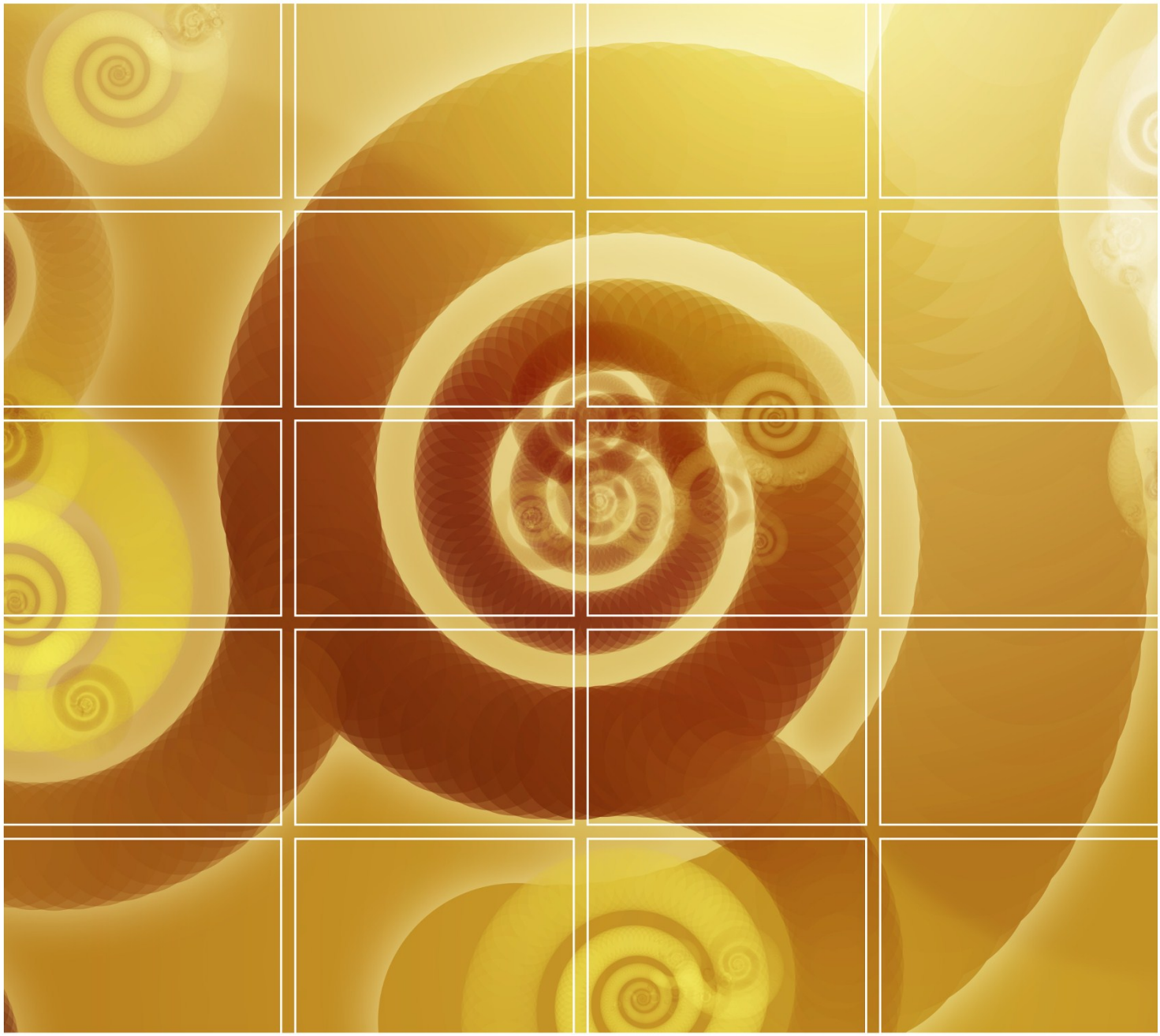

Ammonium Nitrate Storage and Distribution Facility

Environmental Impact Statement —Final Volume II

Crawfords Freightlines

October 2012

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ANNEX LIST

Annex A

DGR's

NSW GOVERNMENT | Planning & Infrastructure

Contact: Andrew Hartcher
Phone: 02 9228 6503
Fax: 02 9228 6466
Email: andrew.hartcher@planning.nsw.gov.au

Mrs Jacinta Coulin
Environmental Resources Management (ERM) Pty Ltd
PO Box 3071
THORNTON NSW 2322

Our ref: SSD-5119
File: 12/02330

Dear Mrs Coulin

State Significant Development - Director General's Requirements
Ammonium Nitrate Distribution and Storage Facility, Sandgate (SSD-5119)

I have attached the Director General's environmental assessment requirements (DGRs) for the preparation of an Environmental Impact Statement (EIS) for the abovementioned development.

These requirements are based on the information you have provided to date and have been prepared in consultation with Newcastle City Council, the Environment Protection Authority, WorkCover NSW, Roads and Maritime Services and the NSW Office of Water (see attachment 2). Please note that the Department may alter these requirements at any time, and that you must consult further with the Department if you do not lodge a development application and EIS for the development within two years of the date of issue of these DGRs. The Department will review the EIS for the development carefully before putting it on public exhibition, and will require you to submit an amended EIS if it does not adequately address the DGRs.

If the development is likely to have a significant impact on matters of National Environmental Significance, it will require an approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This approval would be in addition to any approvals required under NSW legislation and it is your responsibility to contact the Department of Sustainability, Environment, Water, Population and Communities to determine if an approval under the EPBC Act is required for your development (http://www.environment.gov.au or 6274 1111).

I would appreciate it if you would contact the Department at least two week before you propose to submit the DA and EIS for the development. This will enable the Department to:

- confirm the applicable fee (see Division 1AA, Part 15 of the *Environmental Planning and Assessment Regulation 2000*); and
- determine the number of copies (hard-copy and CD-ROM) of the EIS required for review.

If you have any enquiries about these requirements, please contact Andrew Hartcher on 02 9228 6503 or via email at andrew.hartcher@planning.nsw.gov.au.

