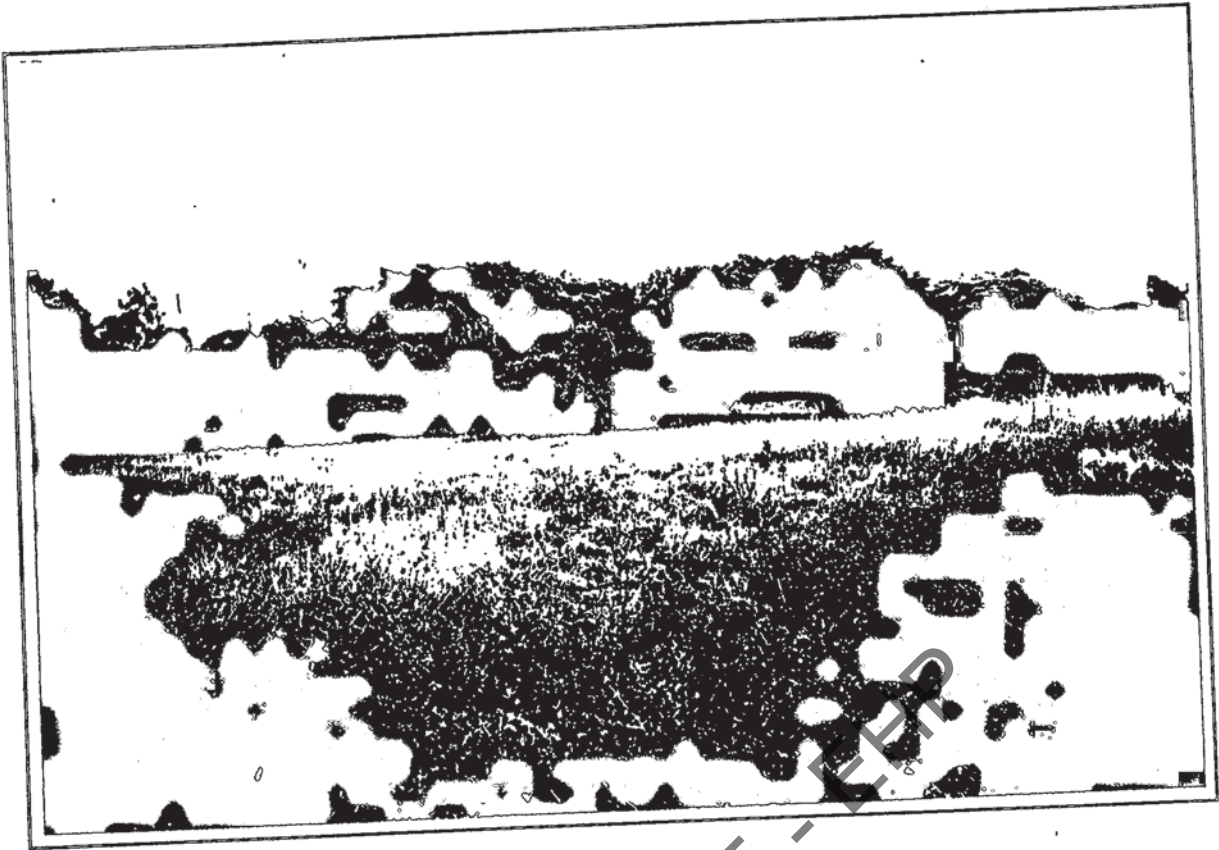


FIGURE 7 Open space facing north-west boundary

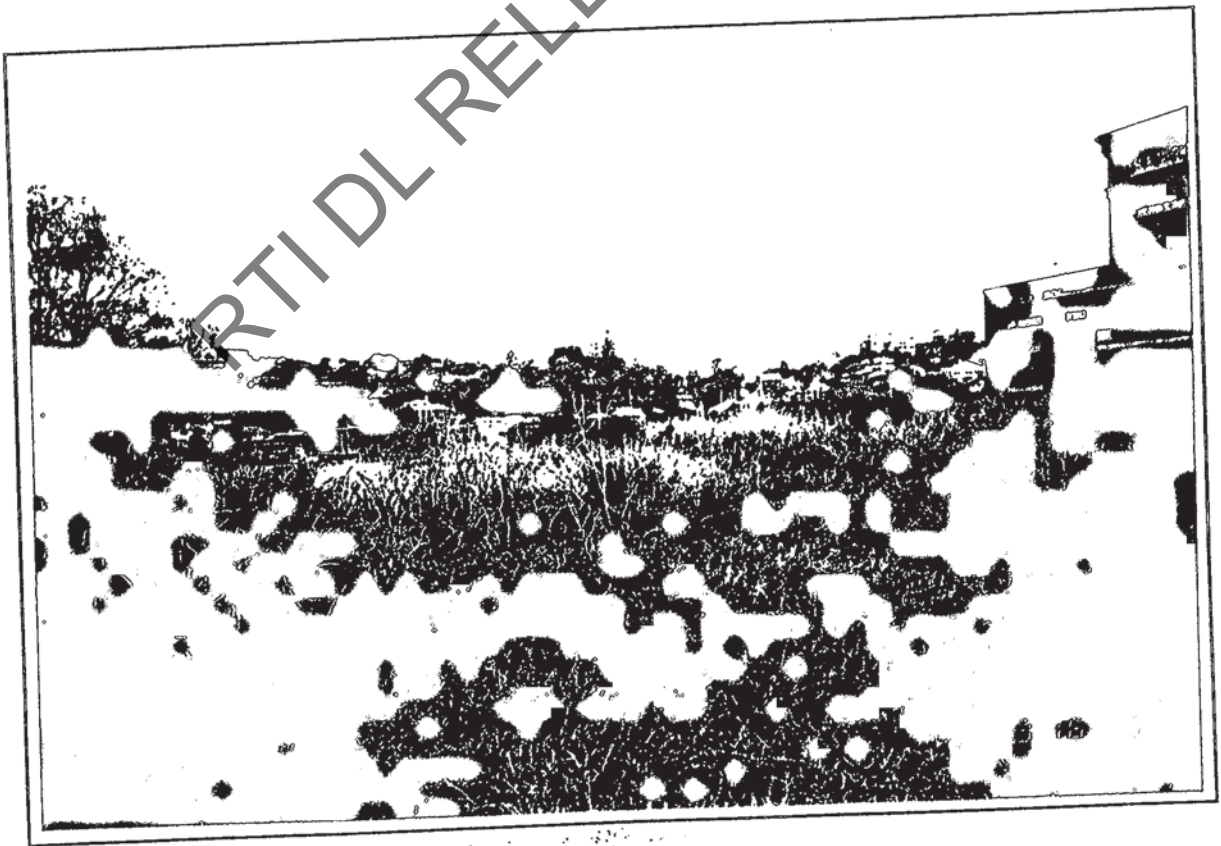


FIGURE 8 Open space facing south-east boundary

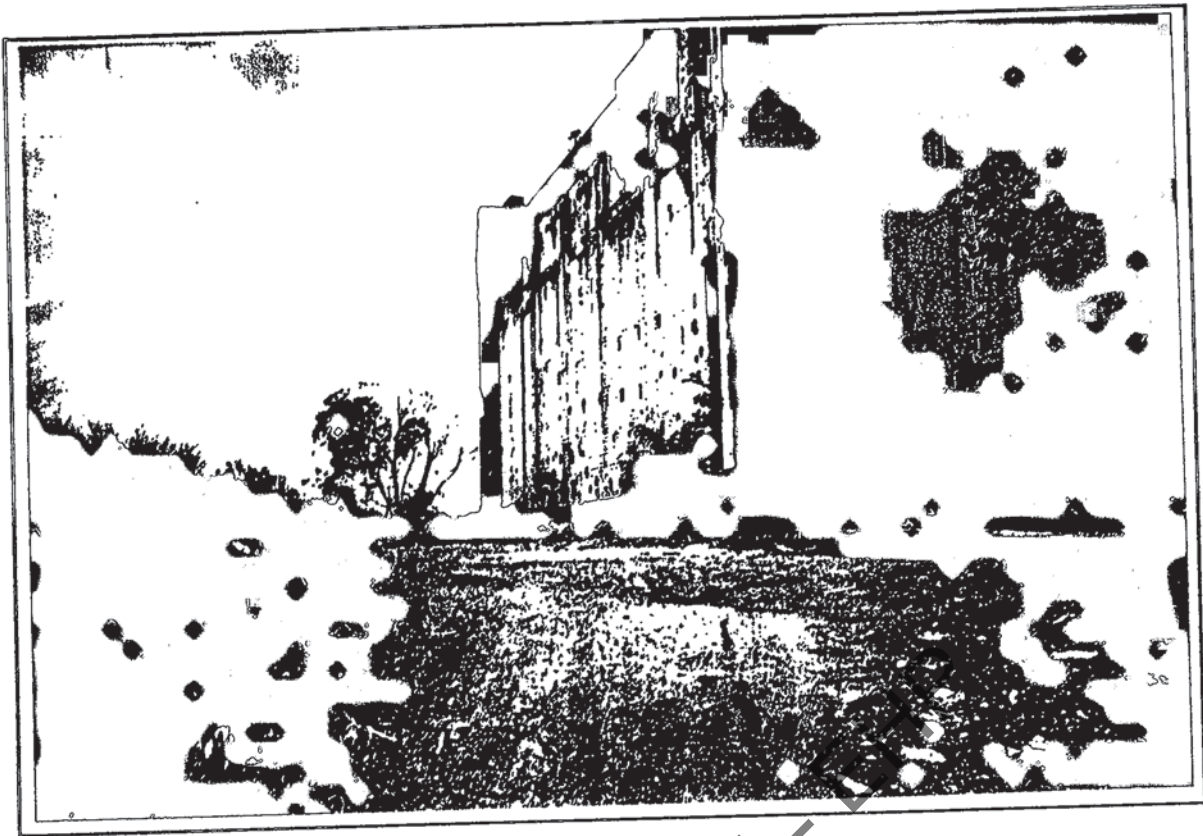


FIGURE 9 Surface of the demolished boilerhouse

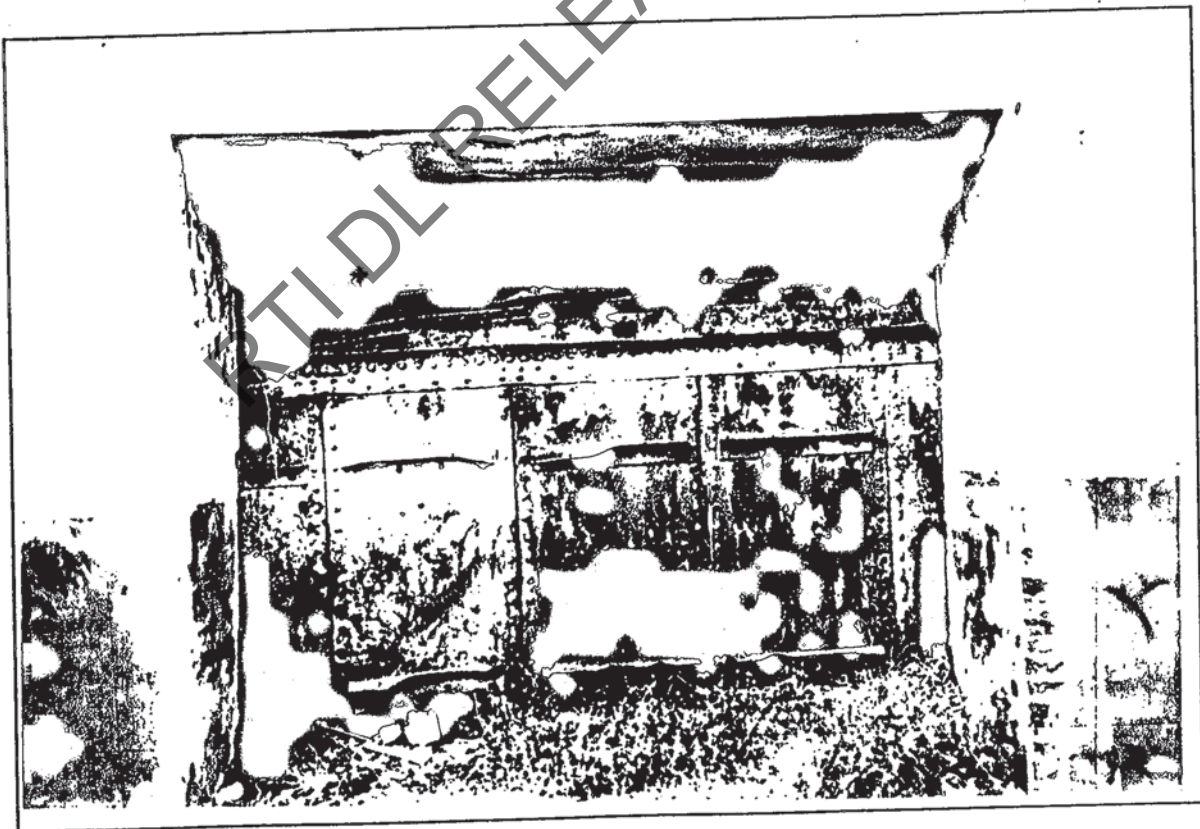


FIGURE 10 Open doorway to boilerhouse basement



FIGURE 11 *Embankment from the powerhouse to New Farm Park*



FIGURE 12 Ash on the surface of the embankment

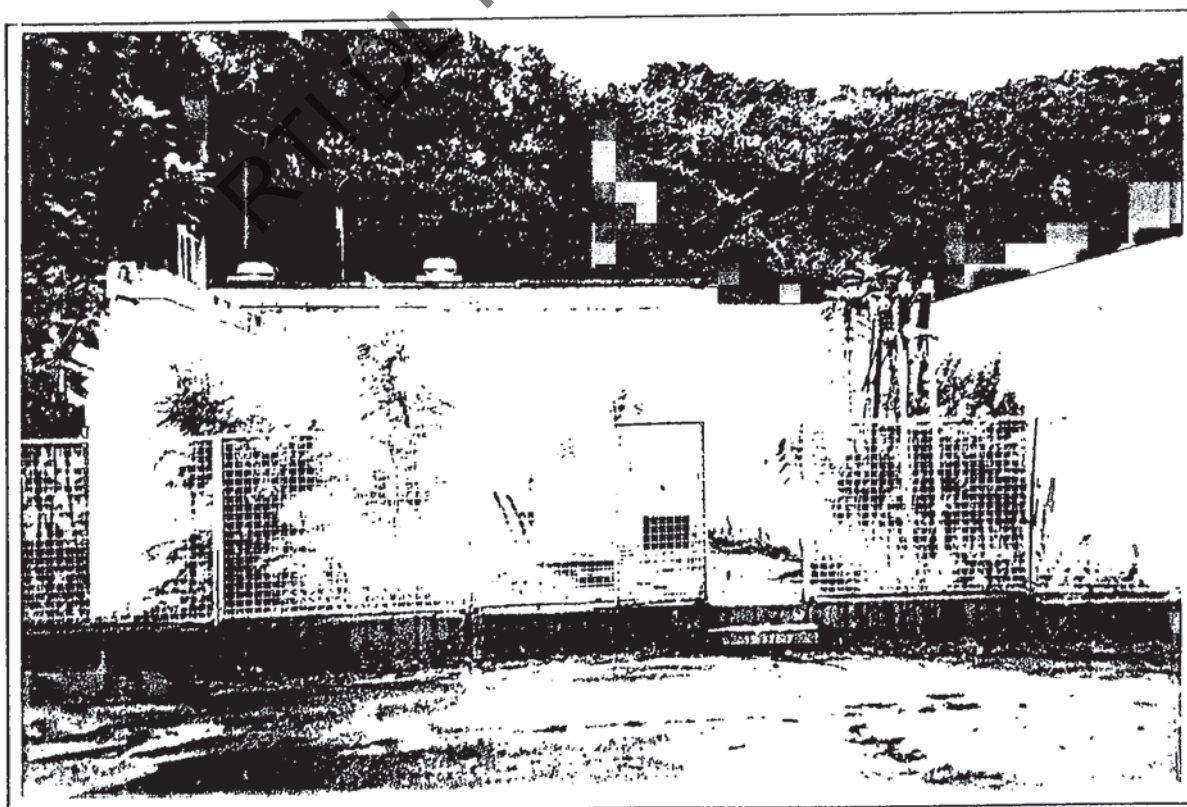
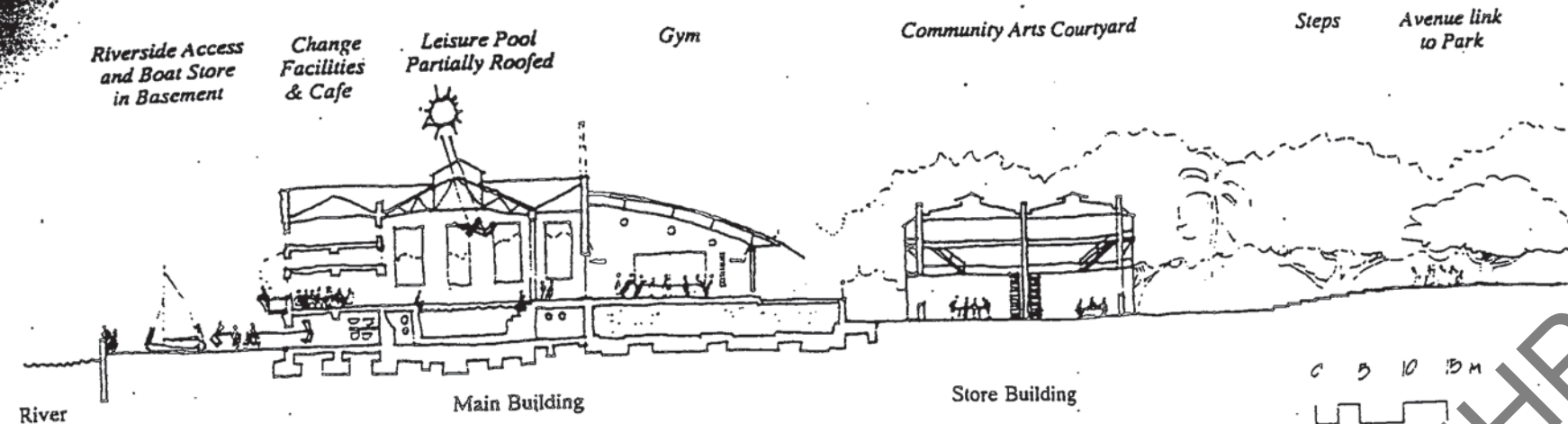
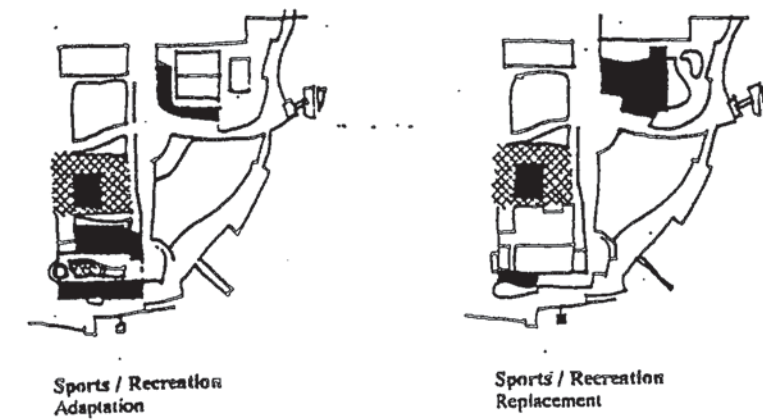


FIGURE 13 Former transformer housing

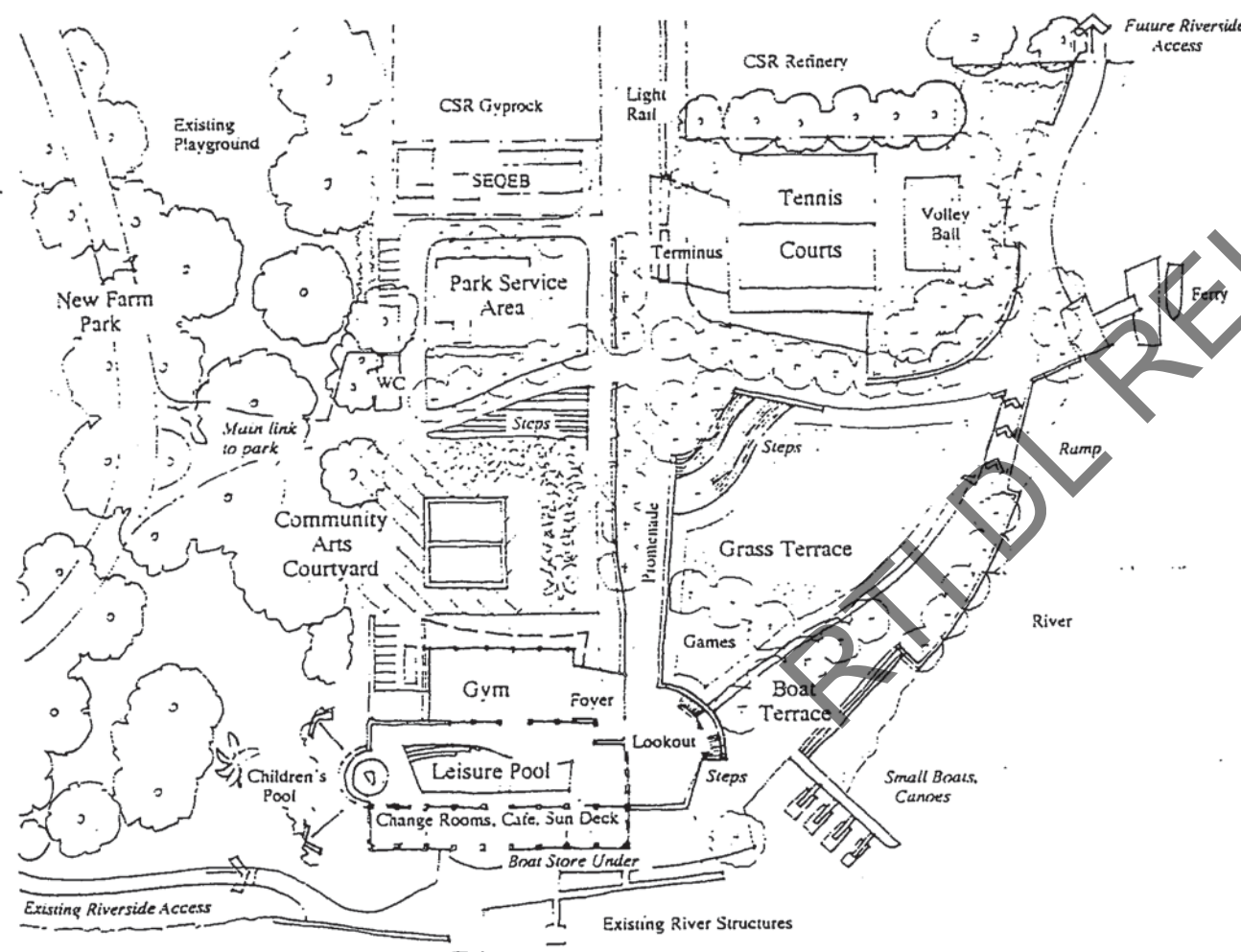
APPENDIX 3
Proposed Redevelopment Schemes



