

CONTAMINATION MANAGEMENT FOR EARTHWORKS AT MAJOR INFRASTRUCTURE PROJECTS

Malcolm Dale¹, Peter Taylor¹ and Howard Chemney²

¹Parsons Brinckerhoff, Sydney, ²Thiess Hochtief Joint Venture, Sydney

ABSTRACT

During major infrastructure projects, management of potential and actual contamination issues is an important part of the approvals, construction and closeout phases of the overall works program. Planning for contamination may save considerable time and expense with the consultants and contractors working to ensure any construction activities are protective of human health and the environment while maximising the re-use potential of materials. While management of soils, spoil and water is common place during the building of major infrastructure, the impact of contamination from past land-use, acid sulfate soils or fibrous cement sheeting fragments (containing asbestos) is less quantifiable, but no less costly if poorly managed.

1 INTRODUCTION

Contamination management has matured over the years, changing from what was once considered an afterthought to an integral part of the planning, approvals, for and construction of major infrastructure projects. Management of acid sulfate soil and asbestos in soils is increasingly dealt with under the banner of contamination management by contractors, consultants and regulators.

Contamination management occurs at the:

- Planning stage where the potential for contamination needs to be identified to highlight the need for preventative or corrective environmental works. This may include desktop studies along the planned alignment to identify potential contaminated sites that may be resumed or used as works depots. At this stage major contamination sources can be identified such as service stations and fuel depots, landfills, industrial facilities and previous fill material (e.g. rail ballasts) and appropriate mitigation and management measures documented.
- Operational stage where the assessment of excavation and imported fill materials is undertaken to ensure they are suitable for their intended use; that may require additional safety measures to protect worker and public safety or require treatment, sampling or storage to protect the local environment; .
- Post construction stages of major infrastructure projects may include decommissioning of fuel facilities, works depots and returning the land to its pre-existing condition as part of the Condition of Consent. Major infrastructure projects may have surplus fill (e.g. from tunnel boring) which can be recycled, remediated or disposed of according to its level of contamination.

This paper outlines some of the planning, management and construction issues related to contamination management particularly in relation to major linear developments such as railways, road, pipelines, electrical distribution lines and tunnels where the author(s) have been involved. The aim of contamination management is to ensure contamination is minimised during the works program, contaminated materials are identified, segregated and recycled/disposed of in accordance with appropriate guidelines and that worker and public health and safety is protected.

2 INFRASTRUCTURE PROJECTS

In NSW there are many infrastructure projects being constructed or designed in recent years where management of earthworks has required input to address potential contamination issues. These include but are not limited to:

- *Railways*: Southern Sydney Freight Line, Cronulla Line Duplication, Strathfield to Hornsby Quadruplication, Epping Chatswood Rail Link (ECRL)
- *Roads*: Pacific Highway Upgrade (e.g. Kempsey to Eungai, Coopernook to Herons Creek, Bulahdelah etc) Northwest Transitway, Tugun Bypass, Wollongong Northern Distributor Extension, Great Western Highway Upgrade
- *Pipelines*: Proposed Upper Georges River Re-cycling pipeline, Hoxton Park Pipeline.
- *Tunnels*: Lane Cove Tunnel, Cross City Tunnel, ECRL, M5 East
- *Others*: Second Sydney Airport/Mascot Third Runway, Port Botany redevelopment and the proposed Sydney Desalination project.

3 CONTAMINATION MANAGEMENT

3.1 CONTAMINATION INVESTIGATIONS

Contamination land guidelines are extensive and many have been in place for 10 to 15 years (e.g. ANZECC, 1992; NEPM, 1999; DUAP, 1998). Contaminated site assessment, investigation and management is a phased process. It is necessary to obtain information from each phase to plan, cost and manage the next stage of works. The management of any contaminated site may include the following stages:

- Preliminary or desktop assessment (also called Phase 1 assessments, this may or may not include preliminary sampling)
- Detailed site investigation (Phase 2 assessments)
- Remedial Action Plan
- Remediation Implementation, validation and site monitoring

Other phases may include human or ecological risk assessments, additional delineation phases or fate and transport modelling. Typically, each of the above stages will be completed with a report from a consultant. In NSW consultant reporting guidelines (NSW, 1997) details requirements to ensure that sufficient and appropriate information is documented to enable review by site auditors, regulators and other interested parties. Many contamination investigation guidelines are written for the redevelopment of land for more sensitive land uses (such as residential) and are less suited for linear infrastructure projects, however, some departments such as the NSW Roads and Traffic Authority have internal contaminated land procedures and guidelines to this reason (RTA, 2005).