Yours sincerely

17.2.12

Chris Wilson
Executive Director
Major Projects Assessment
as delegate of the Director-General

Director General's Environmental Assessment Requirements

Section 78A(8A) of the *Environmental Planning and Assessment Act*

State Significant Development

Application Number	SSD-5119
Development	Use of an existing warehouse and site facilities to store and distribute Ammonium Nitrate.
Location	158 Maitland Road, Sandgate, NSW (Lot 12 DP 625053) Sandgate in the Newcastle local government area
Applicant	Crawfords Freightlines Pty Ltd
Date of Issue	16 February 2012
General Requirements	The Environmental Impact Statement (EIS) must meet the minimum form and content requirements in clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*. In addition, the EIS must include a: • detailed description of the development, including: – need for the proposed development; – justification for the proposed development; – likely staging of the development; – likely interactions between the development and existing, approved and proposed operations in the vicinity of the site; – plans of any proposed building works; • consideration of all relevant environmental planning instruments, including identification and justification of any inconsistencies with these instruments; • risk assessment of the potential environmental impacts of the development, identifying the key issues for further assessment; • detailed assessment of the key issues specified below, and any other significant issues identified in this risk assessment, which includes: – a description of the existing environment, using sufficient baseline data; – an assessment of the potential impacts of all stages of the development, including any cumulative impacts, taking into consideration relevant guidelines, policies, plans and statutes; and – a description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the development, including proposals for adaptive management and/or contingency plans to manage any significant risks to the environment; and • consolidated summary of all the proposed environmental management and monitoring measures, highlighting commitments included in the EIS.
Key issues	The EIS must address the following specific matters: • **Hazards and Risks** – including an assessment of the hazards and risks associated with the existing and proposed operations on site (and the potential for off site impacts) including details of

	hazardous materials used or kept on the premises. The EIS shall also include a screening of potential hazards on and off site to determine the potential for off site impacts and any requirement for a Preliminary Hazard Analysis (PHA). Should potential off-site impacts be identified, a PHA must be prepared in accordance with the Department's *Hazardous Industry Planning Advisory Paper No. 6 Hazard analysis and Multi-level Risk Assessment*. The PHA should: – consider the risks from the facility; and – demonstrate that the proposal would comply with the criteria set out in *Hazardous Industry Planning Advisory Paper No 4 Risk Criteria for Land Use Safety Planning.* • **Strategic and Statutory Context** – including: – detailed justification for the proposal and suitability of the site to be developed; and – demonstration that the proposal is generally consistent with all relevant environmental planning instruments, development control plans (DCPs), and justification for any inconsistencies. • **Infrastructure** – demonstrating that suitable arrangements are in place to provide the necessary local and regional infrastructure for the proposal; • **Soil and Water** – including: – an assessment of soil contamination including acid sulphate soils and their management; – measures to minimise the potential for leakage of ammonium nitrate and other chemicals stored on-site; – details of proposed erosion and sedimentation controls; – a detailed assessment of potential soil, surface and groundwater impacts, particularly on nearby sensitive water sources/bodies; and – details of water supply, wastewater management and disposal (if any), stormwater management and flooding impacts. • **Air** – including odour during construction and operation and measures to reduce greenhouse gas emissions on-site; • **Noise** – during construction and operation including traffic noise; • **Waste** – including: – identification of the quantity and type of waste that would be handled, stored, processed or disposed of at the facility; and – a description of how this waste would be stored and handled on site in accordance with the relevant guidelines and standards, and transported to and from the site. • **Transport, Access and Parking** – including: – details of all traffic types and volumes likely to be generated during construction and operation; – assessment of predicted impacts on road safety and the capacity of the road network to accommodate the facility including current traffic counts, details of truck routes and modelling of key intersections; – assessment of where off site infrastructure works are required as a result of traffic impacts including detailed plans of any proposed road upgrades; – access, including detailed consideration of various access options and justification for the proposed location of the main access points; and – parking. • **Heritage** – including Aboriginal cultural heritage;

	• **Design** – including details of building design and fit-out for handling of chemicals and spill containment (e.g. bunding and vehicle loading/unloading areas); • **Fire and incident management** – including technical information on the environmental protection equipment to be installed on the premises such as air, water and noise controls, spill cleanup equipment and fire management and containment measures; and **Cumulative impacts** – particularly in relation to air, noise and traffic associated with other nearby industrial operations.
Plans and Documents	The EIS must include all relevant plans, architectural drawings, diagrams and relevant documentation required under Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*. These documents should be included as part of the EIS rather than as separate documents.
Consultation	During the preparation of the EIS, you must consult with the relevant local, State or Commonwealth Government authorities, service providers, community groups and affected landowners. In particular you must consult with: • Newcastle City Council; • Environment Protection Authority; • NSW Office of Water; • Roads and Maritime Services; • Hunter Water Corporation; • WorkCover NSW; and • Newcastle Ports Authority. The EIS must describe the consultation process and the issues raised, and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided.
Further consultation after 2 years	If you do not lodge an EIS for the development within 2 years of the issue date of these DGRs, you must consult with the Director General in relation to the requirements for lodgement.
References	The assessment of the key issues listed above must take into account relevant guidelines, policies, and plans as identified. While not exhaustive, the following attachment contains a list of some of the guidelines, policies, and plans that may be relevant to the environmental assessment of this development.

ATTACHMENT 1
Technical and Policy Guidelines

The following guidelines may assist in the preparation of the Environmental Impact Statement. This list is not exhaustive and not all of these guidelines may be relevant to your proposal.

Many of these documents can be found on the following websites:
http://www.planning.nsw.gov.au
http://www.bookshop.nsw.gov.au
http://www.publications.gov.au
http://www.newcastle.nsw.gov.au

Policies, Guidelines and Plans

Aspect	Policy /Methodology
Hazard and Risk	
	AS/NZS 4360:2004 Risk Management
	HB 203:2006 Environmental Risk Management – Principals and Process
	State Environmental Planning Policy No 33– Hazardous and Offensive Development (SEPP 33)
	Planning Advisory Paper No. 6 – Guidelines for Hazardous Analysis (DUAP)
	Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning (DUAP)
	Newcastle and Kooragang Island Area Risk Assessment Study, 1992
Soil and Water	
Soil	Acid Sulfate Soil Manual (ASSMAC)
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC & NHMRC)
	National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC)
	State Environmental Planning Policy No. 55 – Remediation of Land
	Managing Land Contamination - Planning Guidelines SEPP 55 – Remediation of Land (DUAP and EPA)
	Rural Land Capability Mapping
	Agricultural Land Classification
Surface Water	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems - Effluent Management (ARMCANZ/ANZECC)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems - Use of Reclaimed Water (ARMCANZ/ANZECC)
	National Water Quality Management Strategy - Guidelines For Water Recycling: Managing Health And Environmental Risks (Phase1) (EPHC, NRMMC & AHMC)
	National Water Quality Management Strategy - Guidelines For Water Recycling: Managing Health And Environmental Risks (Phase1) (EPHC, NRMMC & AHMC)
	Managing Urban Stormwater: Council Handbook. Draft (EPA)