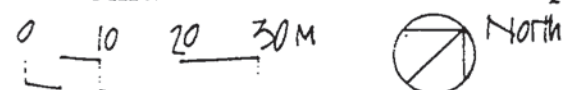
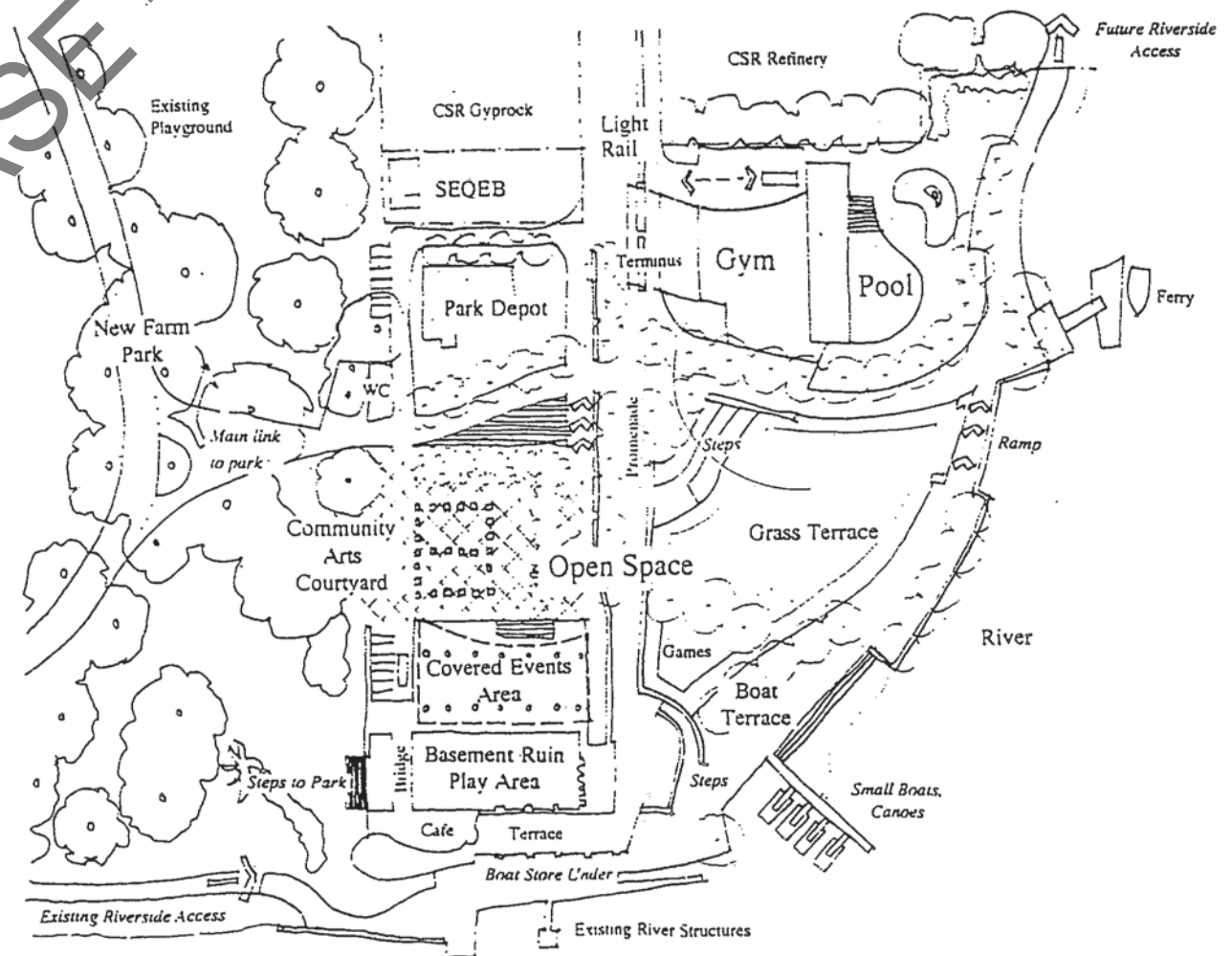
Schematic Site Section - Adaptation



Key Diagram



Schematic Site Plan - Adaptation



Schematic Site Plan - Replacement

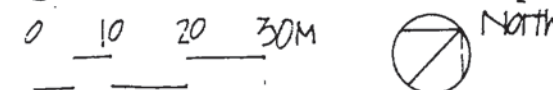
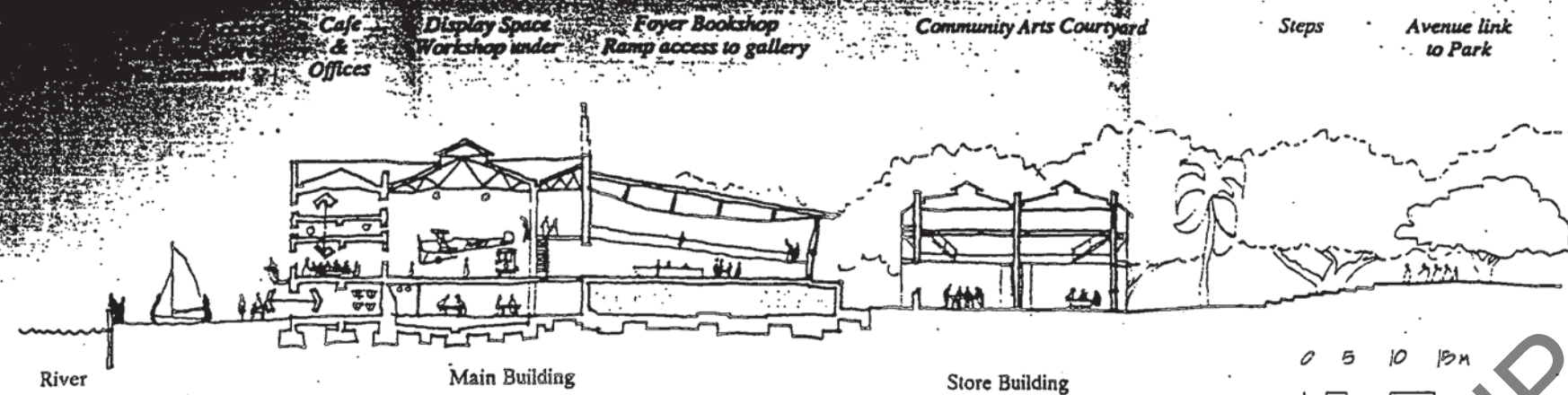


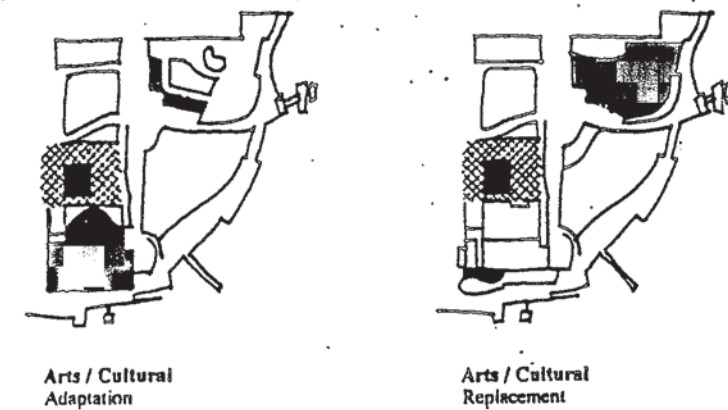
FIGURE 19

Site Redevelopment Sports/Recreational Opti

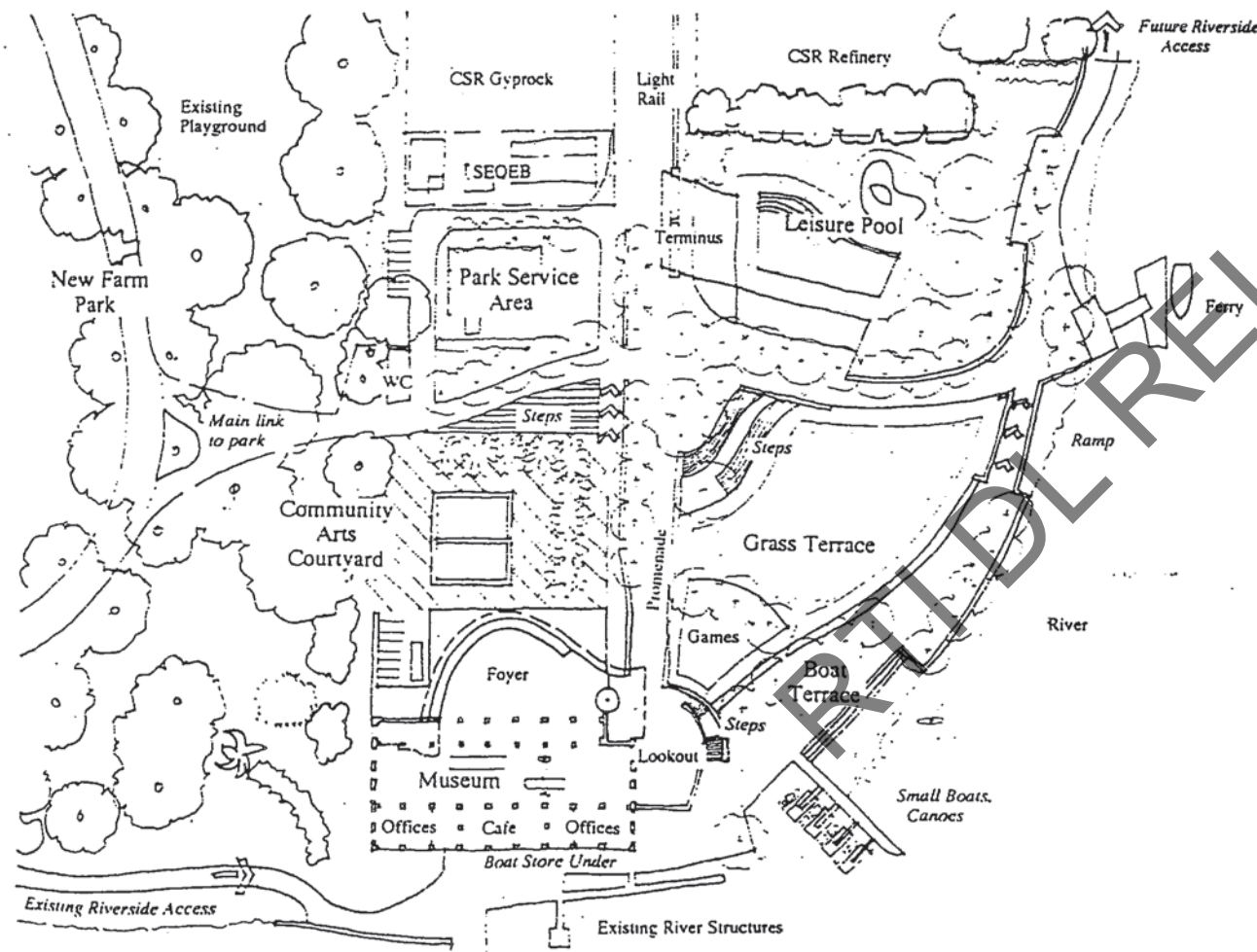
Source: Allom et.al.(1992)



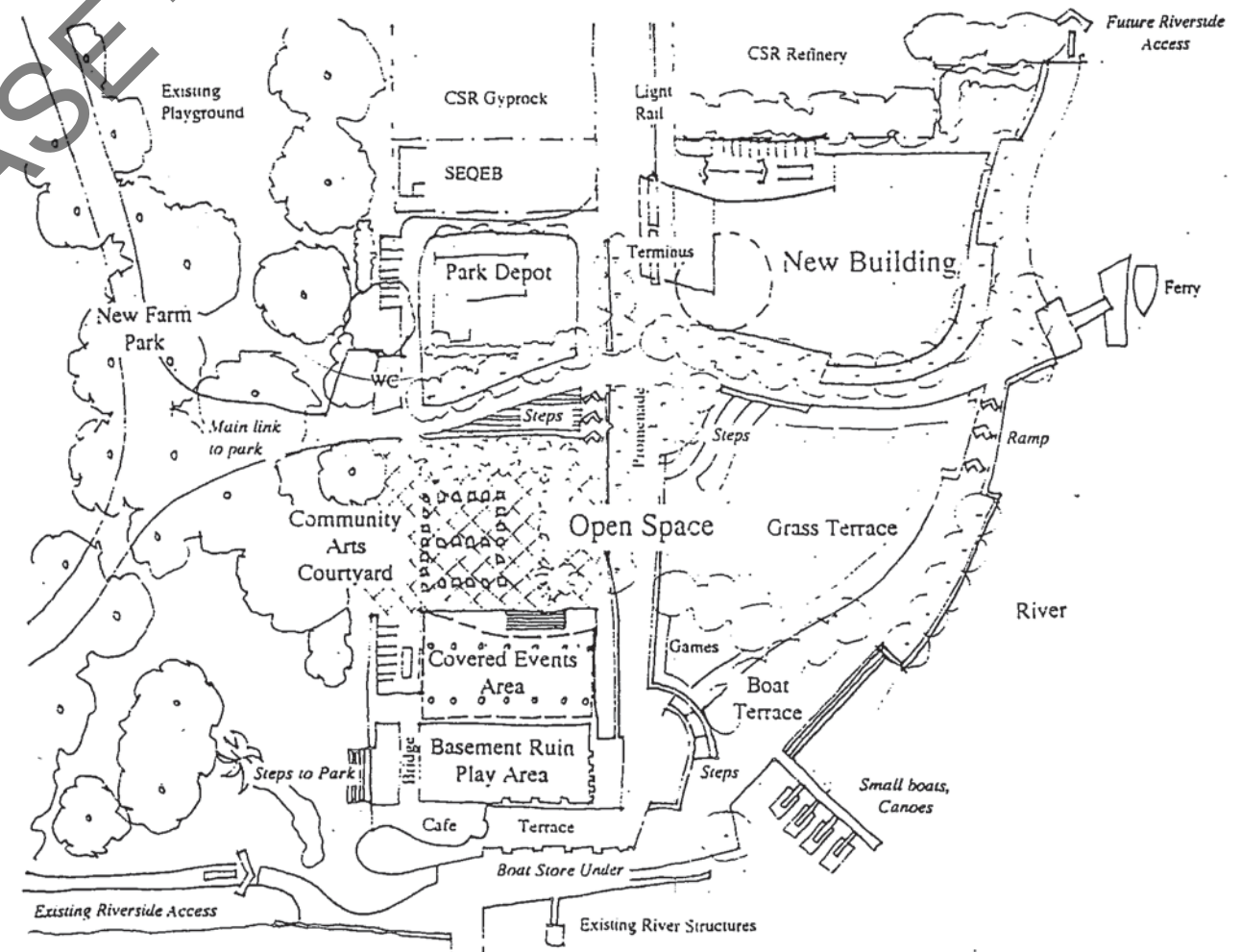
Schematic Site Section - Adaptation



Key Diagram



Schematic Site Plan - Adaptation

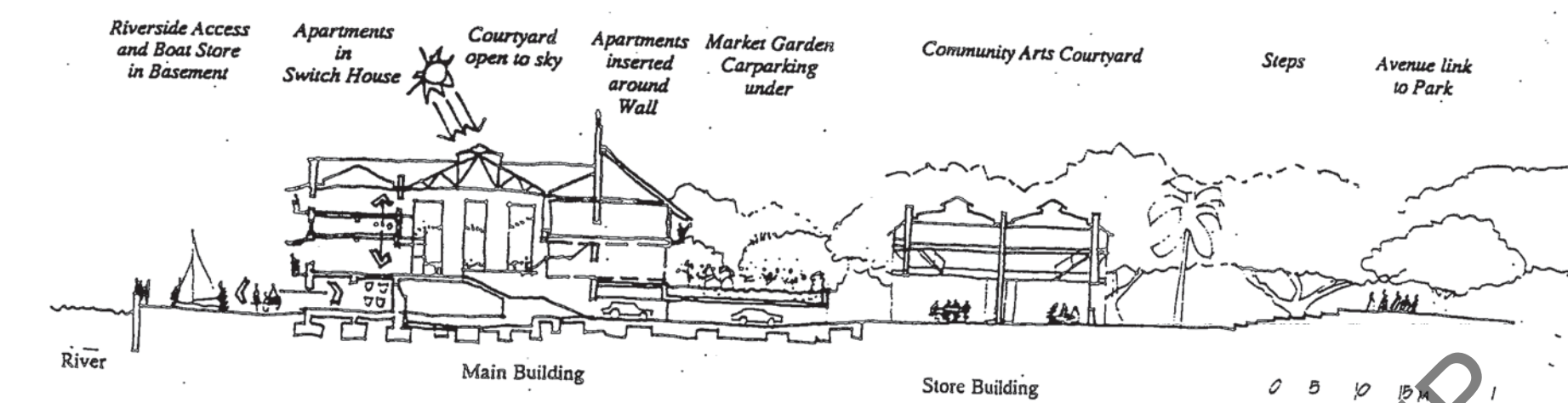


Schematic Site Plan - Replacement

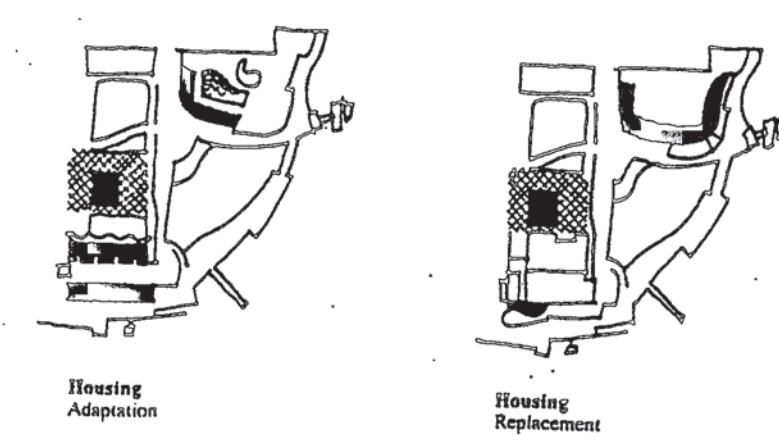
FIGURE 18

Site Redevelopment Arts/Cultural Opti

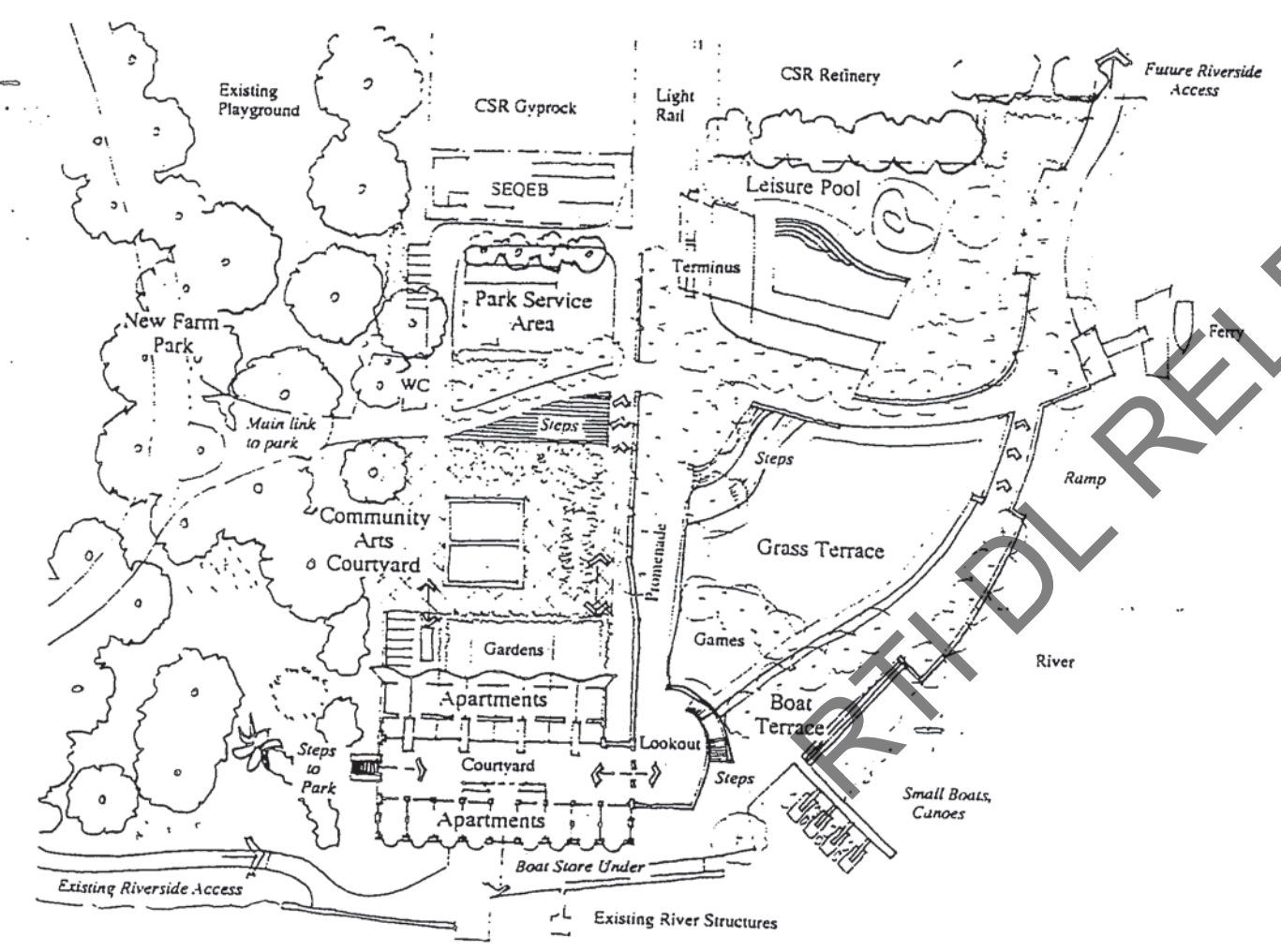
Source: Allom et.al.(1992)