3.2 ROUTE PLANNING AND ENVIRONMENTAL IMPACT ASSESSMENT

In NSW the impact of major infrastructure projects are assessed through Part 3A of the Environmental Planning and Assessment Act (NSW 1997). For many of these infrastructure projects, the development works often require land acquisition which should include a contamination assessment process as part of the planning, acquisition and construction process. This process should commence as soon as possible in the development phase of a project (i.e. in the Environmental Impact Assessment (EIA) stage). For major projects, involving extensive acquisition, an initial screening of potentially contaminated sites should be made during route selection. At this stage the various government departments (such as the NSW Department of Environment and Climate Change) would provide guidance on what issues are of concern through the Director Generals requirements as outline in 75F of the NSW EP&A Act 1997.

It is rare that a contaminated site would alter the alignment of a major road, rail or pipeline, however, encroachment onto existing or former landfills has resulted in redesign of parts of the Tugun Bypass on the Queensland and New South Wales border. The presence of acid sulfate soils, discussed below, may have a greater impact on alignment and construction management. Depending on the findings of an infrastructure EIA, contamination and acid sulfate soil issues will be managed through the “conditions of consent” for the project.

3.3 PRE-CONSTRUCTION MANAGEMENT PLANS

EIA conditions of consent manage contamination issues through requirements to investigate (if not already carried out) or management (eg construction environmental management plans (CEMP) and contamination management plans (CMP)) of the construction/earthworks phases.

Contamination management plans detail procedures to:

- Protect the surrounding environment from contamination resulting from construction activities and from existing contamination from past land uses;
- Determine pre-construction and construction investigation and monitoring requirements;
- Confirm and detail reporting, approval and auditing requirements;
- Determine the presence of existing contamination, the nature, extent, management methods and remedial or disposal options;
- Determine the potential for contamination from construction activities, the nature, extent, management and mitigation requirements and
- Determine potential occupational health and safety requirements and procedures for the investigation, management, remediation and disposal of contaminated materials.

A contamination management plan may need to address works depots, spoil management, acid sulfate soils, demolition, remediation and post construction validation and can be lengthy documents as in the case of the Epping to Chatswood Rail Line. These plans are often sub-plans under the overall CEMP. If not considered at the project design phase, the

preparation of these plans, together with their implementation, verification (by third party reviewers) and compliance, can add significant cost and time delay to the project.

3.4 CONTINGENCY MANAGEMENT

No matter how much investigation or planning for contamination (including acid sulfate soils and asbestos) is undertaken at the pre-construction phases, contaminated sites are often encountered during the construction phases, which may delay project completion and add to costs. These include:

- unknown underground storage tanks at the edge of the road reserve see Figure 1 (e.g. during the Great Western Highway upgrade at Bowenfels and Leura),
- highly contaminated fill (classified as industrial or hazardous waste) between investigation boreholes along a cable trench route in the road reserve at Strathfield and
- Major spills at refuelling facilities during construction phases.

The cost implications of disposing of industrial or hazardous waste (and treatment prior to disposal) or the time to remove, validate, backfill and re-compact a tank excavation can be significant.



Figure 1: Underground storage tank excavation in road verge, Great Western Highway upgrade.

4 ACID SULFATE SOIL MANAGEMENT

Acid sulfate soils (ASS) are soils or sediments containing iron sulfides such as pyrite. When exposed to air due to drainage or disturbance, these soils produce sulfuric acid, often releasing toxic quantities of iron, aluminium and other heavy metals. Many ASS are unconsolidated estuarine muds and clays encountered in many coastal environments and may impact the bearing capacity of foundations and earthworks which may result in settlement or require deep piles or an extensive load-spreading membrane. Drainage of these soils results in production of more acid which may weaken concrete and steel infrastructure such as culverts, pipes and bridges. The leaching of acid and heavy metals into the environment can also result in loss of biodiversity (particularly through “fish kills”). The NSW Roads and Traffic Authority have had acid sulfate soils guidelines in place since 1996 (RTA, 1996).

ASS is normally dealt with in the Phase 1 geotechnical and contamination investigations along major infrastructure alignments. Detailed acid sulfate soils maps have been produced by government organisations (like the NSW Department of Primary Industry) and are available in digital format for route alignment selection, EIA and digital design with GIS or other programs.

Like contamination management, acid sulfate soils encountered during the construction phases are managed by an acid sulfate soil management plan (ASSMP) which may include procedures to:

- Protect the surrounding environment (including waterways) from the potential risk of acid contamination resulting from construction activities.

- Determine pre construction and construction investigations to test for the presence of acid sulfate soils in all areas with the potential to have acid sulphate characteristics disturbed by the proposed works.
- Determine the appropriate spoil management measures, including excavation procedures, storage and treatment, bunding and provisions for protection of surrounding areas and waterways from potential risk of acid contamination.
- Determine a contingency strategy for management of an unexpected discovery of actual or potential acid sulfate soils.