	Managing Urban Stormwater: Treatment Techniques (EPA)
	Managing Urban Stormwater: Source Control. Draft (EPA)
	Managing Urban Stormwater: Soils & Construction (Landcom)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (DEC)
	Using the ANZECC Guideline and Water Quality Objectives in NSW (DEC)
	Floodplain Risk Management Guideline: Practical Consideration of Climate Change (DECC)
Groundwater	National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
	NSW State Groundwater Policy Framework Document (DLWC)
	NSW State Groundwater Quality Protection Policy (DLWC)
	NSW State Groundwater Quantity Management Policy (DLWC) Draft
	The NSW State Groundwater Dependent Ecosystem Policy (DLWC)
	Guidelines for the Assessment and Management of Groundwater Contamination (DECC) Draft
Air Quality	
	Protection of the Environment Operations (Clean Air) Regulations 2010
	Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW (DEC)
	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DEC)
Odour	
	Technical Framework: Assessment and Management of Odour from Stationary Sources in NSW (DEC)
	Technical Notes: Assessment and Management of Odour from Stationary Sources in NSW (DEC)
Greenhouse Gas	
	National Greenhouse Accounts (NGA) Factors
	Guidelines for Energy Savings Action Plans (DEUS)
Noise	
	NSW Industrial Noise Policy (DECC)
	NSW Road Noise Policy (OEH)
	Environmental Noise Control Manual (DECC)
Waste	
	Waste Avoidance and Resource Recovery Strategy (Resource NSW)
	Waste Classification Guidelines (DECC)
	Protection of the Environment Operations (Waste) Regulations 2005
Transport	
	Guide to Traffic Generating Development (RTA)
	Road Design Guide (RTA)
	Road and Related Facilities, EIS Guidline (DoPI)
Heritage	
	Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC)
Non-Indigenous	NSW Heritage Manual (NSW Heritage Office & DUAP)
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)

ATTACHMENT 2

Public Authority Responses to Request for Key Issues

EPA
ENVIRONMENT PROTECTION AUTHORITY

PCU030477

Department of Planning
Received
8 FEB 2012
Scanning Room

Our reference: DOC12/3422,
File No. LIC12/62
Contact: Hamish Rutherford
(02) 4908 6824

Department of Planning and Infrastructure
GPO Box 39
SYNDEY NSW 2001

Attention: Mr Chris Ritchie

Dear Sir/Madam

REQUEST FOR KEY ISSUES AND ASSESSMENT REQUIREMENTS
STATE SIGNIFICANT DEVELOPMENT –
AMMONIUM NITRATE STORAGE AND DISTRIBUTION FACILITY
CRAWFORDS FREIGHTLINES – LOT 12, DP 625053, 158 OLD MAITLAND ROAD, SANDGATE

Reference is made to your letter dated 19 January 2012 inviting the Environment Protection Authority ("the EPA") provide details of key issues and its assessment requirements to be included in the Director-General's Requirements ("DGRs") for the preparation of an Environmental Impact Statement ("EIS") in respect of above State Significant Development application, pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* ("EP&A Act").

The EPA has reviewed the details of the project provided in the background documentation prepared by Environmental Resources Management Australia Pty Ltd ("ERM"), on behalf of Crawfords Freightlines Pty Ltd, dated 12 January 2012. The EPA has identified the information it requires to be covered in the EIS. In summary the EPA considers that the key environmental aspects of this proposal are:

- impacts on water quality;
- chemicals and hazardous materials;
- Impacts on aboriginal cultural heritage;
- impacts on air quality,
- impacts on noise amenity,

The proponent should ensure that the EIS is sufficiently comprehensive and detailed to allow the EPA to determine the extent of the impacts of the proposal. In particular, the requirements of Section 45 of the *Protection of the Environment Operations Act 1997* ("POEO Act") must be addressed.

The EPA has identified the information it requires to assess the proposal in Attachment A. In carrying out the assessment the applicant should refer to the relevant guidelines in Attachment B and also any industry codes of practice and best environmental management practice guidelines.

The EPA requests 2 hard and 4 electronic (CD) copies of the EIS for assessment be delivered to the EPA's Regional Manager – Hunter at PO Box 488G, Newcastle 2300. The electronic copies should be provided in sections, or parts of each section, of not greater than 10 megabytes per section.

PO Box 488G Newcastle NSW 2300
117 Bull Street, Newcastle West NSW 2302
Tel: (02) 4908 6800 Fax: (02) 4908 6810
ABN 30 841 387 271
www.environment.nsw.gov.au

The proponent should be aware that any commitments made in the EIS may be formalised as licence or approval conditions. Consequently, pollution control or conservation measures should not be proposed if they are impractical, unrealistic or beyond the financial viability of the development. It is important that all conclusions are supported by adequate data.

If you require any further information regarding this matter please contact Hamish Rutherford on (02) 4908 6824.

Yours sincerely

3 FEB 2012

MARK HARTWELL
Head Regional Operations Unit – Hunter
Environment Protection Authority

Encl: "Attachment A – Recommended Director General's Requirements for Crawfords Freightliners AN Storage and Distribution Facility."
"Attachment B – Guidance Material"

Attachment A

NSW Environment Protection Authority
Recommended Director General's Requirements (DGRs)
For
Crawfords Freightlines –
Ammonium Nitrate Storage and Distribution Facility
Environmental Impact Statement (EIS)

Environmental impacts of the project

1. Impacts related to the following environmental issues need to be assessed, quantified and reported on:
   - Water and Soils
     - Acid sulphate soils
     - Contaminated sites
     - Flooding and coastal erosion
     - Soils - general
     - Water quality and discharges
   - Chemicals and Hazardous materials
   - Aboriginal cultural heritage
   - Air Issues
     - air quality
     - greenhouse gas
   - Noise and vibration
   - Waste including:
     - General waste – any proposal

Environmental Impact Statements (EIS's) should address the specific requirements outlined under each heading below and assess impacts in accordance with the relevant legislative requirements and guidelines mentioned. A list of guidelines is provided in **Attachment B** to assist the proponent.

Licensing requirements

1. On the basis of the information submitted to date, it appears the proposal is a scheduled activity in respect of "Chemical Storage – General Chemicals Storage" under the *Protection of the Environment Operations Act 1997* (POEO Act) and will therefore require an Environment Protection Licence (EPL) if approval is granted. The EIS should address the requirements of Section 45 of the POEO Act determining the extent of each impact and providing sufficient information to enable the EPA to determine appropriate limits for the EPL.

2. Should project approval be granted, the proponent will need to make a separate application to the EPA for an EPL for the proposed facility prior to undertaking any on site works. Additional information is available through the EPA's *Guide to Licensing* document : (www.environment.nsw.gov.au/licensing/licenceguide.htm).

SPECIFIC ISSUES

Water and soils

Acid sulphate soils

1. The potential impacts of the development on acid sulfate soils must be assessed in accordance with the relevant guidelines in the *Acid Sulphate Soils Manual* (Stone *et al.* 1998) and the *Acid Sulphate Soils Laboratory Methods Guidelines* (Ahern *et al.* 2004).

2. Describe mitigation and management options that will be used to prevent, control, abate or minimise potential impacts from the disturbance of acid sulfate soils associated with the project and to reduce risks to human health and prevent the degradation of the environment. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.

Contaminated sites assessment and remediation

1. The EIS should include an assessment of the contaminated site that is conducted in accordance with the guidelines made or approved under section 105 of the *Contaminated Land Management Act 1997*, for example: *Guidelines for Consultants Reporting on Contaminated Sites (EPA, 2000), Guidelines for the NSW Site Auditor Scheme - 2nd edition (DEC, 2006), Sampling Design Guidelines (EPA, 1995), National Environment Protection (Assessment of Site Contamination) Measure 1999* (or update).

2. The EIS should provide the details on how the site contamination will be remediated and/or managed so that the site is, or can be, made suitable for the proposed use.