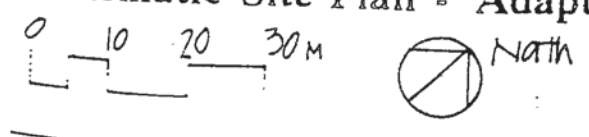
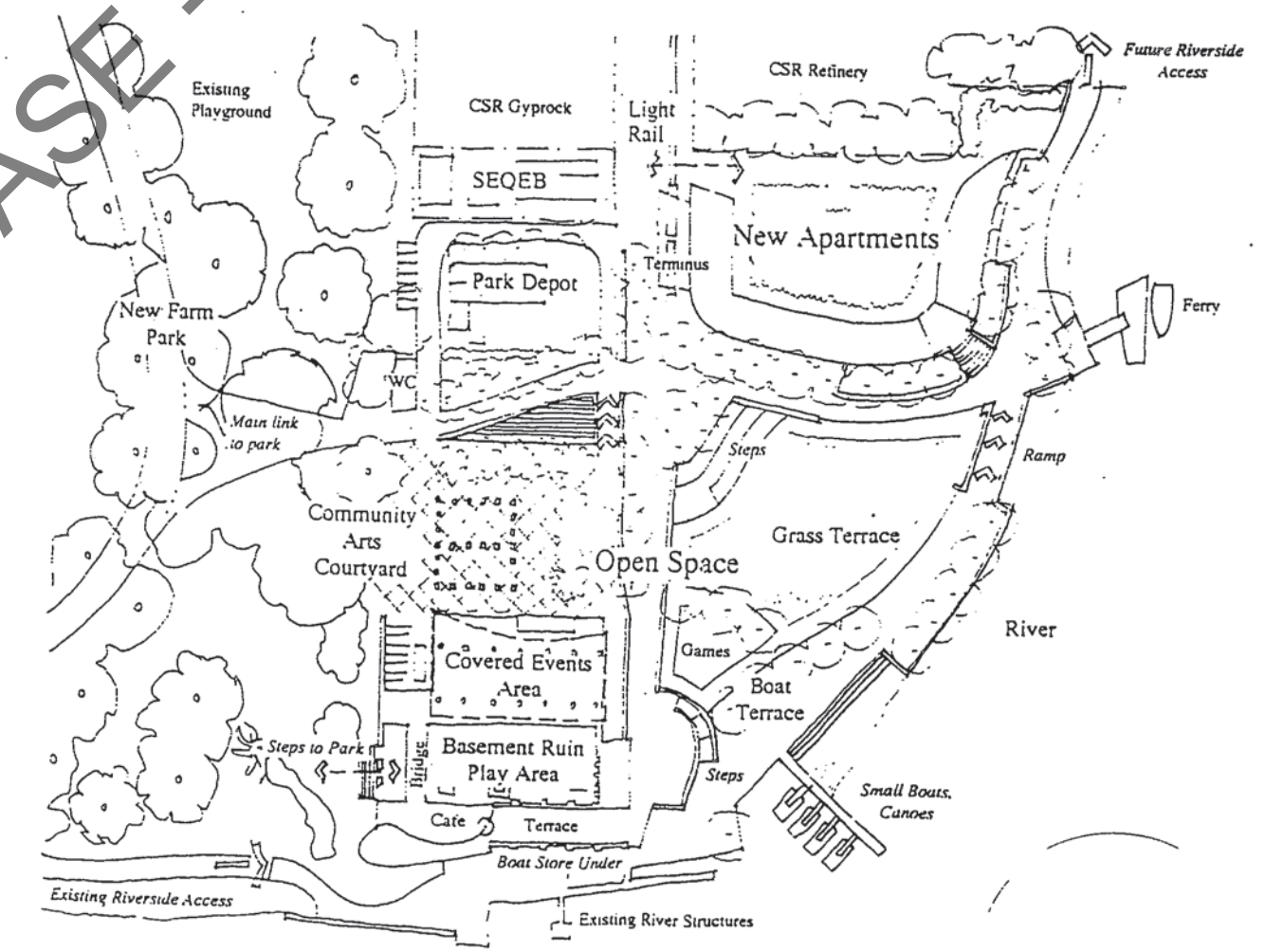
Schematic Site Section - Adaptation



Key Diagram



Schematic Site Plan - Adaptation



Schematic Site Plan - Replacement

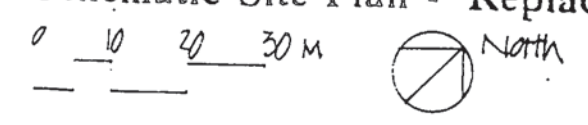
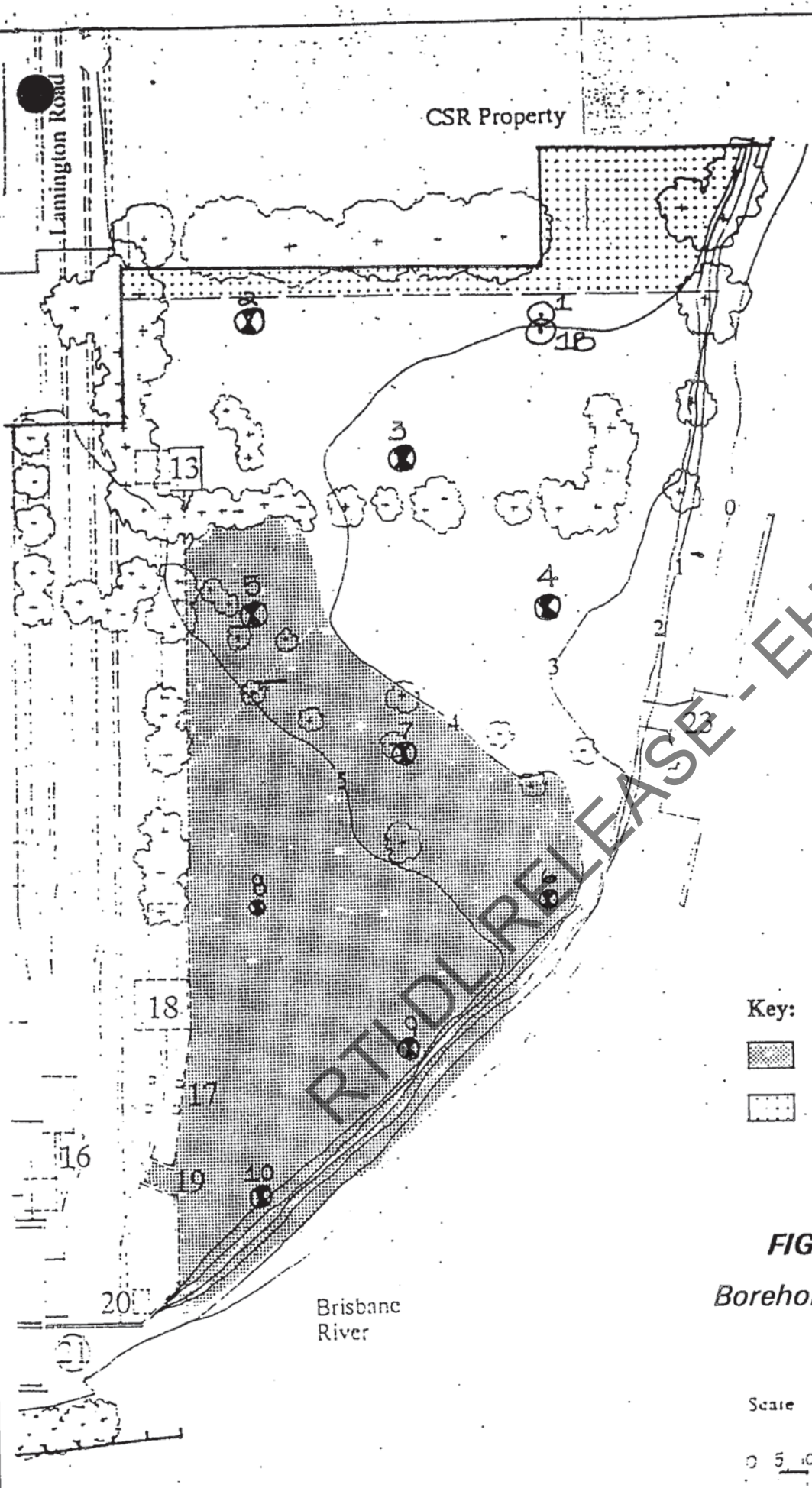


FIGURE 20
Site Redevelopment Housing Option
Source: Allom et.al.(1992)

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APPENDIX 4
Sample Locations and Borelogs



Key:

-  Recent Fill
-  Easements

FIGURE 22
Borehole Locations

Scale



North



Allom Lovell Marquis-Kyle
Architects

Release

Sample Name	Description
Cleared Area Composite	Composite of soils from the open space
Exposed Ash	Surface ash from the embankment which runs next to the south-west wall of the powerhouse facing New Farm Park.
Travel Blank	Travel blank
Transformers	Gravel from transformers
Composite Drains	Composite from drains around the powerhouse and boilerhouse
Boilerhouse #1	Composite of rubble in the boilerhouse basement
Boilerhouse #2	Composite of rubble in the boilerhouse basement
Bore #1A 0.0 - 0.25 m	Open space, coal, coal dust, ash, fill
Bore #1A 0.25 - 1.0 m	Open space, gravelly sand, fill
Bore #1B 0.0 - 0.25 m	Open space, silty clay, topsoil
Bore #1B 0.25 - 1.5 m	Open space, gravelly sand, ash and tuff, fill
Bore #2 0.0 - 0.25 m	Open space, silty sand, topsoil
Bore #2 1.5 - 2.0 m	Open space, sandy clay, alluvium
Bore #3 0.0 - 0.25 m	Open space, sandy gravel, fill
Bore #3 1.0 - 1.5 m	Open space, sandy clay, ash, fill and alluvium

Sample Name	Description
Bore #4 0.0 - 0.25 m	Open space, sandy gravel, fill
Bore #4 0.5 - 1.0 m	Open space, ash, fill
Bore #5 0.0 - 0.25 m	Open space, gravelly sandy clay, topsoil
Bore #5 2.0 - 2.5 m	Open space, ash, coal, coal dust, fill
Bore #6 0.0 - 0.25 m	Open space, sandy gravelly clay, fill
Bore #6 0.25 - 1.5 m	Open space, gravelly sand, rubble, fill
Bore #6 2.5 - 3.0 m	Open space, sandy gravelly clay, ash, fill
Bore #7 0.0 - 0.25 m	Open space, Sandy gravelly clay, topsoil
Bore #7 1.0 - 1.5 m	Open space, gravelly sand, rubble, fill
Bore #7 2.5 - 3.0 m	Open space, gravelly sand, ash, fill
Bore #8 0.0 - 0.25 m	Open space, silty gravelly sand, fill
Bore #8 3.0 - 3.5 m	Open space, silty gravelly sand, ash rubble, fill
Bore #9 0.0 - 0.25 m	Open space, sandy clay, topsoil
Bore #9 3.5 - 4.0 m	Open space, sandy gravelly clay, rubble, ash, fill
Bore #10 0.0 - 0.25 m	Open space, gravelly sand, fill
Bore #10 2.0 - 2.5 m	Open space, gravelly sand, rubble, fill

Sample Name	Description
Bore #10 5.5 - 6.0 m	Open space, sandy clayey gravel, ash, fill

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Memorandum

To File File reference 902026
From MS
Subject Meeting New Farm Powerhouse Date 20/4/98
Notes

David Viney - D&S Project Manager
Chris Woodfull - PPK
Tony Wheeler - BCC
Sue Beale - BCC

Very tight time frame want to get D.A. in the next couple of weeks. They have finalized the concept and what is going where. - Want to know where they are going to go now.

Advised they need a SMP and apply for SCR.

Designated area in front of power station where most contamination exists. Area will be terraced & covered with concrete rest of this area will be boardwalk.

Problem very close to river - ensure environmental impacts ?? Will advise what requirement are.

Car park is to be on CSR site. This site is on the CSR and will involve a material change in use. SCR will be required - need to investigate and find out from CSR what has been done.

FACSIMILE

To **MACC DREYER** Fax **3227 8341**
From **SUSIE BEYLE** Fax **30498**
Date **22-4-98** No of Pages **2 30494**
Subject **POWERHOUSE SITE :
NEW FARM.**



City Design
Architectural Design Section
Floor 3 T.C.Beirne Building
315 Brunswick Street Mail
Fortitude Valley, Brisbane, 4006.
Telephone 07 3403 0527
Facsimile 07 3403 0498

PPK will courier their report dated
April 1998 directly to you.

The following summary of reports may be
useful.

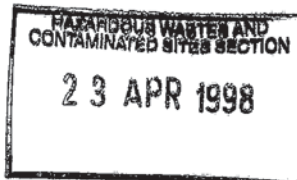
sch4p4(6) Personal information

Our Business - A Better Brisbane

REPORTS on CONTAMINANTS NEW FARM POWERHOUSE SITE

Date	Author	Title	Site	Extent of Investigation
1. July, 1992	Sinclair Knight	"New Farm Powerhouse Study"	L. 1 RP53157; & Powerhouse site & buildings on part of L.3 RP 210504	Preliminary report based on site observations and advice on investigations required.
2. Sept, 1993	BCC, Scientific Service Branch	"Preliminary Site Investigation, New Farm Powerhouse"	L. 1 RP53157; Powerhouse site & buildings on part of L.3 RP 210504; & Site of former transformer building on L. 2 RP 210504	"Stage 1 Preliminary Site Investigation" - Observations and comprehensive testing of borehole material from 14 locations.
3. March, 1997	Woodward-Clyde	"Preliminary Site Assessment on QTSC Site"	L.2 RP 210504	Observations and analysis of metals from three boreholes.
4. Sept., 1997	PPK Environment & Infrastructure P/L	"Environmental Site Assessment on New Farm Power Station"	Powerhouse site & buildings on L. 3 RP 210504	Hazardous materials audit and laboratory testing of 23 soil samples & 3 water samples from within buildings.
5. Oct., 1997	BCC	Tender documents: (a)"Preliminaries & Scope of Works"; & (b)"Technical Specification for Removal of Hazardous Materials"	Turbine building & switch house on powerhouse site on part of L. 3 RP 210504	Complete specification to remove contaminants from buildings.
6. April, 1998	PPK Environment & Infrastructure P/L	"Environmental Site Assessment Lot 2 on RP 210504, New Farm Power Station, Lamington Road, New Farm"	Lot 2 RP 210504	Limited stage 2 ESA: Soil & groundwater sampling & testing
* L.1 RP 53157	"Powerhouse Park" "QEC" site powerhouse part of New Farm Park/ powerhouse allotment			
* L.2 RP 210504				
* L.3 RP 210504				

H:\POWERHOUSE\CONTAMIN\REPORTS.WPD



23/4/98

**PPK Environment &
Infrastructure Pty Ltd**

12th Floor IBM Centre
348 Edward Street
Brisbane QLD 4000
GPO Box 2907 Brisbane
QLD 4000 Australia
Telephone 07 3218 2222
Int Tel +61 7 3218 2222
Facsimile 07 3831 4223
Email ppkbris@ozemail.com.au

ACN 078 004 798
A NATA Certified Quality Company

Mac
As per BCC request, latest New Farm Power Station
ESA for your review. Following our meeting with
BCC next Thursday (or prior to), would it be
possible to get together, perhaps over a coffee
and discuss the role of quantitative Health Risk
Assessments. I will call Friday or Monday to confirm.
Regards

sch4p4(6) Personal information

ents

RTI DL RELEASED



HAZARDOUS WASTES AND
CONTAMINATED SITES SECTION

23 APR 1998

**Environmental Site Assessment -
Lot 2 on RP 210504, New Farm
Power Station, Lamington Road,
New Farm, Queensland**

Brisbane City Council

**PPK Environment &
Infrastructure Pty Ltd**

348 Edward Street
Brisbane Qld 4000
GPO Box 2907
Brisbane Qld 4001
Australia

April, 1998
84K043A-PR001A/jf

Telephone + 61 7 3218 2222
Facsimile: + 61 7 3831 4223

ACN 078 004 798

A NATA Certified Quality Company

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Appendix B	Site Layout and Sample Locations
Appendix C	Soil Bore Logs
Appendix D	Summary of Analytical Results
Appendix E	Returned Chain of Custody and Final Laboratory Certificates
Appendix F	Field Parameters and Purging Volume Sheets

Executive Summary

PPK Environment and Infrastructure was commissioned by Brisbane City Council to undertake a Limited Stage 2 Environmental Site Assessment (ESA) at Lot 2 on RP210504 of the former New Farm Power Station, Lamington Road, New Farm. The investigation program was undertaken to establish the environmental integrity of the site with respect to potential contamination impacts prior to finalising detailed development plans for the land and obtaining development approval.

The scope of works for the investigation program included:

- i. Soil sampling (using the Council drilling crew/contractor) of seven soil bores to a maximum depth of 6 metres (or bit refusal);
- ii. Sampling of soils for laboratory analysis of total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), total Phenols and selected heavy metals (arsenic, cadmium, copper, chromium, lead, nickel, zinc and mercury);
- iii. Supervising the installation of three 50 mm diameter groundwater monitoring wells;
- iv. Sampling of groundwater for laboratory analysis of TPH, PAHs and selected heavy metals (arsenic, cadmium, copper, chromium, lead, nickel, zinc and mercury);
- v. Collation of results and production of report.

The major findings of the environmental site assessment showed:

- Near surface lithology encountered during the sampling programme consisted of a fill material typically ranging in depth from 0.3 to 2.6 metres below ground level (mBGL) overlying a silty clay, containing minor sand lenses, to a depth of 6 mBGL. Sand content in the silty clay increased with depth.
- On-site headspace screening of soil samples collected during the soil bore hole program reported negligible VOC readings in the seven soil bores sampled, (BH2 to BH8).
- The calculated direction of groundwater flow is to the north toward a north reach of the Brisbane River.
- An elevated (ie > DoE investigation levels) copper level was reported in one primary soil sample submitted for laboratory testing. The elevated copper level was below NEHF Health-based investigation guidelines for recreational and/or commercial purposes.
- Elevated TPH (C₆-C₃₆) levels were reported in two primary soil samples submitted for laboratory testing.
- Soil samples submitted for laboratory testing of PAHs and Phenols reported levels within current regulatory/threshold criteria.

- Groundwater samples submitted for laboratory analysis of TPH, PAHs and the selected heavy metals (arsenic, cadmium, chromium, copper, lead, nickel, zinc and mercury) reported levels within ANZECC Guidelines for Fresh Waters and the Dutch Intervention guidelines. Elevated levels, (with respect to background analyte levels), of chromium, copper, lead, nickel and zinc levels may be present in the groundwater.
- The following potential complete exposure pathways to humans and/or environment were identified:
 - ▶ Exposure of on-site commercial workers due to volatilisation of (hydrocarbon) constituents of concern from surface soils into outdoor and indoor air;
 - ▶ Exposure of on-site commercial workers due to ingestion and inhalation (dust) of constituents of concern in surface soils and dermal contact with constituents of concern in surface soils; and
 - ▶ Exposure of off-site nearby property occupants/users to inhalation of airborne constituents of concern from surface soils.
- Based on results of the investigation, and the understanding that the site is to be redeveloped as a community/cultural precinct, the identified complete exposure pathways are considered unlikely to present a risk to human health and/or the environment.

It is recommended that the following risk management options be considered to manage/address potential health and environmental risks associated with potential/actual contamination issues identified at the site:

- Further investigations to delineate the extent of fill material containing contaminants at/above current regulatory/threshold criteria;
- A further round of groundwater monitoring to confirm the initial results of groundwater sampling and the calculated direction of groundwater flow (NB the calculated groundwater flow direction is based on one gauging event). Additional groundwater investigations may be required to confirm background concentrations for selected heavy metals;
- Liaison with the DoE to outline investigation results to date and confirm an appropriate remedial/site management strategy, if required; and/or
- Preparation of a Site Management Plan (SMP) to ensure that any risks identified by investigations are appropriately managed in a manner which protects human health and the environment and ensures the site is suitable for the specified use.

1. Introduction

In March 1998, PPK Environment and Infrastructure (PPK), was commissioned by Brisbane City Council (BCC) to undertake a Limited Phase 2 Environmental Site Assessment (ESA) at Lot 2 on Registered Plan (RP)210504 of the former New Farm Power Station site, Lamington Road, New Farm, Queensland.

PPK understand that BCC are finalising redevelopment plans for the site and the site works were therefore undertaken to establish the environmental integrity of the site with respect to the potential impacts of past uses of the site. The scope of works undertaken for this investigation program was structured to compliment the following previous site investigations at the former Power Station facility:

- Preliminary Site Assessment (PSA) on QTSC/QEC facility of Former New Farm Power Station, Woodward-Clyde, March 1997: and
- ESA of New Farm Power Station, Lot 4 on RP210504, PPK Environment and Infrastructure, September 1997 (Ref ID: 84J153B-PR002Asr).