Figure 2: Acid sulfate soils being removed from the ECRL western cofferdam, Lane Cove River, NSW.

Not all acid sulfate soils are silts or clays. Approximately 17,000 m³ of sands containing pyrite were removed from the western cofferdam in the Lane Cove River (Figure 2) during the cut and cover construction of the twin rail tunnels for the Epping to Chatswood Rail Line. The additional costs included the ASS investigation, preparation of the ASSMP, transportation, storage, treatment with lime, validation sampling and the construction of drains and detention ponds to manage potential acid runoff. After treatment at a nearby works site, a large proportion of the treated ASS was returned back to Lane Cove and placed back between the railway tunnels within the cofferdam and under the water table. The remainder was used to backfill the temporary access ramp (decline) leading to the tunnel at the Waterloo Rd work site.

5 ASBESTOS MANAGEMENT

From the early 1900s until the early 1970s, asbestos was widely used including asbestos or fibrous cement sheets (ACS or FCS) in roofs, pipes and wall cladding. This is often termed bonded asbestos. Asbestos was also used for applications such as insulation of pipes and high temperature electricity cables (often friable), electrical backing boards, in floor tiles, for reinforcement in cements, putties and mastic and in gaskets and friction materials (e.g. brake shoes). Increasingly FCS is a contaminant in soil resulting from demolition of buildings and structures or from legal or illegal filling. Asbestos in soil is a potential human health risk if inhaled in dust particles generated during earthworks.

Workcover NSW classes any asbestos in soils as “friable” (as the bonded or cement matrix could break down over time) and therefore any excavation and transport of impacted near surface soils would require removal by a friable asbestos licensed contractor.

Common types of asbestos impact including:

- fragments of FCS distributed through the surficial soil materials resulting from demolition of houses, sheds, fences in the immediate area (or fibro clad building destroyed by fire. The FCS often fragments into shard in intense heat).
- fill containing fragments or broken FCS sheets, pipes, cable trays, etc resulting from mixing with building rubble and used to construct embankments, level building platforms or to fill drainage lines etc (see Figure 3),

- burial of demolished buildings or waste,
- isolated pockets of illegally dumped fill (including building rubble and general waste).

While soils containing asbestos are not a hazard to the environment, their re-use is not clear for the fear of risks to human health. The Australian Contaminated Land Consultants Association (ACLCA, 2002) produced a guidance document in 2002 but this has not been endorsed by the regulators or health departments. The re-use of asbestos impacted soils is therefore considered on a site specific basis depending on whether the material is geotechnically suitable to be placed in compacted road or railway embankments or bridge abutments or can be contained in a cell or other mound (such as a noise barrier) if geotechnically not suitable (e.g. topsoils with organic matter). If asbestos impacted soil is re-used an asbestos management plan must be prepared in line with the National Code of Practice For the Management and Control of Asbestos In Workplaces, National Occupational Health and Safety Commission (NOHSC:2018 2005).

The success of any hazard control option that involves leaving Asbestos Containing Material (ACM) *in situ*, is contingent on the ability to ensure that it remains undisturbed, is sealed and/or stable and is maintained in good condition to protection of health and safety of workers and the surrounding public. The AMP seeks to ensure that:

- The asbestos contaminated fill is buried a suitable thickness of clean fill below the likely burial depth of any underground services and encapsulated within geofabric or other demarcation barrier,
- The capped area be inspected and maintained regularly to ensure that there is no disturbance to the area such as erosion or excavation,
- All work should be carried out in accordance with Code of Practice for the Safe Removal of Asbestos (NOHSC: 2002 2005) and the NSW OHS Act 2000,
- Records (such as land titles) should be prepared or annotated documenting the location and depth of any asbestos containing fill for the protection of future land users or workers.

The containment of soils impacted with bonded asbestos fragments in major infrastructure projects can be protective of human health and enable considerable cost savings by re-use of the material rather than disposal to an appropriately licensed landfill. Increased costs of asbestos management often relates to poor management of demolition of structures containing FCS including the use of non-licensed demolition contractors and the lack of suitable asbestos registers which identify the location and type of asbestos.



Figure 3: Degraded fibrous cement sheeting with asbestos in contaminated railway ballast.

6 CONCLUSIONS

The cost of modifications to earthworks associated with large infrastructure projects can be high particularly when alignment changes are required. Contamination management should be an integral part of the planning, approvals, construction and closeout phase of any infrastructure project. If contamination issues are not identified early or are not effectively managed through the life of the construction phases, project schedules and costs can increase significantly. Contingency management and the use of licensed contractors can also minimise costs and time overruns from unknown site condition.

7 REFERENCES

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