3. All reports should be prepared in accordance with the *Guidelines for Consultants Reporting on Contaminated Sites* (EPA, 2000).

4. The EIS should specify whether or not a site auditor, accredited under the *Contaminated Land Management Act 1997*, has been or will be engaged to issue a site audit statement to certify on the suitability of the current or proposed uses.

Flooding and coastal erosion

The EIS should include an assessment of the following referring to the relevant guidelines in Attachment 2:

1. Whether the proposal is consistent with any floodplain risk management plans.

2. Whether the proposal is compatible with the flood hazard of the land.

3. Whether the proposal will significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties.

4. Whether the proposal will significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.

5. Whether the proposal incorporates appropriate measures to manage risk to life from flood.

6. Whether the proposal is likely to result in unsustainable social and economic costs to the community as a consequence of flooding.

Soil issues - general

The EIS should include:

1. An assessment of potential impacts on soil and land resources should be undertaken, being guided by *Soil and Landscape Issues in Environmental Impact Assessment* (DLWC 2000). The nature and extent of any significant impacts should be identified. Particular attention should be given to:
   a. Soil erosion and sediment transport - in accordance with *Managing urban stormwater: soils and construction*, vol. 1 (Landcom 2004) and vol. 2 (A. Installation of services; B Waste landfills; C. Unsealed roads; D. Main Roads; E. Mines and quarries) (DECC 2008).
   b. Mass movement (landslides) – in accordance with *Landslide risk management* guidelines presented in Australian Geomechanics Society (2007).
   c. Urban and regional salinity – guidance given in the Local Government Salinity Initiative booklets which includes *Site Investigations for Urban Salinity* (DLWC, 2002).

2. A description of the mitigation and management options that will be used to prevent, control, abate or minimise identified soil and land resource impacts associated with the project. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.

Water

Describe Proposal

1. Describe the proposal including position of any intakes and discharges, volumes, water quality and frequency of all water discharges.

2. Demonstrate that all practical options to avoid discharge have been implemented and environmental impact minimised where discharge is necessary.

3. Where relevant include a water balance for the development including water requirements (quantity, quality and source(s)) and proposed storm and wastewater disposal, including type, volumes, proposed treatment and management methods and re-use options.

Background Conditions

4. Describe existing surface and groundwater quality. An assessment needs to be undertaken for any water resource likely to be affected by the proposal.

   Proponents are generally only expected to source available data and information. However, proponents of relatively large and/or high risk developments may be required to collect some ambient water quality / river flow / groundwater data to enable a suitable level of impact assessment. Issues to include in the description of the receiving waters could also include, for example:

   - water chemistry
   - a description of receiving water processes, circulation and mixing characteristics and hydrodynamic regimes
   - lake or estuary flushing characteristics
   - sensitive ecosystems or species conservation values
   - specific human uses (e.g. fishing, proximity to recreation areas)
   - a description of any impacts from existing industry or activities on water quality

- a description of the condition of the local catchment e.g. erosion, soils, vegetation cover, etc.
- an outline of baseline groundwater information, including, for example, depth to watertable, flow direction and gradient, groundwater quality, reliance on groundwater by surrounding users and by the environment
- historic river flow data

5. State the Water Quality Objectives for the receiving waters relevant to the proposal. These refer to the community's agreed environmental values and human uses endorsed by the NSW Government as goals for ambient waters (http://www.environment.nsw.gov.au/ieo/index.htm). Where groundwater may be impacted the assessment should identify appropriate groundwater environmental values.

6. State the indicators and associated trigger values or criteria for the identified environmental values. This information should be sourced from the ANZECC (2000) Guidelines for Fresh and Marine Water Quality (http://www.mincos.gov.au/publications/australian_and_new_zealand_guidelines_for_fresh_and_marine_water_quality).

7. State any locally specific objectives, criteria or targets which have been endorsed by the NSW Government.

Impact Assessment

8. Describe the nature and degree of impact that any proposed discharges will have on the receiving environment.

    - Depending on the nature, scale and/or risk of the proposal, this could include specific requirements to consider impacts on, for example:
        - water circulation, current patterns, water chemistry and other appropriate characteristics such as clarity, temperature, nutrient and toxicants
        - changes to hydrology (including drainage patterns, surface runoff yield, flow regimes, and groundwater)
        - disturbance of acid sulphate soils and potential acid sulphate soils
        - stream bank stability and impacts on macro invertebrates
    - Depending on the nature, scale and/or risk of the proposal, modelling, monitoring, or both, may need to be undertaken to assess the potential impact of discharges on the receiving environment. If modelling is required to assess the potential impact of any discharge(s), this could include, for example:
        - a range of scenarios that encompass any variations in discharge quality and quantity as well as the relevant range of environmental conditions of the receiving waters. The scenarios could describe a set of worst-case conditions and typical conditions to ensure that both acute and chronic impacts are assessed
        - assumptions used in the modelling, including identification and discussion of the limitations and assumptions to ensure full consideration of all factors, including uncertainty in predictions.

9. Assess impacts against the relevant ambient water quality outcomes. Demonstrate how the proposal will be designed and operated to:
    - protect the Water Quality Objectives for receiving waters where they are currently being achieved; and
    - contribute towards achievement of the Water Quality Objectives over time where they are not currently being achieved.

10. Where a discharge is proposed that includes a mixing zone, the proposal should demonstrate how wastewater discharged to waterways will ensure the ANZECC (2000) water quality criteria for relevant chemical and non-chemical parameters are met at the edge of the initial mixing zone of the discharge, and that any impacts in the initial mixing zone are demonstrated to be reversible.

11. Assess impacts on groundwater and groundwater dependent ecosystems.

12. Describe how stormwater will be managed both during and after construction.

Monitoring

13. Describe how predicted impacts will be monitored and assessed over time.

- For relatively large and/or high risk developments, proponents should develop a water quality and aquatic ecosystem monitoring program to monitor the responses for each component or process that affects the Water Quality Objectives that includes, for example:
  - adequate data for evaluating compliance with water quality standards and/or Water Quality Objectives
  - measurement of pollutants identified or expected to be present in any discharge
- Water quality monitoring should be undertaken in accordance with the *Approved Methods for the Sampling and Analysis of Water Pollutant in NSW* (2004) (http://www.environment.nsw.gov.au/resources/legislation/approvedmethods-water.pdf).

Waste, chemicals and hazardous materials

General waste – any proposal

The EIS should:

1. Include a detailed plan for in-situ classification of waste material, including the sampling locations and sampling regime that will be employed to classify the waste, particularly with regards to the identification of contamination hotspots.

2. Identify, characterise and classify all waste that will be generated onsite through excavation, demolition or construction activities, including proposed quantities of the waste.
   Note: All waste must be classified in accordance with the EPA's *Waste Classification Guidelines*.

3. Identify, characterise and classify all waste that is proposed to be disposed of to an offsite location, including proposed quantities of the waste and the disposal locations for the waste. This includes waste that is intended for re-use or recycling.
   Note: All waste must be classified in accordance with the EPA's *Classification Guidelines*.