Site works reported herein address the scope of works as set out in PPK's proposal, dated 3rd March 1998. The scope of works included:

- Soil sampling (using the Council drilling crew/contractor) of seven soil bores to a depth of approximately 6 metres (or bit refusal);
- Sampling of soils for laboratory analysis of total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), total Phenols and selected heavy metals (arsenic, cadmium, copper, chromium, lead, nickel, zinc and mercury);
- Supervising the installation of three 50 mm diameter groundwater monitoring wells;
- Sampling of groundwater for laboratory analysis of TPH, PAHs, Total Phenols and selected heavy metals; and
- Collation of results and production of report.

Site works were conducted during the period 4 to 13 March 1998.

2. Background Information

2.1 Property Address/Description

The site of concern for this assessment is the former Queensland Electricity Commission (QEC) facility immediately to the north west of the former Powerhouse building. The property is described as Lot 2 on RP 210504 and is located at the southern end of Lamington Road, New Farm. A map showing the site location is supplied in Appendix A.

2.2 Party Responsible for Assessment

City Design
Brisbane City Council,
T. C. Beirne Centre,
Brunswick Street Mall,
Fortitude Valley, Qld, 4006.

2.3 Environmental Consultant

PPK Environment and Infrastructure Pty Ltd
IBM Centre
348 Edward Street,
Brisbane, QLD, 4000

2.4 Proposed Land Use

The New Farm Power Station is currently decommissioned and is being considered for re-development as a community/cultural precinct. The proposed development plan for the former QEC facility includes an underground carpark and courtyard/walkways.

2.5 Operator of Site

The registered owner of the site is Brisbane City Council. The site is currently non-operational.

3. Overview of Previous Works

The Former New Farm Power Station including the QEC facility, have been the subject of three previous site investigations:

- Stage 1 - Preliminary Site Investigation New Farm Powerhouse, Brisbane City Council Analytical Services, (1993; referenced and summarised in the PPK ESA report, September 1997).
- PSA on the QTSC/QEC Site - New Farm, Woodward-Clyde (March, 1997).
- ESA of New Farm Power Station, PPK Environment & Infrastructure (September, 1997).

The following provides a summary of the key findings of the soil sampling programmes conducted as part of these investigations.

Stage 1 Preliminary Site Investigation by Brisbane City Council (1993).

The Stage 1 Preliminary Site Investigation carried out by BCC was principally confined to an area of fill on the eastern side of the site with further sampling occurring in the boiler house rubble, and various surface locations. The sampling results indicated:

- 'Soil samples obtained from the area of fill (boreholes 3, 6 and 10) reported selected heavy metal concentrations greater than Department of Environment (DoE) guidelines.'; and
- 'Organic compound results greater than DoE levels were obtained in three samples (boreholes 1, 3 and 5) and asbestos was detected in borehole 1.'

The report concluded that 'there was no evidence of any significant levels of contamination which would restrict the development of the site for the end uses proposed.'

Preliminary Site Assessment (PSA) on the QTSC Site - New Farm, Woodward-Clyde, (March, 1997).

Woodward-Clyde were commissioned by BCC in 1997 to conduct a PSA for the former QEC facility (also referred to as 'QTSC' site, and which this report is also focused). The assessment works included sampling from three locations (see Figure 1 in Appendix B). The results of this limited investigation indicated:

- Surface samples obtained from the sampling locations reported selected heavy metals (As, Cr, Cu, Pb and/or Zn) at concentrations greater than the DoE threshold values.

The report concluded that 'although heavy metals were detected at levels marginally exceeding the DoE investigative and health based thresholds, the contamination appears to be confined to the relatively shallow depths of ash and coke fill encountered across the site.'

Environmental Site Assessment(ESA) of New Farm Power Station, PPK Environment & Infrastructure (September, 1997).

The ESA undertaken by PPK was concentrated on the Powerhouse area of the site and with respect to the soil sampling program showed:

- 8 out of the 23 soil sample submitted for laboratory analysis reported selected heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb, and/or Zn) and/or PAHs levels in excess of the DoE threshold values.

Report recommendations for consideration included a health risk assessment (HRA) for selected parameters to assist in developing appropriate remedial strategies for impacted soil material and further investigations to delineate the extent of soil contamination in areas which may require remedial works.

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4. Site Description

4.1 Topography

The site occupies a near rectangular piece of land approximately 120 metres by 100 metres in dimension (approximately 1.2 ha) and consists of several buildings which include offices, workshops and former transformer locations. The remainder of the property is covered in either bitumen or concrete with small former garden/grassed areas. The site is relatively flat with the surrounding area sloping towards the Brisbane River.

A site location map is presented on Appendix A.

4.2 Surrounding Land Use

The former New Farm Power Station is situated at the end of Lamington Road, in an area used extensively for light industry and public open space.

Energex (formerly SEQEB) operates a substation adjacent to the northern boundary of the site and a Commonwealth Sugar Refineries (CSR) gypsum bulk handling depot is located approximately 200 metres north of the site. The site is bordered on the south west and north east by New Farm Park and Power House Park, respectively. The Brisbane River defines the southern boundary of the site.

4.3 Regional and Local Geology

The New Farm area is located on Quaternary aged undifferentiated alluvial plains consisting of sand, silt, clay and gravel. The alluvial sediments overlay a sequence of Triassic aged volcanic and sedimentary rocks including ignimbrite, stratified and massive rhyolitic tuff, conglomerate, sandstone, and screebreccia horizons. The Triassic-aged volcano-sedimentary rocks are underlain by the Neranleigh - Fernvale Beds a folded metasedimentary sequence of interbedded shale, siltstone and greywacke (Brisbane Sheet 9543, 1:100 000 Geological Map; Department of Mines, 1986).

Near surface lithology encountered during the sampling programme consisted of a fill material typically ranging in depth from 0.3 to 2.6 metres below ground level (mBGL) overlying a silty clay with minor sand lenses to a depth of 6 mBGL. Sand content within the silty clay increased with increasing depth. A summary of the subsurface geological profile is presented in Table 1 and full bore logs with sampling details are presented in Appendix C.

Table 1: Generalised Stratigraphic Log

Depth (mBGL)	Lithology
0.0-0.3	Concrete.
0.3-2.6	FILL; Material including silty clay, concrete fragments, ash, timber and gravel.
2.6 - 5.0	CLAY; Dark grey brown silty clay, with minor sand lenses, moist, medium to high plasticity.
5.0-6.0	CLAY; Dark grey brown silty sandy clay, fine grained sand, wet, low plasticity.

4.4

Groundwater

Site investigation works encountered the groundwater at approximately 3 to 4 mBGL and the calculated groundwater flow direction is to the north towards a north reach of the Brisbane River.

There are no water supply bore records contained within the Department of Industry (DPI) Water Resources database for the New Farm area. The groundwater in the area is suitable for most purposes but marginal for human consumption, ('Groundwater Resources of Queensland' 1:2500,000 Hydrogeological Series, 1987). The groundwater is reported to have a total dissolved ion concentration of 500-1500 mg/L.

4.5

Surface Drainage

Stormwater runoff from the concrete/bitumen covered areas of the site is collected in a drainage system and directed south towards the Brisbane River.

5. Site Investigation Works

Site works consisted of sampling and testing of soil samples collected from seven soil bores (BH2 to BH8). The soil bore locations were based on a systematic grid pattern over the study area. A site layout showing the sampling locations is presented in Appendix B. Borehole BH1, a geotechnical/monitoring bore drilled by the BCC geotechnical department, was constructed prior to the commencement of the investigation programme and is shown on the sample location plan. BH1 was drilled to a depth of approximately 23.5 metres. The grid pattern was designed to provide a baseline coverage of the near surface soil conditions encountered on site. Sampling methodologies were consistent with PPK's ESA Field Procedures, (December 1995).

5.1 Soil Sampling

Soil samples were obtained at 0.5 mBGL, at 1.0 m BGL and then 1.0 m intervals (from the ground surface) to a depth of 6.0 mBGL from each soil bore for on-site screening of Volatile Organic Compounds (VOCs) and possible laboratory analysis.

On-site headspace screening of soil samples collected during the soil boring program reported negligible VOC readings in the seven bore holes sampled, (BH2 to BH8). A summary of headspace screening results is presented in Table D4 of Appendix D.

After collection, all samples were stored in chilled containers, at a temperature of less than 4°C. A total of fourteen primary soil/fill samples were submitted for NATA certified analysis of selected heavy metals (arsenic, cadmium, chromium, copper, nickel, lead, zinc and mercury) and TPH. Eight near surface soil/fill samples were submitted for NATA certified analysis of PAHs and total Phenols. *what was the selection criteria*

5.2 Groundwater Sampling Methodology and Locations

Three of the soil bores were completed as groundwater monitoring wells (BH3, BH6 and BH8). Monitoring well locations are presented in the site layout in Appendix B with well logs and construction details supplied in Appendix C. Monitoring wells were positioned in a triangular arrangement across the site to determine groundwater flow direction and also the nature and extent of potential groundwater contamination.

The wells were constructed in existing soil sample/geotechnical bores and completed with 50mm diameter Class 18 PVC threaded screen and casing and a sealable cap. A graded sand filter pack was placed around the PVC screen and a bentonite seal was installed immediately above the sand pack to the ground surface to prevent surface water infiltration to the aquifer. Surface completion was a flushed mounted protective cover set in a concrete pad.

Sampling of the groundwater wells was conducted on 12th and 13th March 1998. The sampling procedure was as follows:

- Prior to sampling all wells were gauged with a water level and then developed/purged up to five well volumes (or until dry) so that a representative sample may be obtained.
- Field parameters, (temperature, electrical conductivity and pH) were measured after each well volume was removed to confirm stabilisation of parameters prior to the commencement of sampling.
- Groundwater wells were sampled using a stainless steel bailer. The bailer was rinsed in Decon90 prior to use in each of the wells and a new length of rope tied to the end to reduce the risk of well cross contamination.

A summary of the field gauging and purging data is presented in Appendix F. After collection, groundwater samples were transferred to appropriate acid washed, solvent rinsed, glass and polyethylene sample containers and stored in eskies containing frozen ice bricks to maintain a temperature below 4°C.

5.3 Handling of Samples

Upon completion of daily field activities, all soil and/or groundwater samples were checked for labelling consistency with the Chain of Custody forms and the field sampling record. Once the labelling was verified for the soil samples, the samples were stored overnight/the weekend in PPK's Sample refrigerator at a temperature below 4°C. The samples were then repacked in the esky with fresh ice bricks and submitted to the laboratory.

6. Laboratory Analysis

6.1 Analytical Laboratories Used

All primary and QA/QC analyses were performed by Amdel in their Sydney (New South Wales) laboratory. NATA certified methodologies were used for all analysis. All laboratory QA/QC procedures are described within the laboratory reports.

6.2 Laboratory Results - Soil

Analytical testing of soil/fill samples collected during the sampling program and submitted for laboratory analysis reported:

- Copper levels in one sample (BH5;1.0) above the DoE investigation guidelines;
- Arsenic, cadmium, chromium, and zinc levels were within DoE investigation guidelines;
- TPH C₆-C₃₆ levels in two samples (BH6;0.5 & BH8; 0.2-0.4) were reported in excess of the DoE recommended guidelines. TPH levels for all other soil samples submitted for testing were reported within the recommended regulatory guidelines;
- Concentrations of PAHs and total Phenols below the laboratory limits of detection and consequently lower than the DoE, ANZECC and/or NEHF Health Based Investigation guidelines.

A summary of the analytical results compared to assessment criteria is presented in Tables D1 to D4, Appendix D, and returned chain of custody forms, laboratory certificates and reports are presented in Appendix E.

6.3 Laboratory Results - Groundwater

Analytical testing of groundwater samples collected during the sampling program and submitted for laboratory analysis reported:

- Concentrations of TPH, PAHs below the laboratory limits of detection and consequently lower than the ANZECC guidelines for the Protection of Freshwater Aquatic Ecosystems and the Dutch Intervention Guidelines.
- Selected heavy metals levels reported for all groundwater samples were within the ANZECC guidelines for the Protection of Freshwater Aquatic Ecosystems and the Dutch Intervention Guidelines. Reported chromium, copper, lead, nickel and zinc levels (in groundwater sample BH8) and zinc levels (BH6) may be elevated with respect to potential background levels; (further monitoring would be required to confirm potential contaminant levels and/or background concentrations).

Note should be made that while Brisbane River reaches along the southern boundary of the site are estuarine (ie tidally affected), the ANZECC guidelines for the Protection of Freshwater Aquatic Ecosystems may be considered more appropriate for the hydrological conditions encountered in this area.

A summary of the analytical results compared to assessment criteria is presented in Tables D5 to D7, Appendix D, and returned chain of custody forms, laboratory certificates and reports are presented in Appendix E.

6.4

Quality Assurance/Quality Control

- Field investigation sampling procedures conformed to PPK Quality Assurance/Quality Control protocols to prevent cross contamination and preserve the sample integrity.
- All laboratory QA/QC procedures are described within the laboratory reports.
- Duplicate soil samples equivalent to approximately 10% of the total number of primary samples analysed were submitted to Amdel for NATA certified analysis; and
- The duplicate soil sample (TP7;7.0) analysed by Amdel recorded consistent results for selected heavy metals (arsenic, cadmium, chromium, copper, lead, nickel, zinc and mercury) and TPH when compared with the original soil sample (TP7;4.0) results.

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7. Contamination Criteria

The laboratory analysis results are compared with commonly applied regulatory requirements/criteria for sites which have potentially been impacted through previous land use. The contaminant acceptance criteria are usually threshold concentrations of specific contaminants which, if exceeded in a particular sample, may pose a health or environmental based risk and warrant further site specific investigation or risk analysis.

For all analytes tested in soil samples, Queensland DoE Soil Investigation Levels (Queensland DoE, 1992) have been adopted as the regulatory criteria in the first instance, with ANZECC and/or National Enviro Health Forum (NEHF)/South Australian Health Commission (SAHC) Health Based Soil Investigation Levels criteria used in the absence of DoE guidelines.

For all analytes tested in groundwater samples, ANZECC Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC, 1992) have been adopted as the regulatory criteria in the first instance, with Dutch Intervention Guidelines (Ministry for Housing, Spatial Planning and the Environment, Netherlands, 1994) used in the absence of ANZECC Guidelines.

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8. Qualitative Risk Assessment

Reported levels of copper and/or TPH were reported above the DoE investigation levels. Elevated (ie >DoE investigation levels) contaminant levels were mainly recorded in the near surface fill material, however, elevated copper levels were reported in the underlying silty clay. However, elevated copper levels were below NEHF Health-based investigation guidelines for recreational and/or commercial purposes. The contaminant levels reported in the Woodward Clyde March 1997 PSA also do not exceed NEHF Health-based investigation guidelines for recreational and/or commercial purposes.

The levels of selected heavy metals reported for the groundwater samples were within the ANZECC guidelines for the Protection of Freshwater Aquatic Ecosystems and the Dutch Intervention Guidelines. Note should be made that marginal to moderately elevated levels (with respect to background analyte levels) of chromium, copper, lead nickel and zinc levels may be present in the groundwater. Further monitoring (and/or investigations) would be required to confirm the presence of these metals in the underlying groundwater.

Based upon these results, (and the understanding that the site is to be redeveloped as a community/cultural precinct), the potential complete exposure pathways to humans and/or the environment were identified for the following reasonable case:

1. Exposure of on-site commercial workers due to volatilisation of (hydrocarbon) constituents of concern from surface soils into outdoor and indoor air;
2. Exposure of on-site commercial workers due to ingestion and inhalation (dust) of constituents of concern in surface soils and dermal contact with constituents of concern in surface soils; and
3. Exposure of off-site nearby property occupants/users to inhalation of airborne constituents of concern from surface soils.

PPK consider that the following identified complete exposure pathways are unlikely to present a risk to human health and/or the environment:

1. The identified constituents were predominantly non-volatile, heavy hydrocarbons in the chain length C₂₉ to C₃₆. The elevated TPH levels were also reported in the top 0.5m and carpark construction works may be expected remove a significant proportion of near surface material. Exposure to hydrocarbon vapours is therefore considered unlikely.

2&3. The proposed redevelopment plans (ie carpark and courtyard areas) may be expected to remove or cap areas of contaminated soil. A site-specific workplace health and safety plan (WHASP) will be required for the construction phase of the redevelopment. Exposure to contaminated soils via ingestion, inhalation and/or dermal contact is therefore considered unlikely. Elevated heavy metal levels are also within NEHF Health-based investigation guidelines.

Other Issues

In addition to the above chronic risks, the natural degradation of organic compounds in areas of surface impacts may pose a risk by the generation of potentially explosive or asphyxiant vapours (i.e. methane and carbon dioxide). Such a risk would be likely if vapours can migrate and collect within sub-surface utility/service conduits, in the vicinity of electrical infrastructure or in trenches excavated on-site.

It is assumed that suitable work practices would be in place to reduce the risk of explosion/asphyxiation from works at the site.

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9. Risk Management Options

Based upon the results obtained during the March 1998 ESA and PPK's understanding that the site is to be redeveloped for commercial/recreational activities, the following risk management options may be considered to manage/address potential health and environmental risks associated with impacted soils identified at the site:

- ▣ Further investigations to delineate the extent of fill material containing contaminants at/above current regulatory/threshold criteria;
- ▣ A further round of groundwater monitoring to confirm the initial results of groundwater sampling and the calculated direction of groundwater flow (NB the calculated groundwater flow direction is based on one gauging event). Additional groundwater investigations may be required to confirm background concentrations for selected heavy metals;
- ▣ Liaison with the DoE to outline investigation results to date and confirm an appropriate remedial/site management strategy, if required; and/or
- ▣ Preparation of a Site Management Plan (SMP) to ensure that any risks identified by investigations are appropriately managed in a manner which protects human health and the environment and ensures the site is suitable for the specified use. The SMP would outline management conditions relating to contamination issues that may include, but not be limited to, health and safety and appropriate remedial/management or monitoring strategies.

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10. Conclusions

This investigation consisted of a soil and groundwater sampling program, at New Farm Power Station, Lamington Road, New Farm to assess the environmental integrity of the site prior to redevelopment by Brisbane City Council. The site investigation consisted of the sampling and analyses of soil samples collected from seven soil bores and groundwater samples collected from three groundwater monitoring wells, in accordance with the Scope of Works.

The following conclusions can be made with respect to this assessment:

- Near surface lithology encountered during the sampling programme consisted of a fill material typically ranging in depth from 0.3 to 2.6 metres below ground level (mBGL) overlying a silty clay, containing minor sand lenses, to a depth of 6 mBGL. Sand content in the silty clay increased with depth.
- On-site headspace screening of soil samples collected during the soil bore hole program reported negligible VOC readings in the seven soil bores sampled, (BH2 to BH8).
- The calculated direction of groundwater flow is to the north toward a north reach of the Brisbane River.
- The elevated copper level was below NEHF Health-based investigation guidelines for recreational and/or commercial purposes. An elevated (ie > DoE investigation levels) copper level was reported in one primary soil sample submitted for laboratory testing.
- Elevated TPH (C₆-C₃₆) levels were reported in two primary soil samples submitted for laboratory testing.
- Soil samples submitted for laboratory testing of PAHs and Phenols reported levels within current regulatory/threshold criteria.
- Groundwater samples submitted for laboratory analysis of TPH, PAHs and the selected heavy metals (arsenic, cadmium, chromium, copper, lead, nickel, zinc and mercury) reported levels within ANZECC Guidelines for Fresh Waters and the Dutch Intervention guidelines. Elevated levels, (with respect to background analyte levels), of chromium, copper, lead, nickel and zinc levels may be present in the groundwater.
- The following potential complete exposure pathways to humans and/or environment were identified:
 - Exposure of on-site commercial workers due to volatilisation of (hydrocarbon) constituents of concern from surface soils into outdoor and indoor air;
 - Exposure of on-site commercial workers due to ingestion and inhalation (dust) of constituents of concern in surface soils and dermal contact with constituents of concern in surface soils; and

- ▶ Exposure of off-site nearby property occupants/users to inhalation of airborne constituents of concern from surface soils.
- Based on results of the investigation, and the understanding that the site is to be redeveloped as a community/cultural precinct, the identified complete exposure pathways are considered unlikely to present a risk to human health and/or the environment.

Based on these conclusions, it is recommended that the following risk management options be considered to manage/address potential health and environmental risks associated with potential/actual contamination issues identified at the site:

- Further investigations to delineate the extent of fill material containing contaminants at/above current regulatory/threshold criteria;
- A further round of groundwater monitoring to confirm the initial results of groundwater sampling and the calculated direction of groundwater flow (NB the calculated groundwater flow direction is based on one gauging event). Additional groundwater investigations may be required to confirm background concentrations for selected heavy metals;
- Liaison with the DoE to outline investigation results to date and confirm an appropriate remedial/site management strategy, if required; and/or
- Preparation of a Site Management Plan (SMP) to ensure that any risks identified by investigations are appropriately managed in a manner which protects human health and the environment and ensures the site is suitable for the specified use.

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11. Statement of Limitations

This assessment was restricted to the agreed-upon Scope of Services. No representations or warranties are made concerning the nature or quality of the soil and water, or any other substance on the Property, other than the visual observations and analytical data as stated in this report.

On all sites varying degrees of non-uniformity of the vertical and horizontal soil conditions are encountered. Hence no sampling technique can completely eliminate the possibility that samples are not totally representative of soil conditions encountered. The sampling can only reduce this possibility to an acceptable level.

It should also be recognised that site conditions, including contaminant extent and concentrations can change with time. This is particularly relevant if this report is used after a protracted delay, such that further investigation of the site may be necessary.

In preparing this report, PPK Environment & Infrastructure has relied upon certain verbal information and documentation provided by the client and/or third parties. Except as discussed, PPK Environment & Infrastructure did not attempt to independently verify the accuracy or completeness of that information, but did not detect any inconsistency or omission of a nature that might call into question the validity of any of it. To the extent that the conclusions in this report are based in whole or in part on such information, they are contingent on its validity. PPK Environment & Infrastructure assume no responsibility for any consequences arising from any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to PPK Environment & Infrastructure.

Within the limitations of the agreed-upon Scope of Services, this assessment has been undertaken and performed in a professional manner, in accordance with generally accepted practices, using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, express or implied, is made.