4. Include a commitment to retaining all sampling and classification results for the life of the project to demonstrate compliance with the EPA's *Waste Classification Guidelines*.

5. Provide details of how waste will be handled and managed onsite to minimise pollution, including:

   a) Stockpile location and management

- Labelling of stockpiles for identification, ensuring that all waste is clearly identified and stockpiled separately from other types of material (especially the separation of any contaminated and non-contaminated waste).
- Proposed height limits for all waste to reduce the potential for dust and odour.
- Procedures for minimising the movement of waste around the site and double handling.
- Measures to minimise leaching from stockpiles into the surrounding environment, such as sediment fencing, geofabric liners etc.

b) Erosion, sediment and leachate control including measures to be implemented to minimise erosion, leachate and sediment mobilisation at the site during works. The EIS should show the location of each measure to be implemented. The Proponent should consider measures such as:

- Sediment traps
- Diversion banks
- Sediment fences
- Bunds (earth, hay, mulch)
- Geofabric liners
- Other control measures as appropriate

The Proponent should also provide details of:

- how leachate from stockpiled waste material will be kept separate from stormwater runoff;
- treatment of leachate through a wastewater treatment plant (if applicable); and
- any proposed transport and disposal of leachate off-site.

6. Provide details of how the waste will be handled and managed during transport to a lawful facility. If the waste possesses hazardous characteristics, the Proponent must provide details of how the waste will be treated or immobilised to render it suitable for transport and disposal.

7. Include details of all procedures and protocols to be implemented to ensure that any waste leaving the site is transported and disposed of lawfully and does not pose a risk to human health or the environment.

8. Include a statement demonstrating that the Proponent is aware of the EPA's requirements with respect to notification and tracking of waste.

9. Include a statement demonstrating that the Proponent is aware of the relevant legislative requirements for disposal of the waste, including any relevant Resource Recovery Exemptions, as gazetted by the EPA from time to time.

10. Outline contingency plans for any event that affects operations at the site that may result in environmental harm, including: excessive stockpiling of waste, volume of leachate generated exceeds the storage capacity available on-site etc.

Chemicals and Hazardous Materials

The EIS should detail the handling, storage and management of all chemicals, in particular dangerous goods, at the premises in accordance with the relevant Australian Standards or codes.

Aboriginal cultural heritage

The EPA recommends that the following key issues be addressed by the proponent in preparing the EA.

Existing Aboriginal cultural heritage values

The EPA notes the existence of numerous registered Aboriginal sites in the regional locality. It is recommended that the proponent consider any potential impacts of the proposal on these known sites, the sensitivity and significance of these sites to the traditional Aboriginal knowledge holders and any relationship that may exist between these sites and any Aboriginal cultural heritage values of the project area.

Impacts of the project on Aboriginal cultural heritage values

Standard requirements:

1. The EIS must address and document the information requirements set out in the draft '*Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation*' (Department of Environment and Conservation, 2005). This document is available from DP&I upon request.

2. The EIS must include surveys by suitably qualified archaeological consultants in consultation with all of the local Aboriginal knowledge holders.

3. The EIS should identify the nature and extent of impacts on Aboriginal cultural heritage values across the project area and clearly articulate strategies proposed to avoid/minimise these impacts. If impacts are proposed as part of the final development, clear justification for such impacts should be provided.

4. The EIS must assess and document the archaeological and Aboriginal significance of the site's Aboriginal cultural heritage values.

5. Describe the actions that will be taken to avoid or mitigate impacts of the project on Aboriginal cultural heritage values. This must include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented. Any proposed methodology for Aboriginal cultural heritage investigation should reflect best practice standards recommended by the EPA in the '*Code of Practice for Archaeological Investigations of Objects in New South Wales (2010)*'. This Code or Practice is available online at:
   http://www.environment.nsw.gov.au/licences/archinvestigations.htm

6. The EIS must provide documentary evidence to demonstrate that effective community consultation with Aboriginal communities has been undertaken in assessing impacts, developing protection and mitigation options and making final recommendations. The EPA supports broad-based Aboriginal community consultation and as a guide the EPA's '*Aboriginal cultural heritage consultation requirements for proponents 2010*' provides a useful model to follow. This requirement is available on the EPA's website at:
   http://www.environment.nsw.gov.au/licences/consultation.htm

7. If impacts on Aboriginal cultural heritage values are proposed as part of the final development, an assessment of the proposed impacts in the context of '*inter generational equity*' and cumulative impact must be undertaken. This assessment must examine both cultural and archaeological perspectives equally at both the local and regional levels, with consideration given to the site level and broader landscape level.

Note: If the EIS is relying on past surveys it is critical to confirm that the surveys are consistent with the requirements of the above State Significant Development guidelines. Further, whilst there may be no requirement for obtaining an Aboriginal Heritage Impact Permit (AHIP) under Part 6 of the *National Parks and Wildlife Act 1974* (NPW Act) for projects approved under the State Significant Development

requirements of the *Environmental Planning and Assessment Act 1979*, there are other sections of the NPW Act which remain valid. This includes the requirement to obtain a Care Agreement for salvaged objects (Section 85) and reporting to the EPA on the status of new or impacted Aboriginal sites (Section 89A).

Notes:

1. An Aboriginal Site Impact Recording Form (http://www.environment.nsw.gov.au/licences/DECCAHIMSSiteRecordingForm.htm) must be completed and submitted to the Aboriginal Heritage Information Management System (AHIMS) Registrar, for each AHIMS site that is harmed through archaeological investigations required or permitted through these environmental assessment requirements.

2. Under section 89A of the *National Parks and Wildlife Act* 1974, it is an offence for a person not to notify the EPA of the location of any Aboriginal object the person becomes aware of, not already recorded on the Aboriginal Heritage Information Management System (AHIMS). An AHIMS Site Recording Form should be completed and submitted to the AHIMS Registrar (http://www.environment.nsw.gov.au/contact/AHIMSRegistrar.htm), for each Aboriginal site found during investigations.

Air issues

Air quality

The EIS should include a detailed air quality impact assessment (AQIA). The AQIA should:

1. Assess the risk associated with potential discharges of fugitive and point source emissions for all stages of the proposal. Assessment of risk relates to environmental harm, risk to human heath and amenity.

2. Justify the level of assessment undertaken on the basis of risk factors, including but not limited to:
    a. proposal location;
    b. characteristics of the receiving environment; and
    c. type and quantity of pollutants emitted.

3. Describe the receiving environment in detail. The proposal must be contextualised within the receiving environment (local, regional and inter-regional as appropriate). The description must include but need not be limited to:
    a. meteorology and climate;
    b. topography;
    c. surrounding land-use; receptors; and
    d. ambient air quality.

4. Include a detailed description of the proposal. All processes that could result in air emissions must be identified and described. Sufficient detail to accurately communicate the characteristics and quantity of all emissions must be provided.

5. Include a consideration of 'worst case' emission scenarios and impacts at proposed emission limits.

6. Account for cumulative impacts associated with existing emission sources as well as any currently approved developments linked to the receiving environment.

7. Include air dispersion modelling where there is a risk of adverse air quality impacts, or where there is sufficient uncertainty to warrant a rigorous numerical impact assessment. Air dispersion modelling must be conducted in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (2005) http://www.environment.nsw.gov.au/resources/air/ammodelling05361.pdf.

8. Demonstrate the proposal's ability to comply with the relevant regulatory framework, specifically the *Protection of the Environment Operations Act 1997* and the Protection of the Environment Operations (Clean Air) Regulation 2010.

9. Provide an assessment of the project in terms of the priorities and targets adopted under the NSW State Plan 2010 and its implementation plan 'Action for Air'.

10. Detail emission control techniques/practices that will be employed by the proposal.

Greenhouse gas emissions

1. The EIS should include a comprehensive assessment of, and report on, the project's predicted greenhouse gas emissions (tCO2e). Emissions should be reported broken down by:
   a) direct emissions (scope 1 as defined by the Greenhouse Gas Protocol – see reference below),
   b) indirect emissions from electricity (scope 2), and
   c) upstream and downstream emissions (scope 3)

   before and after implementation of the project, including annual emissions for each year of the project (construction, operation and decommissioning).

2. The EIS should include an estimate of the greenhouse emissions intensity (per unit of production). Emissions intensity should be compared with best practice if possible.

3. The emissions should be estimated using an appropriate methodology, in accordance with NSW, Australian and international guidelines (see below).

4. The proponent should also evaluate and report on the feasibility of measures to reduce greenhouse gas emissions associated with the project. This could include a consideration of energy efficiency opportunities or undertaking an energy use audit for the site.

Guidance Material

- The Greenhouse Gas Protocol: Corporate Standard, World Council for Sustainable Business Development & World Resources Institute http://www.ghgprotocol.org/standards/corporate-standard
- National Greenhouse Accounts (NGA) Factors, Australian Department of Climate Change (Latest release), http://www.climatechange.gov.au/publications/greenhouse-acctg/national-greenhouse-factors.aspx
- National Greenhouse and Energy Reporting System, Technical Guidelines (latest release) http://www.climatechange.gov.au/en/government/initiatives/national-greenhouse-energy-reporting/tools-resources.aspx
- National Carbon Accounting Toolbox http://www.climatechange.gov.au/government/initiatives/ncat.aspx
- Australian Greenhouse Emissions Information System (AGEIS) http://ageis.climatechange.gov.au/

Noise and vibration

1. In relation to noise, the following matters should be addressed (where relevant) as part of the EIS.

General

2. Construction noise associated with the proposed development should be assessed using the *Interim Construction Noise Guideline* (DECC, 2009). http://www.environment.nsw.gov.au/noise/constructnoise.htm

3. Vibration from all activities (including construction and operation) to be undertaken on the premises should be assessed using the guidelines contained in the *Assessing Vibration: a technical guideline* (DEC, 2006). http://www.environment.nsw.gov.au/noise/vibrationguide.htm

4. If blasting is required for any reasons during the construction or operational stage of the proposed development, blast impacts should be demonstrated to be capable of complying with the guidelines contained in *Australian and New Zealand Environment Council – Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration* (ANZECC, 1990). http://www.environment.nsw.gov.au/noise/blasting.htm

Industry

5. Operational noise from all industrial activities (including private haul roads and private railway lines) to be undertaken on the premises should be assessed using the guidelines contained in the *NSW Industrial Noise Policy* (EPA, 2000) and *Industrial Noise Policy Application Notes*. http://www.environment.nsw.gov.au/noise/industrial.htm

Road

6. Noise on public roads from increased road traffic generated by land use developments should be assessed using the guidelines contained in the *Environmental Criteria for Road Traffic Noise* (EPA, 1999). http://www.environment.nsw.gov.au/noise/traffic.htm

7. Noise from new or upgraded public roads should be assessed using the *Environmental Criteria for Road Traffic Noise* (EPA, 1999). http://www.environment.nsw.gov.au/noise/traffic.htm

Railway

8. Noise from increased rail traffic on the NSW Rail Network resulting from rail traffic generating development (e.g. an extractive industry) should be assessed using the environmental assessment requirements for rail traffic-generating developments available at http://www.environment.nsw.gov.au/noise/railnoise.htm

Attachment B – Guidance Material

Title	Web address
Relevant Legislation	
Contaminated Land Management Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+140+1997+cd+0+N
Environmentally Hazardous Chemicals Act 1985	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+14+1985+cd+0+N
Environmental Planning and Assessment Act 1979	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+203+1979+cd+0+N

Title	Web address
National Parks and Wildlife Act 1974	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+80+1974+cd+0+N
Protection of the Environment Operations Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+156+1997+cd+0+N
	Licensing
OEH Guide to Licensing	www.environment.nsw.gov.au/licensing/licenceguide.htm
	Aboriginal Cultural Heritage
Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (2005)	Available from DoPI.
Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010)	http://www.environment.nsw.gov.au/licences/consultation.htm
Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW, 2010)	http://www.environment.nsw.gov.au/licences/archinvestigations.htm
Aboriginal Site Impact Recording Form	http://www.environment.nsw.gov.au/licences/DECCAHIMSSiteRecordingForm.htm
	Air Issues
Air Quality	
Approved methods for modelling and assessment of air pollutants in NSW (2005)	http://www.environment.nsw.gov.au/resources/air/ammodelling05361.pdf
POEO (Clean Air) Regulation 2010	http://www.legislation.nsw.gov.au/maintop/view/inforce/subordleg+642+2002+cd+0+N
Greenhouse Gas	
The Greenhouse Gas Protocol: Corporate Standard, World Council for Sustainable Business Development & World Resources Institute	http://www.ghgprotocol.org/standards/corporate-standard
National Greenhouse Accounts (NGA) Factors, Australian Department of Climate Change (Latest release),	http://www.climatechange.gov.au/publications/greenhouse-acctg/national-greenhouse-factors.aspx
National Greenhouse and Energy Reporting System, Technical Guidelines (latest release)	http://www.climatechange.gov.au/en/government/initiatives/national-greenhouse-energy-reporting/tools-resources.aspx
National Carbon Accounting Toolbox	http://www.climatechange.gov.au/government/initiatives/ncat.aspx
Australian Greenhouse Emissions Information System (AGEIS)	http://ageis.climatechange.gov.au/
	Noise and Vibration
Interim Construction Noise Guideline (DECC, 2009)	http://www.environment.nsw.gov.au/noise/constructnoise.htm
Assessing Vibration: a technical	http://www.environment.nsw.gov.au/noise/vibrationguide.htm