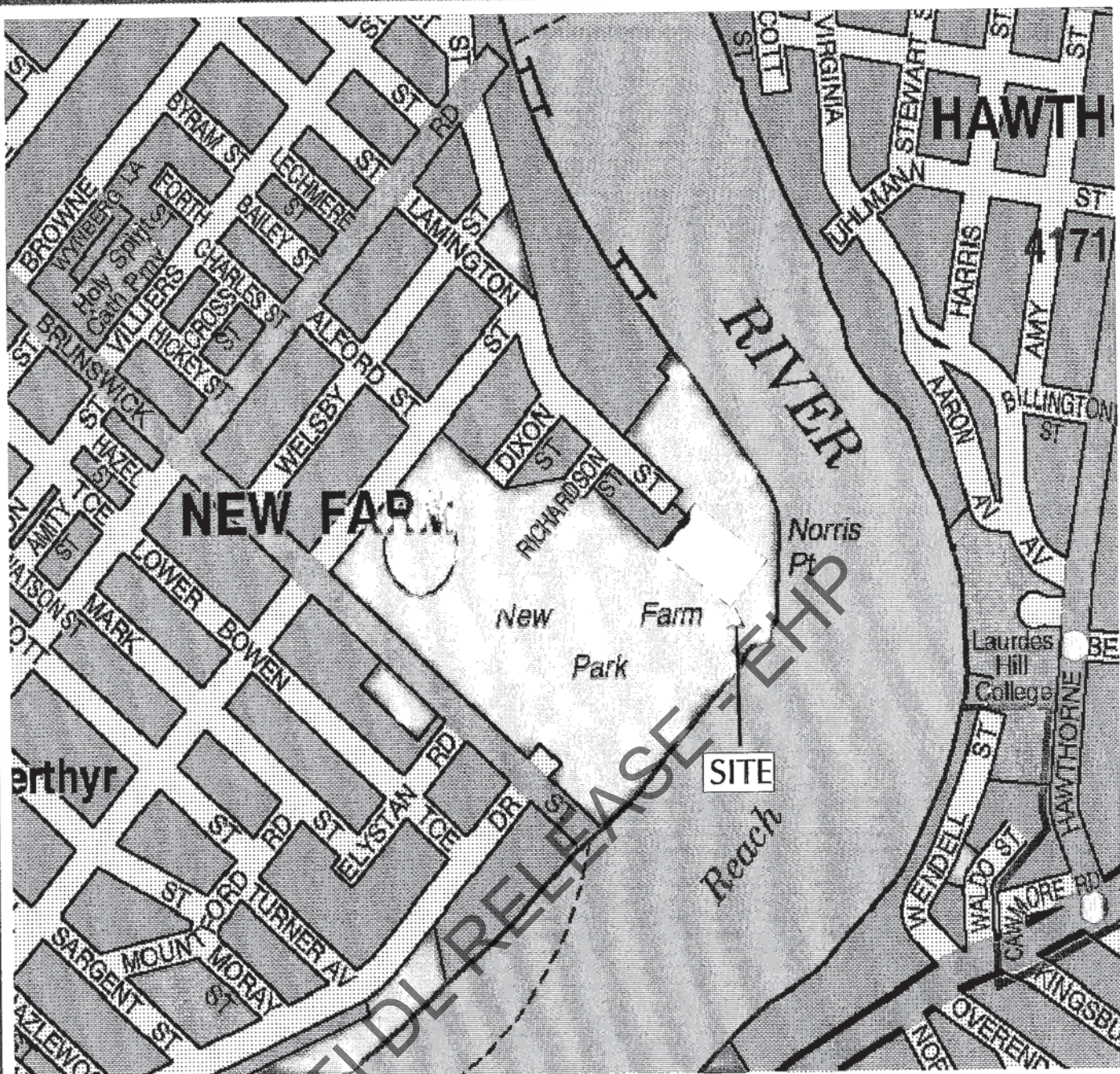
This report is based upon the Scope of Services, and is subject to the Limitations and Restrictions, defined herein. It has been prepared on behalf of Brisbane City Council (BCC) for the benefit of BCC. No person or organisation other than BCC is entitled to rely upon any part of it without the prior written consent of PPK Environment & Infrastructure; and such third party in using or relying on this report shall have no legal recourse against PPK Environment & Infrastructure or its parent or subsidiaries, and shall indemnify and defend them from and against all claims arising out of, or in conjunction with, such use or reliance.

12. References

1. Australian and New Zealand Environment Conservation Council, 1992, *Guidelines for the Assessment and Management of Contaminated Sites*.
2. Australian and New Zealand Environment Conservation Council, 1992, *Australian Water Quality Guidelines for Fresh and Marine Waters*.
3. Imray and Langley, 1996, *Development of Health Based Investigation Levels. (Taken from the Third National Workshop on the Health Risk Assessment and Management of Contaminated Sites)*.
4. Brisbane Geological Survey, 1:100,000 *Brisbane Geological Series*.
5. PPK, 1997, *Environmental Site Assessment of New Farm Power Station, New Farm*, (Ref ID: 84J153B-PR002Asr).
6. Queensland DoE, 1992, *Guidelines for the Assessment of Contaminated Land in Queensland*.
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8. Risk Assessment and Environmental Quality Division, Directorate of Chemicals, External Safety and Radiation Protection, Ministry of Housing, Spatial Planning and the Environment, 1994, *Environmental Quality Objectives in the Netherlands*.

Appendix A

Site Location Map



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TITLE: Brisbane City Council
New Farm Power Station
Lamington Road,
New Farm, QLD.
Site Location

SCALE:
Not to Scale

Date:
23/03/98

84K043A\dir\locat

PPK
Environment & Infrastructure

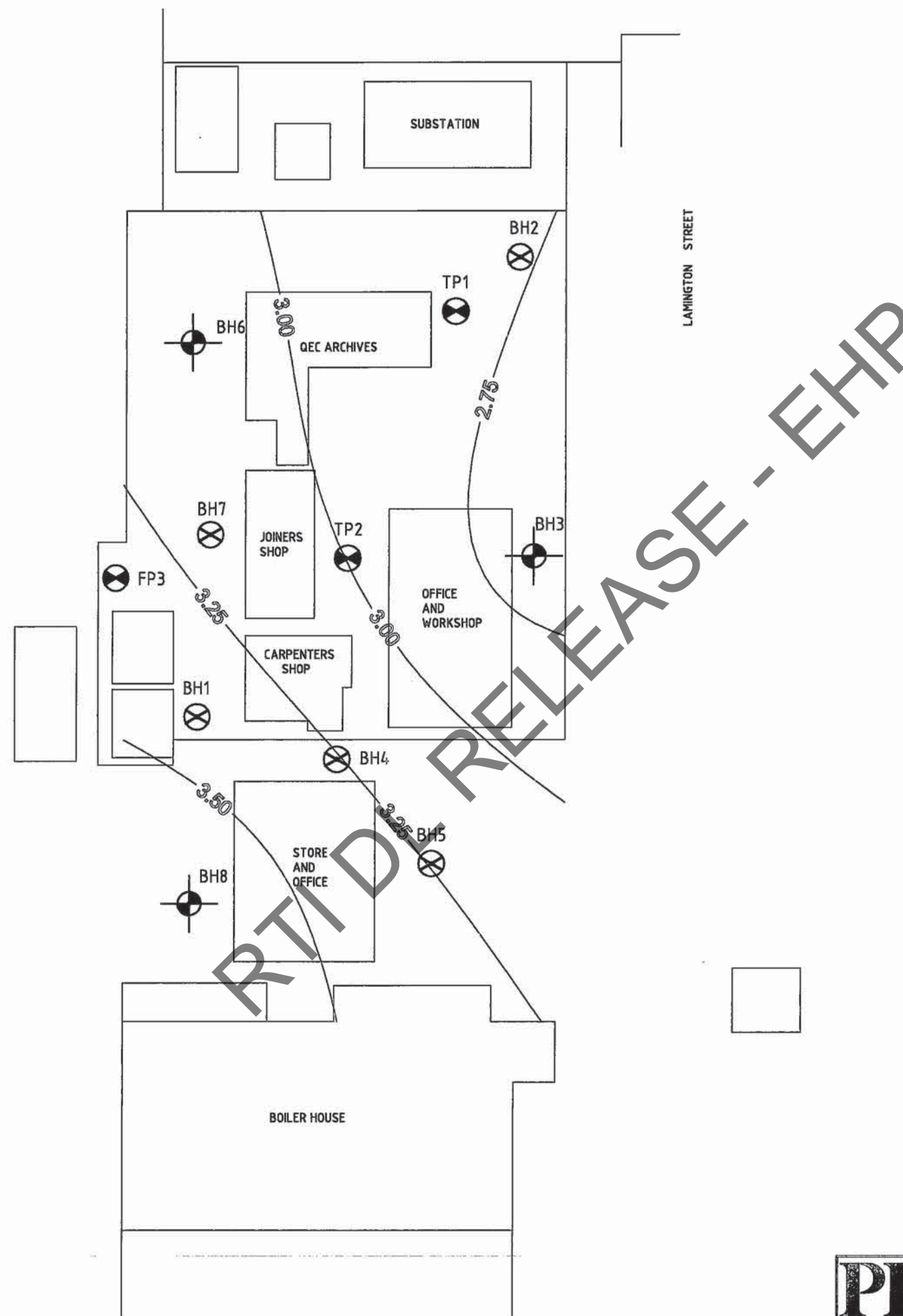
12th Floor IBM Centre
348 Edward Street
Brisbane QLD 4000
G.P.O Box 2907
Brisbane QLD 4000
Tel 07 3218 2222
Fax 07 3831 4223



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Appendix B

Site Layout and Sample Locations



KEY:

TP1



WOODWARD-CLYDE
TEST PIT LOCATION

BH3



BOREHOLE

BH6



BOREHOLE WITH GROUNDWATER
MONITORING WELL INSTALLED

3.00



GROUNDWATER RL
CONTOUR

NOT TO SCALE

RTI 13-106

Collection 14

PPK
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Tel. 07 3218 2222
Fax 07 3831 4223
Email
ppkbris@ozemail.com.au

**NEW FARM POWER STATION
LOT 2 ON RP210504**

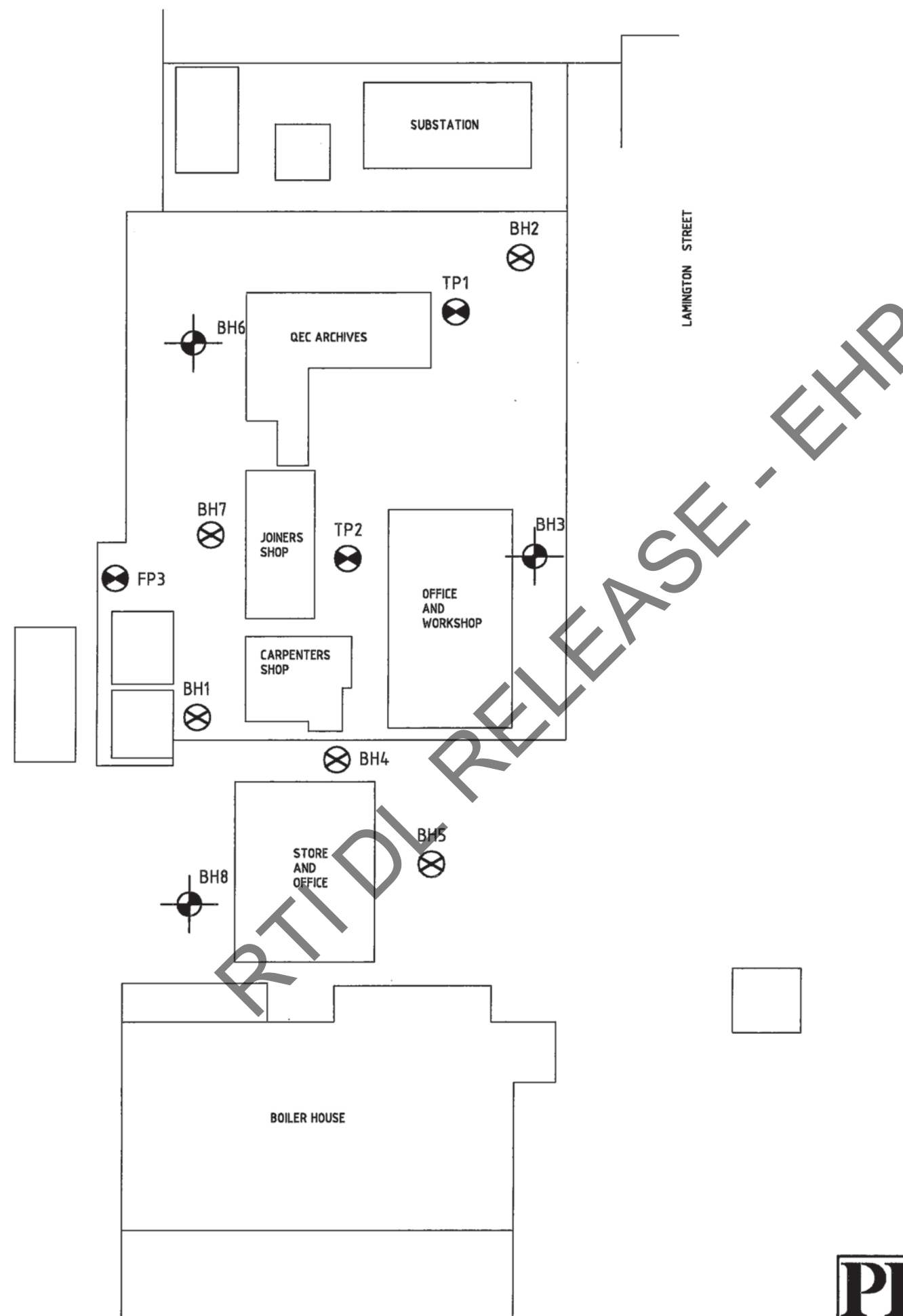
**SITE PLAN SHOWING
GROUNDWATER RL CONTOURS**

Job No
84K043A

Drawing No
FIG 2

Rev.

Release



KEY:

TP1



WOODWARD-CLYDE
TEST PIT LOCATION

BH3



BOREHOLE



BH6

BOREHOLE WITH GROUNDWATER
MONITORING WELL INSTALLED

NOT TO SCALE

RTI 13-106

Collection 14

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**NEW FARM POWER STATION
LOT 2 ON RP210504**

BOREHOLE LOCATIONS

Job No
84K043A

Drawing No
FIG 1

Rev.

Release

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Appendix C

Soil Bore Logs

Borehole Log - BH2

New Farm Power Station ESA

STRATIGRAPHIC DESCRIPTION	LOG	DEPTH (mBGL)	SAMPLE NO	DETAILS
				GENERAL INFORMATION
				LOCATION: New Farm Power Station Lamington Road New Farm
				DATE DRILLED 4 March 1998
				EQUIPMENT USED Drilling Company: Paddy Christensen & Son Drilling Rig with 120 mm solid stem auger.
NATURAL GROUND LEVEL 0.0 Concrete		0.0		
Clay - Medium Brown silty clay, dry, low to med plasticity		0.4	BH2;0.5 PID 0.0 ppm BH2;1.0 PID 0.0 ppm	
Silt - Yellow brown sandy silt, Dry, low plasticity		1.5	BH2;2.0	
Silt - Brown clayey silt, Moist, low to med plasticity		2.0	PID 0.0 ppm	
Clay - Brown clay with streaks of sand, Moist, medium plasticity		2.8	BH2;3.0 PID 0.0 ppm	
Groundwater at ~3.5 m ▼		3.5	BH2;4.0 PID 0.0 ppm	
Clay - Grey brown silty clay with nodules of sand, wet, medium to high plasticity		4.5	BH2;5.0 PID 0.0 ppm	
Clay - Dark grey silty clay with streaks of sand, wet, medium plasticity		5.0	BH2;6.0 PID 0.0 ppm	
Clay - Dark grey sandy silty clay, wet, low to med plasticity		6.0		
Bore Log ceased at 6.0 m				
				BOREHOLE BH2
Logged By: [Personal information]		Sampled By: [Personal information]		
Field Classification 0 No obvious contamination 1 Slight visual contamination and/or slight odour 2 Visual contamination and/or odour 3 Gross visual contamination and/or strong odour		Notes		
		Collection 14		JOB NO. 84K043A Page 2 of 2 bore_bh2

BORE HOLE DETAILS - BH3

New Farm Power Station ESA

STRATIGRAPHIC DESCRIPTION	LOG	WELL CONSTRUCTION	DETAILS																
<p>NATURAL GROUND LEVEL</p> <p>0.0</p> <p>Concrete</p> <p>Clay - Dark grey silty clay, dry, low to med plasticity</p> <p>Sand - Brown clayey sand, fine grained sand, moist, low plasticity</p> <p>Clay - Grey brown silty clay, Moist, medium plasticity</p> <p>Clay - Dark Grey silty clay, wet, medium to high plasticity</p> <p>Groundwater at ~3.8 m</p>			<p>GENERAL INFORMATION</p> <p>LOCATION: Lamington Road, New Farm.</p> <p>DATE DRILLED: 6 March 1998</p> <p>EQUIPMENT USED</p> <p>Drilling Company: Paddy Christensen & Son</p> <p>Drilling Rig with 120 mm solid stem auger.</p> <p>Well Construction Details</p> <p>50 mm Class 18 threaded, slotted, acid washed, PVC screen from 4.0 to 5.5 m BGL. Filter sand from 3.3 m BGL to 6.0 m BGL, bentonite seal from 0.1 m to 3.3 mBGL. Concrete pad and flush mount from ground surface to 0.1 mBGL. Lockable cap.</p> <p>PID READINGS</p> <table border="1"> <thead> <tr> <th>DEPTH(mBGL)</th> <th>PID (ppm)</th> </tr> </thead> <tbody> <tr><td>0.5</td><td>0.0</td></tr> <tr><td>1.0</td><td>0.0</td></tr> <tr><td>2.0</td><td>0.0</td></tr> <tr><td>3.0</td><td>0.0</td></tr> <tr><td>4.0</td><td>0.0</td></tr> <tr><td>5.0</td><td>0.0</td></tr> <tr><td>6.0</td><td>0.0</td></tr> </tbody> </table>	DEPTH(mBGL)	PID (ppm)	0.5	0.0	1.0	0.0	2.0	0.0	3.0	0.0	4.0	0.0	5.0	0.0	6.0	0.0
DEPTH(mBGL)	PID (ppm)																		
0.5	0.0																		
1.0	0.0																		
2.0	0.0																		
3.0	0.0																		
4.0	0.0																		
5.0	0.0																		
6.0	0.0																		
Borehole terminated at 3.5 mBGL																			
<p>Logged By: [Redacted] Personal information</p> <p>Sampled By: [Redacted] Personal information</p> <p>Field Classification</p> <p>0 No obvious contamination</p> <p>1 Slight visual contamination and/or slight odour</p> <p>2 Visual contamination and/or odour</p> <p>3 Gross visual contamination and/or strong odour</p>			<p>BOREHOLE BH3</p> <p>PPK Environment & Infrastructure</p>																
<p>Notes</p>			<p>JOB NO. 84K043A Page 257, BH3</p>																

New Farm Power Station ESA

STRATIGRAPHIC DESCRIPTION	LOG	DEPTH (mBGL)	SAMPLE NO	DETAILS
<p>NATURAL GROUND LEVEL</p> <p>0.0 Concrete</p> <p>Fill - Ash and bits of concrete</p> <p>Clay - Red brown silty clay, moist, low to med plasticity</p> <p>Groundwater at ~3.0 m ▼</p> <p>Clay - Brown silty clay with nodules of yellow medium grained sand, wet, medium to high plasticity</p> <p>Bore Log ceased at 6.0 m</p>		<p>0.0</p> <p>0.3</p> <p>0.5</p> <p>3.0</p> <p>6.0</p>	<p>BH4;0.5 PID 0.0 ppm</p> <p>BH4;1.0 PID 0.0 ppm</p> <p>BH4;2.0 PID 0.0 ppm</p> <p>BH4;3.0 PID 0.0 ppm</p> <p>BH4;4.0 PID 0.0 ppm</p> <p>BH4;5.0 PID 0.0 ppm</p> <p>BH4;6.0 PID 0.0 ppm</p>	<p>GENERAL INFORMATION</p> <p>LOCATION: New Farm Power Station Lamington Road New Farm</p> <p>DATE EXCAVATED 6 March 1998</p> <p>EQUIPMENT USED Drilling Company: Paddy Christensen & Son Drilling Rig with 120 mm solid stem auger.</p>
<p>RTI/DL RELEASE - EHP</p>				<p>BOREHOLE BH4</p>
<p>Logged By: [Redacted] Personal information</p>		<p>Sampled By: [Redacted] Personal information</p>		<p>JOB NO. 84K043A Page 2 of 30. bore_bh4</p>
<p>Field Classification</p> <p>0 No obvious contamination</p> <p>1 Slight visual contamination and/or slight odour</p> <p>2 Visual contamination and/or odour</p> <p>3 Gross visual contamination and/or strong odour</p>		<p>Notes</p> <p>Collection 14</p>		

Borehole Log - BH5

New Farm Power Station ESA

STRATIGRAPHIC DESCRIPTION	LOG	DEPTH (mBGL)	SAMPLE NO	DETAILS
				GENERAL INFORMATION
				LOCATION: New Farm Power Station Lamington Road New Farm
				DATE EXCAVATED 6 March 1998
				EQUIPMENT USED Drilling Company: Paddy Christensen & Son Drilling Rig with 120 mm solid stem auger.
NATURAL GROUND LEVEL 0.0 Concrete		0.0		
Clay - Red brown silty clay, moist, low to med plasticity		0.55	BH5;0.5 PID 0.0 ppm	
Clay - Dark grey sandy silty clay, fine grained sand, moist, medium plasticity		0.75	BH5;1.0 PID 0.0 ppm	
			BH5;2.0 PID 0.0 ppm	
Groundwater at ~2.8 m ▼		2.8	BH5;3.0 PID 0.0 ppm	
Clay - Dark Grey brown silty clay wet, medium to high plasticity			BH5;4.0 PID 0.0 ppm	
			BH5;5.0 PID 0.0 ppm	
Clay - Dark brown silty clay with rare fine grained sand, wet, medium plasticity		5.5		
		6.0	BH5;6.0 PID 0.0 ppm	
Bore Log ceased at 6.0 m				
				BOREHOLE BH5
Logged By Personal information		Sampled By Personal information		
Field Classification 0 No obvious contamination 1 Slight visual contamination and/or slight odour 2 Visual contamination and/or odour 3 Gross visual contamination and/or strong odour		Notes		
		Collection 14		JOB NO. 84K043A Page 2590. bore_bh5

BORE HOLE DETAILS - BH6

New Farm Power Station ESA

STRATIGRAPHIC DESCRIPTION LOG

WELL CONSTRUCTION

DETAILS

STRATIGRAPHIC DESCRIPTION LOG		DEPTH (mBGL)	WELL CONSTRUCTION
NATURAL GROUND LEVEL		0.0	
Concrete		0.0	
Fill - Ash and occasional gravel		0.35	
		1.3	
Clay - Brown silty clay, dry, low plasticity		2.0	
Clay - Brown silty clay with rare fine grained sand, moist, low to medium plasticity		3.0	
Groundwater at ~3.0 m		3.0	
Clay - Grey brown silty clay wet, medium to high plasticity		5.0	
		6.0	
Sand - Dark Grey silty sand, with fine grained sand, wet, low plasticity			
Bore Log ceased at 6.0 m			

GENERAL INFORMATION

LOCATION: Lamington Road, New Farm.