Title	Web address
guideline (DEC, 2006)	
Australian and New Zealand Environment Council – Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC, 1990)	http://www.environment.nsw.gov.au/noise/blasting.htm
NSW Industrial Noise Policy (EPA 2000)	http://www.environment.nsw.gov.au/noise/industrial.htm
Industrial Noise Policy Application Notes	http://www.environment.nsw.gov.au/noise/applicnotesindustnoise.htm
Environmental Criteria for Road Traffic Noise (EPA, 1999)	http://www.environment.nsw.gov.au/noise/traffic.htm
Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects (DECC, 2007)	http://www.environment.nsw.gov.au/noise/railinfranoise.htm
Environmental assessment requirements for rail traffic-generating developments	http://www.environment.nsw.gov.au/noise/railnoise.htm

Waste, Chemicals and Hazardous Materials and Radiation

Waste

Waste Classification Guidelines (DECC, 2008)	http://www.environment.nsw.gov.au/waste/envguidlns/index.htm
DECCW Resource recovery exemption	http://www.environment.nsw.gov.au/waste/RRecoveryExemptions.htm
POEO (Waste) Regulations 2005	http://www.legislation.nsw.gov.au/maintop/view/inforce/subordleg+497+2005+cd+0+N

Water and Soils

Acid sulphate soils

Acid Sulphate Soils Planning Maps	http://canri.nsw.gov.au/download/
Acid Sulphate Soils Manual (Stone *et al.* 1998)	Manual available for purchase from: http://www.landcom.com.au/whats-new/the-blue-book.aspx Chapters 1 and 2 are on DoP's Guidelines Register at: Chapter 1 Acid Sulphate Soils Planning Guidelines: http://www.planning.nsw.gov.au/rdaguidelines/documents/NSW%20Acid%20Sulfate%20Soils%20Planning%20Guidelines.pdf Chapter 2 Acid Sulphate Soils Assessment Guidelines: http://www.planning.nsw.gov.au/rdaguidelines/documents/NSW%20Acid%20Sulfate%20Soils%20Assessment%20Guidelines.pdf
Acid Sulphate Soils Laboratory Methods Guidelines (Ahern *et al.* 2004)	http://www.derm.qld.gov.au/land/ass/pdfs/lmg.pdf This replaces Chapter 4 of the Acid Sulphate Soils Manual above.

Contaminated Sites Assessment and Remediation

Managing land contamination: Planning Guidelines – SEPP 55 Remediation of Land	http://www.planning.nsw.gov.au/DevelopmentAssessments/RegisterofDevelopmentAssessmentGuidelines/tabid/207/language/en-US/Default.aspx
Guidelines for Consultants Reporting on	http://www.environment.nsw.gov.au/resources/clm/97104consulta

From: David Paine <dpaine@ncc.nsw.gov.au>
To: '"andrew.hartcher@planning.nsw.gov.au"' <andrew.hartcher@planning.nsw...
Date: 2/16/2012 8:39 am
Subject: FW: Request for Key Issues and Assessment requirements - Ammonium Nitrate Storage and Distribution facility

Hi Andrew,
I refer to your letter dated 19/1/12 re: the above proposed development and the request for DGRs requirements from Crawfords Freightlines Pty Ltd. Council believe that the key environmental issues for assessment in relation to the proposed facility have been covered by the various correspondence included in the information attached to the DoP letter including the issues raised by Council in our previous comments and the subsequent audit and notice\order served by Council on Crawfords.

In summary they are:

* Stormwater and wastewater management - to prevent contamination of nearby waters including SEPP14 wetland from contamination by spilt ammonium nitrate

* Contamination - previous contaminating activities have been carried out on the site. An assessment of the suitability of the site for the proposed use should be made in accordance with SEPP55 and Element 4.02 of the NDCP 2005.

* Material handling - appropriate handling of ammonium nitrate to ensure that spills or dust emissions are minimized.

* Sealing of the site - appropriate sealing of all vehicle traffic and storage areas of the site to prevent dust and sediment and erosion control impacts and allow appropriate stormwater management to occur.

* Noise - hours of operation and traffic and transport noise including rail and road transport. Although the premises is fairly isolated, there are some residential properties that may be affected by transport noise

* Traffic - Assess the likely impact of traffic movements generated by the proposal on the safety and efficiency of the local road network. In this regard, the application is be supported by a Traffic Impact Statement.

I also note that the premises may be affected by acid sulfate soils for works below ground level. Appropriate consideration and assessment will be required in relation to any proposed earthworks.

regards

David Paine Senior Development Officer (Planning) | The City of Newcastle
City Administration Centre, 282 King Street | PO Box 489, Newcastle NSW 2300
Phone 4974 2747 | Fax +61 2 4974 2701 | Email
dpaine@ncc.nsw.gov.au<mailto:dpaine@ncc.nsw.gov.au>

The City of Newcastle
Web: http://www.newcastle.nsw.gov.au
E-mail: mail@ncc.nsw.gov.au

From: "Fernando, Sohan" <Sohan.Fernando@workcover.nsw.gov.au>
To: "Chris.ritchie@planning.nsw.gov.au" <Chris.ritchie@planning.nsw.gov.au>,...
CC: Lilia Donkova <Lilia.Donkova@planning.nsw.gov.au>
Date: 1/31/2012 4:51 pm
Subject: Ammonium Nitrate Storage & distribution facility - Crawfords Sandgate

Hi Chris/Andrew,

I have had a look at the documents sent by you and my comments are:

1. All three toxic combustion products identified are heavier than air. If the hazard analysis has not taken this into consideration, the matter must be addressed.
2. The behaviour of the toxic combustion products should be discussed/addressed in conditions when a temperature or atmospheric inversion occurs. Under such conditions, it is known that combustion products (even though they may be assumed to be buoyant due to a temperature above ambient) can slump to ground level at distances greater than those estimated under no inversion conditions.
3. Dispersion results on page 26 show values in ppm and mg/m3. The equivalent value or conversion should be included.

Regards

Sohan Fernando
Senior Safety Analyst
Major Hazard Facilities Team
WorkCover NSW
Tel: 8281 6485 Fax:9271 6485

Transport
Roads & Maritime
Services

6 February 2012

SF2012/001554
CR2012/000733
BK

Director, Mining and Industry Projects
GPO Box 39
SYDNEY NSW 2001

Attention: Mr Andrew Hartcher

Dear Mr Hartcher,

MAITLAND ROAD (HW10) AND INNER CITY BY-PASS (HW23): AMMONIUM NITRATE STORAGE AND DISTRIBUTION FACILITY, LOT 12 DP625053, OLD MAITLAND ROAD, SANDGATE – DIRECTOR GENERAL REQUIREMENTS

I refer to your letter dated 19 January 2012, received on 27 January 2012, requesting the provision of key issues which Roads and Maritime Services (RMS) believes should form part of the Director-Generals Environmental Assessment Requirements (DGR's) for the subject proposal.

The Environmental Assessment (EA) should refer to the following guidelines with regard to the traffic and transport impacts of the proposed development:

- Department of Planning EIS Guidelines
    - Road and Related Facilities
- RTA's *Guide to Traffic Generating Developments 2002*
    - Section 2 Traffic Impact Studies

A traffic and transport study shall be prepared in accordance with the RTA's *Guide to Traffic Generating Developments 2002* and is to include (but not be limited to) the following:

- Assessment of all relevant vehicular traffic routes and intersections for access to / from the subject area.
- Current traffic counts for all of the traffic routes and intersections.
- The anticipated additional vehicular traffic generated from both the construction and operational stages.