DATE DRILLED: 6 March 1998

EQUIPMENT USED

Drilling Company:
Paddy Christensen & Son
Drilling Rig with
120 mm solid stem auger.

Well Construction Details
50 mm Class 18 threaded, slotted, acid washed, PVC screen from 2.0 to 5.0 m BGL. Filter sand from 1.5 m BGL to 6.0 m BGL, bentonite seal from 0.1 m to 1.5 mBGL. Concrete pad and flush mount from ground surface to 0.1 mBGL. Lockable cap.

PID READINGS

DEPTH(mBGL)	PID (ppm)
0.5	0.0
1.0	0.0
2.0	0.0
3.0	0.0
4.0	0.0
5.0	0.0
6.0	0.0

BOREHOLE BH6

Logged By: [Redacted] Personal information

Sampled By: [Redacted] Personal information

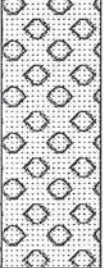
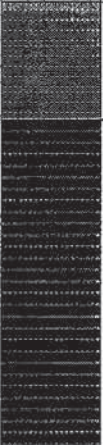
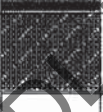
Field Classification

- 0 No obvious contamination
- 1 Slight visual contamination and/or slight odour
- 2 Visual contamination and/or odour
- 3 Gross visual contamination and/or strong odour

Notes

Borehole Log - BH7

New Farm Power Station ESA

STRATIGRAPHIC DESCRIPTION	LOG	DEPTH (mBGL)	SAMPLE NO	DETAILS
				GENERAL INFORMATION
				LOCATION: New Farm Power Station Lamington Road New Farm
				DATE EXCAVATED 9 March 1998
				EQUIPMENT USED Drilling Company: Paddy Christensen & Son Drilling Rig with 120 mm solid stem auger.
NATURAL GROUND LEVEL -0.0 Concrete Fill - Orange gravelly sandy clay, dry, low plasticity Fill - Large pieces of gravel, small amount of fines, dry Angular gravel up to 5x4x2 cm		0.0 0.3 0.7	BH6;0.5 PID 0.0 ppm BH7;1.0 PID 0.0 ppm	
Clay - Grey brown silty clay wet, medium to high plasticity Groundwater at ~3.0 m ▼		2.5 3.3	BH7;2.0 PID 0.0 ppm BH7;3.0 PID 0.0 ppm	
Clay - Dark grey silty clay, wet, medium to high plasticity, some organic matter present		5.5	BH7;4.0 PID 0.0 ppm BH7;5.0 PID 0.0 ppm	
Sand - Dark Grey silty sand, with fine grained sand, wet, low plasticity Bore Log ceased at 6.0 m		6.0	BH7;6.0 PID 0.0 ppm	
				BOREHOLE BH7
Logged By [Personal information]		Sampled By [Personal information]		
Field Classification 0 No obvious contamination 1 Slight visual contamination and/or slight odour 2 Visual contamination and/or odour 3 Gross visual contamination and/or strong odour		Notes		

BORE HOLE DETAILS - BH8

New Farm Power Station ESA

STRATIGRAPHIC DESCRIPTION LOG		WELL CONSTRUCTION	DETAILS																
<p>NATURAL GROUND LEVEL</p> <p>0.0 Concrete</p> <p>0.2 Fill - Ash</p> <p>0.4 Fill - Dark brown silty clay with pieces of wood, moist, medium plasticity,</p> <p>2.6 Clay - Grey brown silty clay wet, medium to high plasticity</p> <p>3.3 Groundwater at ~3.3 m ▼</p> <p>Sand - Dark grey silty sand wet, low plasticity</p> <p>4.7 Clay - Dark Grey silty clay, with rare fine grained sand, wet, low plasticity</p> <p>6.0 Bore Log Terminated at 6.0 m</p>		<p>DEPTH (mBGL)</p> <p>0.0</p> <p>0.2</p> <p>0.4</p> <p>2.6</p> <p>3.3</p> <p>4.7</p> <p>6.0</p>	<p>GENERAL INFORMATION</p> <p>LOCATION: Lamington Road, New Farm.</p> <p>DATE DRILLED: 6 March 1998</p> <p>EQUIPMENT USED</p> <p>Drilling Company: Paddy Christensen & Son</p> <p>Drilling Rig with 120 mm solid stem auger.</p> <p>Well Construction Details</p> <p>50 mm Class 18 threaded, slotted, acid washed, PVC screen from 2.0 to 5.0 m BGL. Filter sand from 1.5 m BGL to 6.0 m BGL, bentonite seal from 0.1 m to 1.5 mBGL. Concrete pad and flush mount from ground surface to 0.1 mBGL. Lockable cap.</p> <p>PID READINGS</p> <table border="1"> <thead> <tr> <th>DEPTH(mBGL)</th> <th>PID (ppm)</th> </tr> </thead> <tbody> <tr><td>0.5</td><td>0.0</td></tr> <tr><td>1.0</td><td>0.0</td></tr> <tr><td>2.0</td><td>0.0</td></tr> <tr><td>3.0</td><td>0.0</td></tr> <tr><td>4.0</td><td>0.0</td></tr> <tr><td>5.0</td><td>0.0</td></tr> <tr><td>6.0</td><td>0.0</td></tr> </tbody> </table>	DEPTH(mBGL)	PID (ppm)	0.5	0.0	1.0	0.0	2.0	0.0	3.0	0.0	4.0	0.0	5.0	0.0	6.0	0.0
DEPTH(mBGL)	PID (ppm)																		
0.5	0.0																		
1.0	0.0																		
2.0	0.0																		
3.0	0.0																		
4.0	0.0																		
5.0	0.0																		
6.0	0.0																		
<p>Logged By: [Personal information]</p> <p>Field Classification</p> <p>0 No obvious contamination</p> <p>1 Slight visual contamination and/or slight odour</p> <p>2 Visual contamination and/or odour</p> <p>3 Gross visual contamination and/or strong odour</p>		<p>Sampled By: [Personal information]</p> <p>Notes</p>	<p>BOREHOLE BH8</p> <p>PPK Environment & Infrastructure</p> <p>JOB NO. 84K043A Page NO. BH8</p>																

RTI DL RELEASE - EHP

Appendix D

Summary of Analytical Results

Table D1 - Summary of Soil Analytical Results (TPH and Phenols)

Bore ID	Sample ID	Date Sampled	Depth (mBGL)	PID Screen (ppm)	TPH C ₆ -C ₉	TPH C ₁₀ -C ₁₄	TPH C ₁₅ -C ₂₈	TPH C ₂₉ -C ₃₆	Total TPH	Total Phenols
BH7	BH7;2.5-2.7	9-3-98	2.5-2.7	0.0	nd	nd	nd	nd	nd	nd
BH7	BH7;4.0	9-3-98	4.0	0.0	nd	nd	nd	nd	nd	-
BH7	BH7;7.0*	9-3-98	7.0	0.0	nd	nd	nd	nd	nd	-
BH6	BH6;2.0	6-3-98	2.0	0.0	nd	nd	nd	nd	nd	-
BH3	BH3;3.0	6-3-98	3.0	0.0	nd	nd	nd	nd	nd	-
BH6	BH6;0.5	6-3-98	0.5	0.0	nd	22	274	866	1160	nd
BH3	BH3;0.5	6-3-98	0.5	0.0	nd	nd	nd	nd	nd	2.5
BH8	BH8;0.2-0.4	6-3-98	0.2-0.4	0.0	nd	41	404	1410	1860	nd
BH4	BH4;3.0	6-3-98	3.0	0.0	nd	nd	nd	nd	nd	-
BH4	BH4;0.3-0.5	6-3-98	0.3-0.5	0.0	nd	nd	nd	242	242	nd
BH8	BH8;3.0	6-3-98	3.0	0.0	nd	nd	nd	nd	nd	6.1
BH5	BH5;1.0	6-3-98	1.0	0.0	nd	nd	nd	nd	nd	-
BH5	BH5;3.0	6-3-98	3.0	0.0	nd	nd	nd	nd	nd	nd
BH2	BH2;0.5-0.7	4-3-98	0.5-0.7	0.0	nd	nd	nd	335	335	-
BH2	BH2;3.0	4-3-98	3.0	0.0	nd	nd	nd	nd	nd	0.3
Queensland DoE				100	100	100	1000	1000	1000	NC
NEHF Health Based (Recreational)				NC	NC	NC	NC	NC	NC	17000
NEHF Health Based (Commercial)				NC	NC	NC	NC	NC	NC	42500

Notes: All values given in mg/kg on a dry weight basis
Proposed SAHC/NEHF Health Based Soil Investigation Levels (Health Risk Assessment and Management of Contaminated Sites, Monograph No. 5, 1996)
Results in **bold** indicate levels exceeding DoE criteria
* Field Duplicate submitted for analysis of BH 7; 4.0
nd indicates analyte not detected above Limit of Detection
NC indicates no current regulatory criteria for the analyte tested
- indicates analyte not tested in this sample

Table D2 - Summary of Soil Analytical Results (Polycyclic Aromatic Hydrocarbons)

Bore ID	Sample ID	Date Sampled	Depth (mBGL)	NAP	ACY	ACE	FLU	PHE	ANT	FLA	PYR	BAA	CHR	B(B&K)F	BAP	DBA	BGP	IPY	Total
BH7	BH7;2.5-2.7	9-3-98	2.5-2.7	nd	nd	nd	nd	0.8	nd	2.1	1.9	0.9	1.1	2.0	0.7	nd	0.5	0.6	10.4
BH3	BH3;3.0	6-3-98	3.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-
BH6	BH6;0.5	6-3-98	0.5	nd	nd	nd	nd	1.3	nd	2.2	1.9	0.9	1.0	2.0	0.6	nd	0.6	0.7	11.0
BH3	BH3;0.5	6-3-98	0.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-
BH8	BH8;0.2-0.4	6-3-98	0.2-0.4	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-
BH4	BH4;0.3-0.5	6-3-98	0.3-0.5	nd	nd	nd	nd	0.5	nd	1.1	1.1	0.5	0.6	1.0	nd	nd	0.5	0.6	6.2
BH5	BH5;3.0	6-3-98	3.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-
BH2	BH2;3.0	4-3-98	3.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-
Queensland DoE				NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	1	NC	NC	NC	20
NEHF Health Based (Recreational)				NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	2	NC	NC	NC	40
NEHF Health Based (Commercial)				NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	5	NC	NC	NC	100

Notes: All values given in mg/kg on a dry weight basis
Proposed SAHC/NEHF Health Based Soil Investigation Levels (Health Risk Assessment and Management of Contaminated Sites, Monograph No. 5, 1996)
Results in **bold** indicate levels exceeding DoE criteria
nd indicates analyte not detected above Limit of Detection
NC indicates no current regulatory criteria for the analyte tested
- indicates analyte not tested in this sample

PAH Nomenclature

NAP	Naphthalene	PHE	Phenanthrene	BAA	Benzo (a) anthracene	BAP	Benzo (a) pyrene
ACY	Acenaphthylene	ANT	Anthracene	CHR	Chrysene	DBA	Dibenzo (a,h) anthracene
ACE	Acenaphthene	FLA	Fluoranthene	B(B&K)F	Benzo (b) fluoranthene	BGP	Benzo (g,h,i) perylene
FLU	Fluorene	PYR	Pyrene			IPY	Indeno (1,2,3 - cd) pyrene

Table D3 - Summary of Soil Analytical Results (Metals)

Bore ID	Sample ID	Date Sampled	Depth (mBGL)	Arsenic	Cadmium	Chromium	Copper	Nickel	Lead	Zinc	Mercury
BH7	BH7;2.5-2.7	9-3-98	2.5-2.7	nd	nd	22	17	13	16	45	0.08
BH7	BH7;4.0	9-3-98	4.0	nd	nd	30	29	20	9	55	nd
BH7	BH7;7.0*	9-3-98	7.0	6	nd	32	21	23	9	58	nd
BH6	BH6;2.0	6-3-98	2.0	nd	nd	31	15	21	8	46	0.12
BH3	BH3;3.0	6-3-98	3.0	6	nd	27	18	12	7	45	nd
BH6	BH6;0.5	6-3-98	0.5	nd	nd	nd	32	9	9	36	nd
BH3	BH3;0.5	6-3-98	0.5	nd	nd	88	19	22	8	53	nd
BH8	BH8;0.2-0.4	6-3-98	0.2-0.4	nd	nd	nd	28	8	10	49	nd
BH4	BH4;3.0	6-3-98	3.0	nd	nd	29	12	11	6	33	nd
BH4	BH4;0.3-0.5	6-3-98	0.3-0.5	nd	nd	10	28	14	17	50	nd
BH8	BH8;3.0	6-3-98	3.0	5	nd	33	18	20	11	62	nd
BH5	BH5;1.0	6-3-98	1.0	nd	nd	32	80	24	6	79	nd
BH5	BH5;3.0	6-3-98	3.0	nd	nd	29	17	5	nd	24	nd
BH2	BH2;0.5-0.7	4-3-98	0.5-0.7	nd	nd	6	41	nd	99	47	0.07
BH2	BH2;3.0	4-3-98	3.0	5	nd	34	18	9	39	31	nd
Queensland DoE				20	3	50	60	1	300	60	200
NEHF Health Based (Recreational)				200	40	III - 24% VI - 200	2000	30	600	600	14000
NEHF Health Based (Commercial)				500	100	III - 60% VI - 500	5000	75	1500	3000	35000

check thresholds

Notes: All values given in mg/kg on a dry weight basis
Proposed SAHC/NEHF Health Based Soil Investigation Levels (Health Risk Assessment and Management of Contaminated Sites, Monograph No. 5, 1996)
Results in **bold** indicate levels exceeding DoE criteria
* Field Duplicate submitted for analysis of BH 7; 4.0
nd indicates analyte not detected above Limit of Detection
NC indicates no current regulatory criteria for the analyte tested

Table D4. VOC results using Headspace Analysis for Soil Bores (in ppm)

Soil Bore ID	Depth (mBGL)						
	0.5	1.0	2.0	3.0	4.0	5.0	6.0
BH1	-	-	-	-	-	-	-
BH2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BH3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BH4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BH5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BH6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BH7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BH8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes: mBGL (metres below ground level)
- Indicates reading not taken

RTI DL RELEASE - EHP

Table D5 - Summary of Groundwater Analytical Results (TPH)

Sample	Date Sampled	TPH C ₆ -C ₉	TPH C ₁₀ -C ₁₄	TPH C ₁₅ -C ₂₈	TPH C ₂₉ -C ₃₆	TPH
BH3	13/3/98	nd	nd	nd	nd	nd
BH6	13/3/98	nd	nd	nd	nd	nd
BH8	13/3/98	nd	nd	nd	nd	nd
BH10*	13/3/98	nd	nd	nd	nd	nd
ANZECC Guidelines		NC	NC	NC	NC	NC
Dutch Intervention Values			600			600

Notes: All results stated in µg/L unless otherwise specified
 Results shaded indicate levels exceeding ANZECC Guidelines for Fresh Waters
 Results in **bold** indicates levels exceeding Dutch Intervention Values
 * Indicates field rinsate blank
 nd Indicates analyte not detected above Limit of Detection
 NC Indicates no current regulatory criteria for the analyte tested

Table D6 - Summary of Groundwater Analytical Results (Metals)

Sample	Date Sampled	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
BH3	13/3/98	3	nd	5	9	5	nd	5	27
BH6	13/3/98	3	nd	7	9	9	nd	9	147
BH8	13/3/98	8	nd	23	33	22	nd	22	115
BH10*	13/3/98	nd	nd	nd	4	2	nd	2	37
ANZECC Guidelines (Fresh)		50	0.2-2.0	10	0.2-5.0	1.0-5.0	0.1	15-50	5-50
ANZECC Guidelines (Marine)		50	2	50	5	15	0.1	15	50
Dutch Intervention Value		60	6	30	75	75	0.3	75	800

Notes: All results stated in µg/L unless otherwise specified
 Results shaded indicate levels exceeding ANZECC Guidelines for Fresh Waters
 Results in **bold** indicates levels exceeding Dutch Intervention Values
 * Indicates field rinsate blank
 nd Indicates analyte not detected above Limit of Detection
 NC Indicates no current regulatory criteria for the analyte tested

Table D7 - Summary of Groundwater Analytical Results (Polycyclic Aromatic Hydrocarbons)

Bore ID	Date Sampled	NAP	ACY	ACE	FLU	PHE	ANT	FLA	PYR	BAA	CHR	B(B&K)F	BAP	DBA	BGP	IPY	Total
BH3	13/3/98	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BH6	13/3/98	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BH8	13/3/98	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BH10*	13/3/98	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
ANZECC Guidelines		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	3.0
Dutch Intervention Guidelines		70	NC	NC	NC	NC	5	1	NC	0.5	0.05	0.05	0.05	NC	0.05	0.05	NC

Notes: All results stated in µg/L unless otherwise specified
 Results shaded indicate levels exceeding ANZECC Guidelines for Fresh Waters
 Results in **bold** indicates levels exceeding Dutch Intervention Values
 * Indicates field rinsate blank
 nd Indicates analyte not detected above Limit of Detection
 NC Indicates no current regulatory criteria for the analyte tested

PAH Nomenclature

NAP	Naphthalene	PHE	Phenanthrene	BAA	Benzo (a) anthracene	BAP	Benzo (a) pyrene
ACY	Acenaphthylene	ANT	Anthracene	CHR	Chrysene	DBA	Dibenzo (a,h) anthracene
ACE	Acenaphthene	FLA	Fluoranthene	B(B&K)F	Benzo (b) fluoranthene	BGP	Benzo (g,h,i) perylene
FLU	Fluorene	PYR	Pyrene	BKF	Benzo (k) fluoranthene	IPY	Indeno (1,2,3 - cd) pyrene

Appendix E

Returned Chain of Custody and Final Laboratory Certificates

Appendix F

Field Parameters and Purging Volume Sheets

Job Number : 8B00074
Client : PPK Brisbane
Reference : 84K043A/1928

Analyte	Lab No	E48913	E48914	E48915	E48916	E48917
		BH7;2.5-				
	Sample Id	2.7	BH7;4.0	BH7;7.0	BH6;2.0	BH3;3.0
	PQL					
E4042 Moisture Content %(w/w)	1	20	30	35	16	32
E084 TPH in Soil						
TPH C6-C36 as C8	-	nd	nd	nd	nd	nd
C6-C9 Fraction	10	nd	nd	nd	nd	nd
C10-C14 Fraction	20	nd	nd	nd	nd	nd
C15-C28 Fraction	100	nd	nd	nd	nd	nd
C29-C36 Fraction	100	nd	nd	nd	nd	nd
M340S Metals in Soil						
Arsenic	5	nd	nd	6	nd	6
Cadmium	1	nd	nd	nd	nd	nd
Chromium	5	22	30	32	31	27
Copper	5	17	29	21	15	18
Nickel	5	13	20	23	21	12
Lead	5	16	9	9	8	7
Zinc	5	45	55	58	46	45
Mercury in Soil	0.05	0.08	nd	nd	0.12	nd
E4032 Tot. Phenolics as phenol	0.1	nd	--	--	--	--

Job Number : 8B00074
 Client : PPK Brisbane
 Reference : 84K043A/1928

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 plus Cover Page

Analyte	Lab No	E48918	E48919	E48920	E48921	E48922
				BH8;0.2-		BH4;0.3-
	Sample Id	BH6;0.5	BH3;0.5	0.4	BH4;3.0	0.5
	PQL					
E1042 Moisture Content %(w/w)	1	23	23	23	23	19
E084 TPH in Soil						
TPH C6-C36 as C8	-	1160	nd	1860	nd	242
C6-C9 Fraction	10	nd	nd	nd	nd	nd
C10-C14 Fraction	20	22	nd	41	nd	nd
C15-C28 Fraction	100	274	nd	404	nd	nd
C29-C36 Fraction	100	866	nd	1410	nd	242
M340S Metals in Soil						
Arsenic	5	nd	nd	nd	nd	nd
Cadmium	1	nd	nd	nd	nd	nd
Chromium	5	nd	38	nd	29	10
Copper	5	32	19	28	12	28
Nickel	5	9	22	8	11	14
Lead	5	9	8	10	6	17
Zinc	5	36	53	49	33	50
Mercury in Soil	0.05	nd	nd	nd	nd	nd
E1032 Tot. Phenolics as phenol	0.1	nd	2.5	nd	--	nd

PQL = Practical Quantitation Limit
 LNR = Samples Listed not Received
 nd = Not Detected (<PQL)
 -- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
 Waters : mg/L (ppm) unless otherwise specified
 Leachates : mg/L (ppm) in leachate

Job Number : 8B00074

Client : PPK Brisbane

Reference : 84K043A/1928

Page 3 of 6
plus Cover Page

Analyte	Lab No	E48923	E48924	E48925	E48926	E48927
					BH2;0.5-	
	Sample Id	BH8;3.0	BH5;1.0	BH5;3.0	0.7	BH2;3.0
	PQL					
E1042 Moisture Content %(w/w)	1	38	17	28	19	22
E084 TPH in Soil						
TPH C6-C36 as C8	-	nd	nd	nd	335	nd
C6-C9 Fraction	10	nd	nd	nd	nd	nd
C10-C14 Fraction	20	nd	nd	nd	nd	nd
C15-C28 Fraction	100	nd	nd	nd	nd	nd
C29-C36 Fraction	100	nd	nd	nd	335	nd
M340S Metals in Soil						
Arsenic	5	5	nd	nd	nd	5
Cadmium	1	nd	nd	nd	nd	nd
Chromium	5	33	32	29	6	34
Copper	5	18	80	17	41	18
Nickel	5	20	24	5	nd	9
Lead	5	11	6	nd	99	39
Zinc	5	62	79	24	47	31
Mercury in Soil	0.05	nd	nd	nd	0.07	nd
E032 Tot. Phenolics as phenol	0.1	6.1	--	nd	--	0.3

PQL = Practical Quantitation Limit

LNR = Samples Listed not Received

nd = Not Detected (<PQL)

-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified

Waters : mg/L (ppm) unless otherwise specified

Leachates : mg/L (ppm) in leachate

Job Number : 8B00074

Client : PPK Brisbane

Reference : 84K043A/1928

Page 4 of 6
plus Cover Page

Analyte	Lab No	CB				
		CONTROL				
	Sample Id	BLANK				
	PQL					
E1042 Moisture Content %(w/w)	1					
E084 TPH in Soil						
TPH C6-C36 as C8	-	nd				
C6-C9 Fraction	10	nd				
C10-C14 Fraction	20	nd				
C15-C28 Fraction	100	nd				
C29-C36 Fraction	100	nd				
M340S Metals in Soil						
Arsenic	5	nd				
Cadmium	1	nd				
Chromium	5	nd				
Copper	5	nd				
Nickel	5	nd				
Lead	5	nd				
Zinc	5	nd				
Mercury in Soil	0.05	nd				
E1032 Tot. Phenolics as phenol	0.1	nd				

PQL = Practical Quantitation Limit

LNR = Samples Listed not Received

nd = Not Detected (<PQL)

-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified

Waters : mg/L (ppm) unless otherwise specified

Leachates : mg/L (ppm) in leachate

Lab Number : 8B00074
 Client : PPK Brisbane
 Reference : 84K043A/1928

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 plus Cover Page

Analyte	Lab No	E48913	E48917	E48918	E48919	E48920
		BH7;2.5-				BH8;0.2-
	Sample Id	2.7	BH3;3.0	BH6;0.5	BH3;0.5	0.4
	PQL					
E092 PAH's in Soil						
Phthalene	0.5	nd	nd	nd	nd	nd
Acenaphthylene	0.5	nd	nd	nd	nd	nd
Acenaphthene	0.5	nd	nd	nd	nd	nd
Fluorene	0.5	nd	nd	nd	nd	nd
Phenanthrene	0.5	0.8	nd	1.3	nd	nd
Anthracene	0.5	nd	nd	nd	nd	nd
Fluoranthene	0.5	2.1	nd	2.2	nd	nd
Pyrene	0.5	1.9	nd	1.9	nd	nd
Benzo(a)anthracene	0.5	0.9	nd	0.9	nd	nd
Chrysene	0.5	1.1	nd	1.0	nd	nd
Benzo(b)&(k)fluoranthene	0.5	2	nd	2	nd	nd
Benzo(a)pyrene	0.5	0.7	nd	0.6	nd	nd
Benzo(1.2.3-cd)pyrene	0.5	0.6	nd	0.7	nd	nd
Dibenz(a,h)anthracene	0.5	nd	nd	nd	nd	nd
Benzo(g,h,i)perylene	0.5	0.5	nd	0.6	nd	nd
Total PAHs Measureable	-	10.4	nd	11.0	nd	nd
Surrogate % Recovery	-	--	--	--	--	--
2-Fluorobiphenyl	-	101	107	100	97	103
4-Terphenyl	-	122	123	128	113	124

PQL = Practical Quantitation Limit
 LNR = Samples Listed not Received
 nd = Not Detected (<PQL)
 -- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
 Waters : mg/L (ppm) unless otherwise specified
 Leachates : mg/L (ppm) in leachate

Job Number : 8B00074

Client : PPK Brisbane

Reference : 84K043A/1928

Page 6 of 6

plus Cover Page

Analyte	Lab No	E48922	E48925	E48927	CB	
		BH4;0.3-			CONTROL	
	Sample Id	0.5	BH5;3.0	BH2;3.0	BLANK	
	PQL					
E092 PAH's in Soil						
Naphthalene	0.5	nd	nd	nd	nd	
Acenaphthylene	0.5	nd	nd	nd	nd	
Acenaphthene	0.5	nd	nd	nd	nd	
Fluorene	0.5	nd	nd	nd	nd	
Phenanthrene	0.5	0.5	nd	nd	nd	
Anthracene	0.5	nd	nd	nd	nd	
Fluoranthene	0.5	1.1	nd	nd	nd	
Pyrene	0.5	1.1	nd	nd	nd	
Benzo(a)anthracene	0.5	0.5	nd	nd	nd	
Chrysene	0.5	0.6	nd	nd	nd	
Benzo(b)&(k)fluoranthene	0.5	1	nd	nd	nd	
Benzo(a)pyrene	0.5	nd	nd	nd	nd	
Indeno(1.2.3-cd)pyrene	0.5	0.6	nd	nd	nd	
Dibenz(a,h)anthracene	0.5	nd	nd	nd	nd	
Benzo(g,h,i)perylene	0.5	0.5	nd	nd	nd	
Total PAHs Measurable	-	6.2	nd	nd	nd	
Surrogate % Recovery	-	--	--	--	--	
2-Fluorobiphenyl	-	101	101	101	108	
14-Terphenyl	-	128	115	116	122	

PQL = Practical Quantitation Limit

LNR = Samples Listed not Received

nd = Not Detected (<PQL)

-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified

Waters : mg/L (ppm) unless otherwise specified

Leachates : mg/L (ppm) in leachate

Release

QA/QC APPENDIX NO. 8B00074

<u>Method</u>	<u>Description</u>
E084	Total Petroleum Hydrocarbons
E092	Polynuclear Aromatic Hydrocarbons
M340S	Metals by ICP-AES
M350S	Mercury in Soil
E1032	Total Phenolics as phenol

Chromatography QA/QC

	Yes	No	N/A
Retention Time Window Within Acceptance Criteria($\pm 2\%$)	✓		
Check Standard Within Acceptance Criteria($\pm 10\%$)	✓		
Recalibration Within Acceptance Criteria($\pm 15\%$)	✓		

Other QA/QC

Holding time conforming With Method Specification	✓
Chain of Custody Attached	✓

N/A=Not Applicable

Comments

1. Laboratory QA/QC including Duplicates, Matrix Spike Duplicates, and check/reference samples are included in this QA/QC appendix. (Where applicable)
2. Inter-Laboratory proficiency trial results available on request. (Where applicable)
3. Surrogate description and recoveries are recorded in the Report. (Where applicable)
4. Acceptance criteria for specific analytes are listed on each QA/QC page.
5. Practical Quantitation Limit (PQL is typically 2-10 x method detection limit (MDL)).
6. PQL's are matrix dependent and are increased accordingly where sample extracts are diluted.
7. Results are uncorrected for matrix spike or surrogate recoveries.

sch4p4(6) Personal information

per G.W. ANDERSON
Manager Environmental Sydney

QOC : Matrix Spike / Check Solution

[illegible]

■ POL = Practical Quantitation Limit

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/l (ppm)

nd = Not Detected
-- = Not Applicable

All results are within the acceptance criteria:

Refer to Amdel-Sydney Quality Control Manual SPM-01 4th Edition 1/7/97

QC : Duplicates

Analyte	PQL	Dupl 1	Dupl 2	Average	RPD (%)
E084 TPH in Soil					
TPH C6-C36 as C8	-	nd	nd		
C6-C9 Fraction	10	nd	nd		
C10-C14 Fraction	20	nd	nd		
C15-C28 Fraction	100	nd	nd		
C29-C36 Fraction	100	nd	nd		
M340S Metals in Soil					
Arsenic	5	nd	nd		
Cadmium	1	nd	nd		
Chromium	5	22	22	22	0%
Copper	5	17	17	17	0%
Nickel	5	13	13	13	0%
Lead	5	18	16	17	11%
Zinc	5	47	45	46	4%
Mercury in Soil	0.05	0.10	0.08	0.09	22%

PQL = Practical Quantitation Limit

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm)

nd = Not Detected
-- = Not Applicable

All results are within the acceptance criteria:

Refer to Amdel-Sydney Quality Control Manual SPM-01 4th Edition 1/7/97

QA/QC : Matrix Spike / Check Solution

[illegible]

PQL = Practical Quantitation Limit

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/l (ppm)

nd = Not Detected
-- = Not Applicable

All results are within the acceptance criteria:

Refer to Amdel-Sydney Quality Control Manual SPM-01 4th Edition 1/7/97

Job Number : 8B00083

Page 1 of 2

Client : PPK Brisbane

plus Cover Page

Reference : 84K043A/1933/1934

	Lab No	E49458	E49459	E49460	E49461	CB
						CONTROL
	Sample Id	BH3	BH6	BH8	BH10	BLANK
Analyte	PQL					
E083 TPH in Water						
PH C6-C36 as C8	-	nd	nd	nd	nd	nd
C6-C9 Fraction	0.02	nd	nd	nd	nd	nd
C10-C14 Fraction	0.04	nd	nd	nd	nd	nd
C15-C28 Fraction	0.2	nd	nd	nd	nd	nd
C29-C36 Fraction	0.2	nd	nd	nd	nd	nd
W047 Phenolics as Phenols	0.01	nd	nd	nd	nd	nd
Dissolved Metals in Waters						
Arsenic	0.001	0.003	0.003	0.008	nd	nd
Cadmium	0.0005	nd	nd	nd	nd	nd
Chromium	0.001	0.005	0.007	0.023	nd	nd
Copper	0.001	0.009	0.009	0.033	0.004	nd
Nickel	0.001	0.006	0.044	0.028	0.001	nd
Lead	0.001	0.005	0.009	0.022	0.002	nd
Zinc	0.002	0.027	0.147	0.115	0.037	nd
1350 Mercury in Water	0.001	nd	nd	nd	nd	nd

PQL = Practical Quantitation Limit

LNR = Samples Listed not Received

nd = Not Detected (<PQL)

-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified

Waters : mg/L (ppm) unless otherwise specified

Leachates : mg/L (ppm) in leachate

Release

Number : 8B00083
 Client : PPK Brisbane
 Reference : 84K043A/1933/1934

Page 2 of 2
 plus Cover Page

	Lab No	E49458	E49459	E49460	E49461	CB
						CONTROL
	Sample Id	BH3	BH6	BH8	BH10	BLANK
Analyte	PQL					
E091 PAH's in Water						
Naphthalene	0.001	nd	nd	nd	nd	nd
Acenaphthylene	0.001	nd	nd	nd	nd	nd
Acenaphthene	0.001	nd	nd	nd	nd	nd
Fluorene	0.001	nd	nd	nd	nd	nd
Phenanthrene	0.001	nd	nd	nd	nd	nd
Anthracene	0.001	nd	nd	nd	nd	nd
Fluoranthene	0.001	nd	nd	nd	nd	nd
Pyrene	0.001	nd	nd	nd	nd	nd
Benzo(a)anthracene	0.001	nd	nd	nd	nd	nd
Chrysene	0.001	nd	nd	nd	nd	nd
Benzo(b) & (k) fluoranthene	0.002	nd	nd	nd	nd	nd
Benzo(a)pyrene	0.001	nd	nd	nd	nd	nd
Benzo(1,2,3-cd)pyrene	0.001	nd	nd	nd	nd	nd
Dibenz(a,h)anthracene	0.001	nd	nd	nd	nd	nd
Benzo(g,h,i)perylene	0.001	nd	nd	nd	nd	nd
Total PAHs Measureable	-	nd	nd	nd	nd	nd
Surrogate % Recovery	-	109	107	90.0	116	111

PQL = Practical Quantitation Limit
 LNR = Samples Listed not Received
 nd = Not Detected (<PQL)
 -- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
 Waters : mg/L (ppm) unless otherwise specified
 Leachates : mg/L (ppm) in leachate

QA/QC APPENDIX NO. 8B00083

<u>Method</u>	<u>Description</u>
E083	Total Petroleum Hydrocarbons
E091	Polynuclear Aromatic Hydrocarbons
W047	Total Phenolics
M370WD	Dissolved Metals by ICP-MS
M350WD	Mercury

Chromatography QA/QC

	Yes	No	N/A
Retention Time Window Within Acceptance Criteria($\pm 2\%$)	✓		
Check Standard Within Acceptance Criteria($\pm 10\%$)	✓		
Recalibration Within Acceptance Criteria($\pm 15\%$)	✓		

Other QA/QC

Holding time conforming With Method Specification	✓
Chain of Custody Attached	✓

N/A=Not Applicable

Comments

1. Laboratory QA/QC including Duplicates, Matrix Spike Duplicates, and check/reference samples are included in this QA/QC appendix. (Where applicable)
2. Inter-Laboratory proficiency trial results available on request. (Where applicable)
3. Surrogate description and recoveries are recorded in the Report. (Where applicable)
4. Acceptance criteria for specific analytes are listed on each QA/QC page.
5. Practical Quantitation Limit (PQL is typically 2-10 x method detection limit (MDL)).
6. PQL's are matrix dependent and are increased accordingly where sample extracts are diluted.
7. Results are uncorrected for matrix spike or surrogate recoveries.

sch4p4(6) Personal information

per G.W. ANDERSON
Manager Environmental Sydney

Number : 8B00083

Page 1 of 2

QC : Matrix Spike / Check Solution.

Analyte	Level (ppm)	Level	Detected	Recovery Details			
		Result1 (ppm)	Result2 (ppm)	Rec 1 (%)	Rec 2 (%)	Average (%)	RPD (%)
083 TPH in Water							
TPH C6-C36 as C8	9.5	7.5	7.6	79%	80%	79%	1%
C6-C9 Fraction	4.0	2.90	2.90	73%	73%	73%	0%
15-C28 Fraction	5.5	4.6	5.2	84%	95%	89%	12%
047 Phenolics as Phenols	1.0	0.92		92%			
Dissolved Metals in Waters							
Arsenic	0.100	0.106	0.106	106%	106%	106%	0%
Cadmium	0.1000	0.104	0.105	104%	105%	105%	1%
Chromium	0.100	0.101	0.104	101%	104%	103%	3%
Copper	0.100	0.097	0.098	97%	98%	98%	1%
Nickel	0.100	0.099	0.100	99%	100%	100%	1%
Lead	0.100	0.112	0.101	112%	101%	107%	10%
Zinc	0.100	0.102	0.103	102%	103%	103%	1%
M350 Mercury in Water	0.12	0.110	0.110	92%	92%	92%	0%

QL = Practical Quantitation Limit

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/l (ppm)

nd = Not Detected
-- = Not Applicable

All results are within the acceptance criteria:

Refer to Amdel-Sydney Quality Control Manual SPM-01 4th Edition 1/7/97

■AQC : Matrix Spike / Check Solution

[illegible]

PQL = Practical Quantitation Limit

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/l (ppm)

nd = Not Detected
-- = Not Applicable

All results are within the acceptance criteria:

Refer to Amdel-Sydney Quality Control Manual SPM-01 4th Edition 1/7/97

Job Title: *New Farm Contaminated Site assessment - Power Station*
Laboratory Name: *AMDEL*
Address: *3/1 Fort Lane Merton*

Rust PPK Job Number: *84K043A*
Amdel:
8B00074

Job Location: *New Farm*

Project Manager: *Carole Woodhead*
Results Expected by/on: *16/3/98*
Fax Results to: *Joe Feltham*
Fax Number: *38514223*
Phone Number: *32182214*

Fax Number:
Phone Number: *33695555*
Contact Name: *Bell Stannopolous*
Delivery Method: *Pick-up*
Quote Number:

Spreadsheet of Results Required: *Y*
Format: *Excel*
Turnaround Time Required: *3-5 days*
Invoice to: *PPK*
Comments: *Please E-mail results*

Initials: *Hold*
Comments/Additional Information and/or Analysis Required: *High Level Metals*

Date Sampled	Time	Sample I.D.	Container Size	Sample Location	Medium*	Preservative Type	Filtered (X)	TPH	BTEX	PAH's	OC/OP/PCBS	Metals**	Total Phospho	Initials	Comments/Additional Information and/or Analysis Required
<i>9-3-98</i>		<i>BH7; 0.5</i>			<i>S</i>							<i>✓</i>	<i>✓</i>	<i>Hold</i>	<i>Hold</i>
		<i>BH7; 2.5-2.7</i>						<i>✓</i>				<i>✓</i>	<i>✓</i>	<i>Hold</i>	<i>Hold</i>
		<i>BH7; 3.0</i>						<i>✓</i>				<i>✓</i>	<i>✓</i>	<i>Hold</i>	<i>Hold</i>
		<i>BH7; 4.0</i>						<i>✓</i>				<i>✓</i>	<i>✓</i>	<i>Hold</i>	<i>Hold</i>
		<i>BH7; 5.0</i>						<i>✓</i>				<i>✓</i>	<i>✓</i>	<i>Hold</i>	<i>Hold</i>
		<i>BH7; 6.0</i>						<i>✓</i>				<i>✓</i>	<i>✓</i>	<i>Hold</i>	<i>Hold</i>
		<i>BH7; 7.0</i>						<i>✓</i>				<i>✓</i>	<i>✓</i>	<i>Hold</i>	<i>Hold</i>
		<i>BH8; 1.0</i>						<i>✓</i>				<i>✓</i>	<i>✓</i>	<i>Hold</i>	<i>Hold</i>
		<i>BH3; 1.0</i>						<i>✓</i>				<i>✓</i>	<i>✓</i>	<i>Hold</i>	<i>Hold</i>
		<i>BH6; 4.0</i>						<i>✓</i>				<i>✓</i>	<i>✓</i>	<i>Hold</i>	<i>Hold</i>
		<i>BH6; 2.0</i>						<i>✓</i>				<i>✓</i>	<i>✓</i>	<i>Hold</i>	<i>Hold</i>
		<i>BH3; 2.0</i>						<i>✓</i>				<i>✓</i>	<i>✓</i>	<i>Hold</i>	<i>Hold</i>

Relinquished by: *Joe Feltham*
Date & Time: *9-3-98 11:00*
Company: *PPK*
Signature: *sch4p4(6) Personal information*

Relinquished by: *K. Goodall*
Date & Time: *9/3/98 12:30*
Company: *Amdel*
Signature: *sch4p4(6) Personal information*

Relinquished by:
Date & Time:
Company:
Signature:

Medium*: *(S) = Soil, W = Water, V = Vapour*
Legend**: (circle the following to be tested)
Metals: Al *(As)* Be *(Cd)* Co *(Cr)* Cu *(Fe)* *(Hg)*
Li Mg Mn *(Ni)* *(Pb)* Se Sn V *(Zn)*

Received in Good Order & Condition by (Name):
Date & Time:
Company:
Signature: *RTI 13-106*

Received in Good Order & Condition by (Name): *Robin H*
Date & Time: *4:30 10/3*
Company: *AMDEL*
Signature: *sch4p4(6) Personal information*

Received in Good Order & Condition by (Name):
Date & Time:
Company:
Signature:

Samples on Ice: ☒ Yes ☐ No
Please fax back a signed copy when samples are received at the laboratory
Page 288

Job Title: Contaminated Site Assessment - Power Station

Laboratory Name: AMDEL

Address:

Fax Number:

Phone Number: 33695555

Contact Name: Bullataropolous

Delivery Method: Prebook

Quote Number:

Rust PPK Job Number: 84K043A

Amadel # 8800074

Job Location: New Farm

Project Manager: Chris Woodhouse

Results Expected by/on: 16-3-98

Fax Results to: Joe Feltham

Fax Number: 38314228

Phone Number: 32182214

Spreadsheet of Results Required: (X) N

Format: Excel

Turnaround Time Required: 3-5 days

Invoice to: PPK

Comments: Please email results

Date Sampled	Time	Sample I.D	Container Size	Sample Location	Medium*	Preservative Type	Filtered (X)	TPH	BTEX	PAH's	OC/OP/PCB's	Metals**	Total Phenols	Initials	Comments/Additional Information and/or Analysis Required
63.78		BH3;50			S										
		BH3;3.0						✓		✓					Hold
		BH3;6.0						✓							Hold
		BH6;0.5						✓							
		BH8;5.0													
		BH6;8.0													
		BH8;1.0													
		BH6;3.0													
		BH3;0.5						✓	✓			✓			
		BH8;6.0													
		BH8;0.5													
		BH8;0.2-04						✓	✓			✓	✓		

Relinquished by: Joe Feltham

Date & Time: 2-3-98 11:00

Company: PPK

Signature: sch4p4(6) Personal information

Relinquished by: K. Goodall

Date & Time: 9/3/98 12:30

Company: Amadel

Signature: sch4p4(6) Personal information

Relinquished by:

Date & Time:

Company:

Signature:

Medium*: (S) Soil, W = Water, V = Vapour

Legend**: (circle the following to be tested)

Metals: Al (As) Be (Cd) Co (Cr) (Cu) Fe (Hg) Li Mg Mn (Ni) (Pb) Se Sn V (Zn)

Samples on Ice: ☒ Yes ☐ No

Received in Good Order

Condition by (Name):

Date & Time: 8-30 10/3

Company:

Signature: sch4p4(6) Personal information

Received in Good Order

Condition by (Name):

Date & Time:

Company:

Signature:

Received in Good Order

Condition by (Name):

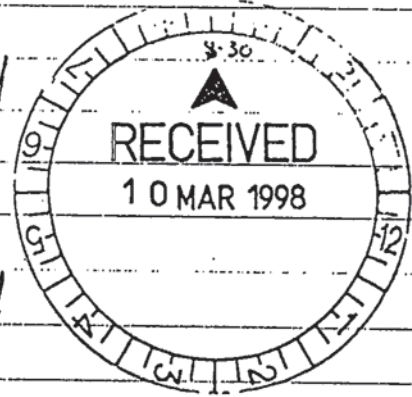
Date & Time:

Company:

Signature:

Please fax back a signed copy when samples are received at the laboratory

RTI DL RELEASE - EHP



Hold
Hold
Hold

sch4p4(6) Personal information

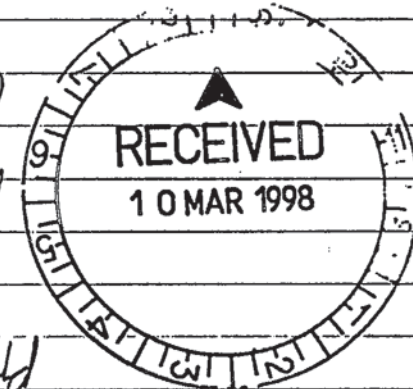
Job Title: **Contaminated Site Assessment - New Farm Power Station**
Laboratory Name: **AMDEL**
Address:

Rust PPK Job Number: **84K043A**
Amadel # 8B00074
Job Location: **New Farm**

Project Manager: **Chris Wood**
Results Expected by/on: **16-3-98**
Fax Results to: **Joe Feltham**
Fax Number: **33314223**
Phone Number: **32182214**
Spreadsheet of Results Required: **(S) N**
Format: **Excel**
Turnaround Time Required: **3-5 days**
Invoice to: **PPK**
Comments: **Please email results**

Fax Number:
Phone Number: **33686555**
Contact Name: **Bill Stannopolous**
Delivery Method:
Quote Number:

Date Sampled	Time	Sample I.D.	Container Size	Sample Location	Medium*	Preservative Type	Filtered (X)	TPH	BTEX	PAH's	OC/OP/PCB's	Metals**	Total Phenols	Initials	Comments/Additional Information and/or Analysis Required
6-3-98		BH6; 6.0			S										(6) Personal information Hold Hold Hold Hold
		BH8; 4.0													
		BH4; 1.0													
		BH4; 3.0													
		BH4; 0.5													
		BH4; 0.3-0.5													
		BH4; 2.0													
		BH8; 3.0													
		BH4; 5.0													
		BH4; 4.0													
		BH6; 5.0													
		BH5; 4.0													



Shed by: **Joe Feltham**
me **2-3-98 11:00**
PPK
sch4p4(6) Personal information
Received in Good Order
(Name):

Relinquished by: **K. Goodall**
Date & Time: **7/3/98 12:30**
Company: **Amadel**
Signature: sch4p4(6) Personal information
Received in Good Order
& Condition by (Name):
Date & Time: **8:30 10/3**
Company:
Signature: sch4p4(6) Personal information

Relinquished by:
Date & Time:
Company:
Signature:
Received in Good Order
& Condition by (Name):
Date & Time:
Company:
Signature:

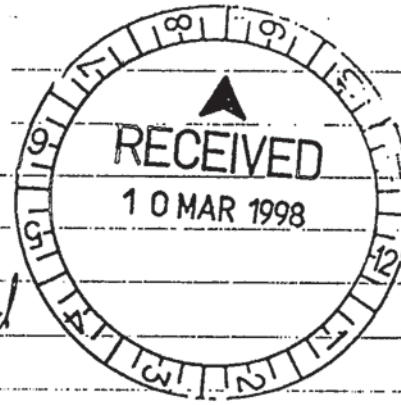
Medium*: **(S)** Soil, W = Water, V = Vapour
Legend**: (circle the following to be tested)
Metals: Al **(As)** Be **(Cd)** Co **(Cr)** Cu **(Fe)** Hg
Li Mg Mn **(Ni)** **(Pb)** Se Sn V **(Zn)**
Samples on Ice: ☒ Yes ☐ No
Please fax back a signed copy when samples are received at the laboratory
Page 290

Job Title: **Contaminated Site Assessment** **New Farm power station**
Laboratory Name: **AMDEL**
Address:
Fax Number:
Phone Number: **3369 5555**
Contact Name: **Bill Stannopolous**
Delivery Method:
Quote Number:
Rust PPK Job Number: **84K043A**
Job Location: **New Farm**
Project Manager: **Chris Woodcock**
Results Expected by/on: **16-3-98**
Fax Results to: **Joe Feltham**
Fax Number: **3831 4223**
Phone Number: **3218 2214**
Spreadsheet of Results Required: **(Y) N**
Format: **Excel**
Turnaround Time Required: **3-5 days**
Invoice to: **PPK**
Comments: **Please email results**

Date Sampled	Time	Sample I.D.	Container Size	Sample Location	Medium*	Preservative Type	Filtered (X)	TPH	BTEX	PAH's	OC/OP/PCBs	Metals**	Total Phosphate	Initials	Comments/Additional Information and/or Analysis Required
6-3-98		BH8; 2.0			5										
		BH5; 1.5													
		BH5; 1.0													
		BH5; 2.0													
		BH5; 3.0													
		BH5; 6.0													
		BH5; 5.0													
		BH3; 4.0													
		BH4; 6.0													
		BH2; 0.5-0.7													
		BH2; 1.0													
		BH2; 2-2.3													

Relinquished by: **Joe Feltham**
Date & Time: **2-3-98 11:00**
Company: **PPK**
Signature: **sch4p4(6) Personal information**
Relinquished by: **K. Goodall**
Date & Time: **9/3/98 12:30**
Company: **Amadel**
Signature: **sch4p4(6) Personal information**
Relinquished by:
Date & Time:
Company:
Signature:
Medium*: **(S)** Soil, W = Water, V = Vapour
Legend**: (circle the following to be tested)
Metals: Al **(As)** Be **(Cd)** Co **(Cr)** Cu Fe **(Hg)**
Li Mg Mn **(Ni)** **(Pb)** Se Sn V **(Zn)**
Samples on Ice: ☒ Yes ☐ No
Received in Good Order & Condition by (Name):
Date & Time: **8-30 10/3**
Company:
Signature: **sch4p4(6) Personal information**
Received in Good Order & Condition by (Name):
Date & Time:
Company:
Signature:
Please fax back a signed copy when samples are received at the laboratory

RTI DL RELEASE - EHP



Job Title: **Contaminated Site Assessment Power Station**
Laboratory Name: **AMDEL**
Address:

Rust PPK Job Number:

84K043A
Amadel #
8B0074

Job Location:

New Farm

Project Manager: **Chris Wood**

Results Expected by/on: **16-3-98**

Fax Results to: **Joe Fetham**

Fax Number: **38314223**

Phone Number: **32152214**

Spreadsheet of Results Required: **Yes**

Format: **Excel**

Turnaround Time Required: **3-5 days**

Invoice to: **PPK**

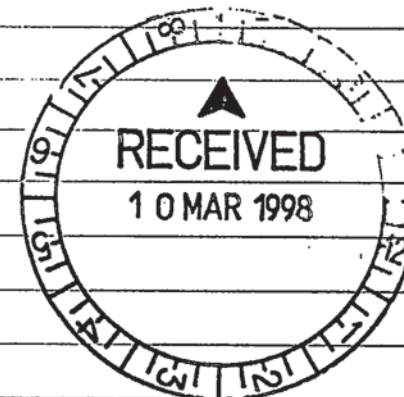
Comments: **Please email results**

Fax Number:
Phone Number: **3369 5555**
Contact Name: **Bull Stannopolous**
Delivery Method:
Quote Number:

Date Sampled	Time	Sample I.D.	Container Size	Sample Location
4-3-98		BH2; 3.0		
		BH2; 4.0		
		BH2; 5.0		
		BH2; 6.0		

Medium*	Preservative Type	Filtered (X)	TPH	BTEX	PAH's	OC/OP/PCB's	Metals** + Hg	Total Phenols
			☒		☒		☒	☒

Initials	Comments/Additional Information and/or Analysis Required
↓	Hold



Relinquished by: **Joe Fetham**
Date & Time: **9-3-98 11:00**
Company: **PPK**
Signature: sch4p4(6) Personal information

Relinquished by: **K. Goodall**
Date & Time: **9/3/98 12:30**
Company: **Amadel**
Signature: sch4p4(6) Personal information

Relinquished by:
Date & Time:
Company:
Signature:

Medium*: **S** Soil, W = Water, V = Vapour
Legend**: (circle the following to be tested)
Metals: Al **As** Be **Cd** Co **Cr** **Cu** Fe **Hg**
Li Mg Mn **Ni** **Pb** Se Sn V **Zn**

Received in Good Order
Condition by (Name):
Date & Time:
Company:
Signature: RTI 13-106

Received in Good Order
& Condition by (Name):
Date & Time: **8:30 10/3**
Company:
Signature: sch4p4(6) Personal information

Received in Good Order
& Condition by (Name):
Date & Time:
Company:
Signature:

Samples on Ice: ☒ Yes ☐ No
Please fax back a signed copy when samples are received at the laboratory
Page 292

Job Title: *New Farm*
Contaminated Site Assessment - Power Station
Laboratory Name: *AMDEL*
Address: *3/1 Fort Lane*
Milton
Fax Number:
Phone Number: *33625555*
Contact Name: *Bill Skaropoulos*
Delivery Method: *Courier*
Quote Number:

Rust PPK Job Number:
84K043A
AMDEL
8B00083

Job Location:
New Farm

Project Manager: *Chris Woodhead*
Results Expected by/on: *26-3-98*
Fax Results to: *Joe Feltham*
Fax Number: *36314223*
Phone Number: *32132214*
Spreadsheet of Results Required: *Yes*
Format: *Excel*
Turnaround Time Required: *3-5 days*
Invoice to: *PPK*
Comments: *Please email results*

Date Sampled	Time	Sample I.D.	Container Size	Sample Location	Medium*	Preservative Type	Filtered (X)	TPH	BTEX	PAH's	OC/OP/PCB's	Metals** + Hg	Total Phenols	Initials	Comments/Additional Information and/or Analysis Required
<i>13-3-98</i>		<i>BH3; 3</i> ✓	<i>250ml</i>		<i>W</i>										
		<i>BH3; 1</i> ✓	<i>50ml</i>					✓							<i>High level Metals Re</i>
		<i>BH3; 2</i> ✓	<i>50ml</i>												
		<i>BH3; 4</i> ✓	<i>1 Litre</i>												
		<i>BH6; 1</i> ✓	<i>50ml</i>					✓							
		<i>BH6; 2</i> ✓	<i>"</i>					✓							
		<i>BH6; 3</i> ✓	<i>250ml</i>									✓			
		<i>BH6; 4</i> ✓	<i>1 Litre</i>									✓			
		<i>BH8; 1</i> ✓	<i>50ml</i>					✓							
		<i>BH8; 2</i> ✓	<i>"</i>									✓			
		<i>BH8; 3</i> ✓	<i>250ml</i>									✓			
		<i>BH8; 4</i> ✓	<i>1 Litre</i>									✓			

Relinquished by: *Joe Feltham*
Date & Time: *13/3/98 13:00*
Company: *PPK*
Signature: *sch4p4(6) Personal information*

Relinquished by: *R Goodall*
Date & Time: *13/3/98 13:10*
Company: *Amde*
Signature: *sch4p4(6) Personal information*

Relinquished by:
Date & Time:
Company:
Signature:

Medium*: S = Soil, *(W)* = Water, V = Vapour
Legend**: (circle the following to be tested)
Metals: Al *(S)* Be *(Cd)* Co *(Cr)* Cu *(Fe)* *(Hg)*
Li Mg Mn *(Ni)* *(Pb)* Se Sn V *(Zn)*

Received in Good Order & Condition by (Name):
Date & Time:
Company:
Signature: *RTI 13-106*

Received in Good Order & Condition by (Name): *VSINGH*
Date & Time: *16-3-98 8:15am*
Company: *Amde*
Signature: *sch4p4(6) Personal information*

Received in Good Order & Condition by (Name):
Date & Time:
Company:
Signature:

Samples on Ice: ☒ Yes ☐ No
Please fax back a signed copy when samples are received at the laboratory

Samples on Ice: ☒ Yes ☐ No

***Please fax back a signed copy when
samples are received at the laboratory***

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Sample Location	Medium*	Preservative	Filtered (X)	TPH	BTEX	PAH's	OC/OP/PCBB	Metals**	Total PAH
	←			✓		✓		✓	✓

Appendix F

Field Parameters and Purging Volume Sheets

PPK Environment & Infrastructure

SUBJECTIVE ANALYSIS

Project Name: *New Farm
Power Station*

Job Number: *642043A*

Date: *12/3/98*

Sheet: *1* of *2*

Bore ID	Diameter (mm)	Date	Time	WATER COLUMN Height (mBGL)	Total Depth (mBGL)	Water Depth (mBTOC)	Colour	Odour	Other	Bore Volume (Litres)	Required Purge Volume (Litres)
BH6	120	12/3/98	12:20	1.86	4.98	3.12	Grey Brown	Earthy	-	21 L	21 L
BH3	120	12/3/98	13:00	2.80	5.46	2.66	Grey Brown	Earthy	-	32 L	32 L
BH8	120	12/3/98	14:00	2.43	5.00	2.57	Grey Brown	Earthy	-	28 L	28 L

Bore Volume (in litres) Calculated as:
 $\text{Volume} = (\text{Pi} \times \text{D}^2) / 4 \times (\text{Bore Depth} - \text{SWL})$
 {or = (Conversion Factor) * (Bore Depth - SWL)}

Conversion Factors
 Diameter (D): Conversion Factor:
 50mm (2 inch) 20.268 cm²
 100mm (4 inch) 81.073 cm²
 150mm (6 inch) 182.414 cm²

Attachments: *1*

sh 4416 Personal information

12/3/98

PPK Environment & Infrastructure

BORE PURGE VOLUME ANALYSIS

Project Name: *New Farm Power Station*

Job Number: *84K047A*

Date: *12-13/3/98*

Sheet: *2 of 2*

Bore ID	Bore Volume (L)	Date	1st Bore Volume				2nd Bore Volume				3rd Bore Volume				Additional Information
			Time	Temp (C)	EC (mS/cm)	pH	Time	Temp (C)	EC (mS/cm)	pH	Time	Temp (C)	EC (mS/cm)	pH	
BH6	21 L	12/3/98	12:20	23.2	26.1	6.50	1400	Dry at 11 Litres			16:30	23.1	25.6	6.24	* Dry at 11 litres (1400) finished volume at 1630
BH6	21 L	13/3/98	10:00	23.0	10.1	5.36	← Sampling								
BH3	32 L	12/3/98	13:00	23.9	6.2	6.87	15:15	23.4	6.3	6.87					Dry after 2 volumes
BH3	32 L	13/3/98	08:30	25.9	4.5	7.37	← Sampling								
BH8	27 L	12/3/98	13:40	24.0	5.6	6.49	15:40	23.3	6.2	6.52	16:10	23.6	7.1	6.60	* Dry after 3 purge volumes
BH8	27 L	13/3/98	09:00	23.6	5.0	6.39	← Sampling								

Note: EC = Electrical Conductivity

Release

Memorandum

To File
From sch4p4 (a) Personal information

File reference 902 026

Subject Newfarm Powerhouse Rehabilitation

Date 8/10/97

Notes

Inspected Site. - Chris Bowen - BCC
Felicity Boevenk - BCC
David Vinny - Consultant.
Naomi - BCC.

Site going to be used as arts & cultural centre. Still in concept stage. No real large contaminated land issues - some asbestos, oil and fill on site but all should be able to be managed.

BCC will be requiring a S14 for asbestos & material for removal of ~~from~~ powerhouse.

BCC will forward copies of all reports in near future.

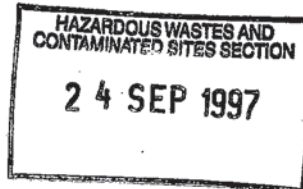
Contact name: Ms Felicity Boevink

Phone: 340 36176

Fax direct: 340 35230

Your reference:

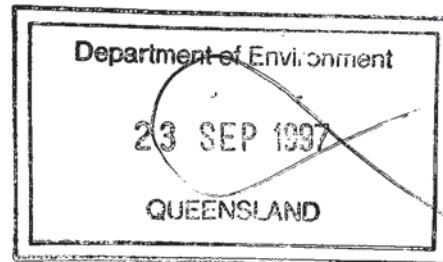
Our reference: FB:FB



Brisbane City Council
69 Ann Street
BRISBANE QLD 4000
GPO Box 1434
BRISBANE QLD 4001

19 September 1997

Department of Environment & Heritage
Waste Management Branch
Hazardous Wastes & Contaminated Sites Section
PO Box 155
Brisbane Albert St Qld 4002



Dear Mr Idiebele

Re: New Farm Powerhouse Rehabilitation /

The Brisbane City Council is conducting major rehabilitation works on the New Farm Powerhouse, Lamington Street New Farm.

The powerhouse is a substantial structure on the New Farm peninsula built in several stages from 1926 to 1940. The site produced power from coal fired turbines from 1928 to 1968. Plant and ancillary structures were removed from the powerhouse in 1977, and partial demolition of the powerhouse buildings occurred in 1984.

The Brisbane City Council is now planning for the site to be redeveloped as a major arts and cultural centre. Facilities may include a theatre, cafe's, bookshops, artist's studios and a film studio. More than 80 arts and cultural organisations will be involved in the development and use of the site. This development will be a community based, not for profit venture.

The redevelopment of the powerhouse site will involve the State Arts Office. The Arts Minister, Joan Sheldon, will be invited to tour the site in the near future.

Redevelopment of the site is scheduled for completion by December 1999. Construction works are scheduled to start in July 1998.

Contamination of the site due to past uses, demolition materials disposal and extensive filling have been identified by the project group as major issues for the redevelopment of the powerhouse.

Because of the *very high profile and complex nature* of this redevelopment Council believes that it is essential that the Contaminated Sites Section be fully briefed on all project plans. Council requests that an officer from your section be nominated at this early stage to assess the project. A site visit between Council Officers and your nominated officer is requested prior to Council beginning works on the site. I suggest that this site visit be organised for the week of the 13th October. Please do not hesitate to contact me on phone 340 36176 to arrange the site visit or if you have any further questions.

Yours sincerely

sch4p4(6) Personal information

Felicity Boevink

Environmental Officer Hazards Management

NOTIFICATION OF A CONTAMINATED SITE

✓ 140-034961

The following information is supplied by the Queensland Electricity Commission. It lists land suspected of being contaminated or land used for a prescribed purpose under the Contaminated Land Act 1991 and the Contaminated Land Regulation 1991.

LOCAL GOVERNMENT COUNCIL/SHIRE:
BRISBANE CITY

SITE NAME:
NEW FARM POWER STATION

SITE ADDRESS:
LAMINGTON STREET
NEW FARM 4005

PROPERTY DESCRIPTION

LOT NUMBER:	2
SITE PLAN NUMBER:	RP210504
FOLIO NUMBER:	132
VOLUME NUMBER:	4703
AREA:	4797 square metres
PAST LAND USE CATEGORY:	411
PRESENT USE CATEGORY:	3519

COMMENTS ON LAND USE:
DISUSED WORKSHOP/MAINTENANCE AREA; TRANSFORMER BAYS.

RTI DL RELEASE - EHP



→ file 901551
 → each site copied to notification file
 61 Mary Street Brisbane
 G.P.O. Box 10, Brisbane, Q. 4001, Australia
 Telephone (07) 228 2111
 Facsimile (07) 228 7100

sch4p4(6) Personal Information

Ref. 392/20/4

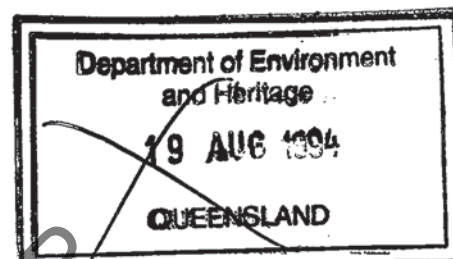
12 August 1994

Contaminated Land Section
 Waste Management Branch
 Department of Environment and Heritage
 PO Box 155
 BRISBANE (Albert Street) 4002.

Attention: Ms. A. Gunning-Davis

Dear Ms. Gunning-Davis,

94/13493

QEC CONTAMINATED LAND REGISTER NOTIFICATIONS

A recent enquiry by QEC staff regarding an entry which we believed should be on the Contaminated Land Register, and subsequent discussion with you, indicated that our previous submission of details of 58 land parcels owned by the Commission, which we believed required notification under the Contaminated Land Act 1991, may not have been incorporated into the Contaminated Land Register.

The original submission was made in late December 1992, and took the form of a computer disk containing a run-time module of the Clipper database (supplied by the Contaminated Land Section) containing the details of the land parcels, as well as a hard copy of each of the 58 submissions.

Enclosed please find information on land parcels owned by the QEC which, we believe, require notification under the Contaminated Land Act 1991, and which we suspect have not been included on the Contaminated Land Register. The enclosed forms contain the relevant details for the 59 land parcels currently owned. The details for these land holdings are also available on computer disk as dBase IV files which are compatible with your Clipper database, if required.

We would also like to take this opportunity to notify you of a change of ownership for a property which we believe is on the Register. On 26 February 1993, the Commission notified your section of the existence of contamination on the Howard Power Station site (Lot No. 1 / Reg. Plan No. 176847) which was at that time privately owned. In January 1994 the Commission purchased that site. Your Register should reflect that the current owner is the Queensland Electricity Commission, GPO Box 10, Brisbane, Queensland 4001.

PL 2218

Greta - Please input sites.

Prescribed Purposes normally available from Comments.

sch4p4(6) Personal Information

Thank you

sch4p4(6) Personal Information

Should you require further information, clarification of the information supplied, or the enclosed information on computer disk, please contact Mr. Des Chalmers (phone No. 228 7305 or 390 9206).

Yours sincerely,

sch4p4(6) Personal information

S.S. Durrington
MANAGER TECHNOLOGY

RTI DL RELEASE - EHP