- The distribution on the road network of the trips generated by the proposed development. It is requested that the predicted traffic flows are shown diagrammatically to a level of detail sufficient for easy interpretation.

- Consideration of the traffic impacts on existing and proposed intersections and the capacity of the local and classified road network to safely and efficiently cater for the additional vehicular traffic generated by the proposed development during the construction and operational stages. The traffic impact shall also include the cumulative traffic impact of any other proposed developments in the area.

  Comment: As a minimum, RMS will require the study to include an assessment of the impacts of the proposed development on the intersection of Maitland Road and Old Maitland Road.

- Identify the necessary road network infrastructure upgrades that are required to maintain existing levels of service on both the local and classified road network for the development. In this regard, preliminary concept drawings shall be submitted with the EA for any identified road infrastructure upgrades. However, it should be noted that any identified road infrastructure upgrades will need to be to the satisfaction of RMS and Council.

- Intersection analysis (such as SIDRA) shall be submitted to determine the need for intersection and road capacity upgrades. The analysis shall include, but not be limited to the following:

  - Current traffic counts and 10 year traffic growth projections
  - With and without development scenarios
  - 95th percentile back of queue lengths
  - Delays and level of service on all legs for the relevant intersections
  - Electronic data for RMS review.

- Any other impacts on the local and classified road network including consideration of pedestrian, cyclist and public transport facilities and provision for service vehicles.

In addition to the above, RMS requests that the proponent undertake an analysis / risk assessment of the buffer zone required around the proposed facility to eliminate potential explosive impacts on the classified road network. Any proposals for storage and transport of explosive material must not compromise the safe and efficient operation of the classified road network, in particular, the extension of SH23 from Shortland to Sandgate, which is currently under construction. A review of Australian Standard AS2187.1 Table 3.2.3.2 indicates that:

  - Note 10 states that *"However, full Class B protected work distances should be used for roads if the nature of the traffic is e.g. constant, dense or fast, so that the reaction of drivers to a sudden blast would result in unacceptable damage or injury."*

RMS would not support a facility that requires the any closure of classified roads because of the storage or transport of explosive material.

It is recommended that the proponent discuss the project with RMS prior to commencing the preparation of the traffic and transport study and explosive risk assessment.

Newcastle City Council and the appropriate rail authority should also be consulted regarding requirements.

Yours sincerely,

Dave Young
Manager, Land Use Development
Infrastructure Services
Hunter Region

CC General Manager
Newcastle City Council

Department of Primary Industries
Office of Water

Contact Elizabeth Cala
Phone 02 4904 2533
Mobile 0459 807 128
Fax 02 4904 2503
Email elizabeth.cala@water.nsw.gov.au

Our ref ER 21774
Your ref SSD-5119

Mining and Industry Projects
Department of Planning & Infrastructure
GPO Box 39
SYDNEY NSW 2001

Attention: Chris Ritchie

Dear Chris

Request for Key Issues and Assessment Requirements

State Significant Development Proposal – Ammonium Nitrate Storage and Distribution Facility

I refer to your letter of 19 January 2012 requesting details of key issues and assessment requirements for the above proposed project.

A summary of the NSW Office of Water's key issues and assessment requirements is set out below. Detailed advice on the Office of Water's assessment requirements is provided in the **Attachment A**, which should be read in full.

Water licensing – A water licence from the Office of Water is generally required to take water from a water source.[1] This licensing requirement is fundamental to sustainable water management as it facilitates water accounting, which ensures the total volume of water taken from a water source remains within defined extraction limits.

The Office of Water advises that the EIS should include a detailed assessment of water requirements for the proposed project. In particular, the EIS should demonstrate the following:

- An adequate and secure water supply is available for the life of the proposed project.
- Water supplies will be taken from an appropriately authorised and reliable supply.
- Any water licences required to authorise the taking of water can be obtained through application and/or trade.

To demonstrate the above, the following information is essential for inclusion in the EIS:

- Identification of water requirements for the life of the proposed project in terms of both volume and timing; identification of the water sources that water will be taken from; and identification of which water sources are the subject of a water sharing plan.

[1] Some exemptions apply, such as for basic landholder rights.

- Identification of any requirements (including potential requirements) to intercept groundwater; identification of the groundwater sources that may/will be intercepted; identification of which water sources are the subject of a water sharing plan; and details of predicted dewatering volumes.

Impacts on water sources – Water is a limited and precious resource and must be managed in a sustainable and integrated manner for the benefit of both present and future generations.[2]

The Office of Water advises that the EIS should include a detailed assessment of the potential impact of the proposed project on the water sources of the State. In particular, the EIS should include a detailed analysis of the following:

- the water sources, floodplains and dependent ecosystems likely to be affected by the proposed project, together with a detailed description of those water sources, floodplains and dependent ecosystems that are likely to be significantly affected,
- the likely impact on water sources, floodplains and dependent ecosystems of the proposed project, and
- a full description of the measures proposed to mitigate any adverse effects of the proposed project on water sources, floodplains and dependent ecosystems.

The above analysis should include the following:

- Description of the regional environment including surface water catchment, groundwater system, and dependent ecosystems.
- Predictive assessments of the impact of the proposed project on surface and groundwater sources, floodplains, dependent ecosystems, basic landholder rights to water and adjacent/downstream licensed water users, in particular with respect to:
    - water quality,
    - high priority groundwater dependent ecosystems identified in relevant water sharing plans, and
    - areas which are sensitive because of physical or biological factors such as acid sulphate soils and conservation areas.
- A commitment to adequate ongoing monitoring of surface and groundwater sources and dependent ecosystems within and adjacent to the proposed project area to verify predictive assessments.
- Analysis of options for the proposed project in terms of avoiding impacts on surface and groundwater sources, floodplains, dependent ecosystems, basic landholder rights to water and adjacent/downstream licensed water users. If the options analysis cannot demonstrate avoidance, then mitigation, remediation and rehabilitation options must be examined.
- Mitigation strategies to address unavoidable impacts on surface and groundwater sources, floodplains and dependent ecosystems, for the operational and post-operational phases of the proposed project.
- A commitment to restore any land, water sources and dependent ecosystems which are degraded by the proposed project.
- Justification of criteria regarding completion of any rehabilitation program.
- Contingency strategies linked to monitoring results and rehabilitation programs.

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[2] *Water Management Act 2000*, section 3.

If you require further information please contact Elizabeth Cala, Planning and Assessment Coordinator on (02) 4904 2533 at the Newcastle office.

Yours sincerely

Mark Mignanelli
Manager Major Projects, Mines and Assessment
9 February 2012

Key Issues and Assessment Requirements

State Significant Development Proposal – Ammonium Nitrate Storage and Distribution Facility

1. Legislation

The EIS is required to demonstrate that the proposed project is consistent with the objects of the *Water Management Act 2000*, and the water management principles prescribed in section 5 of that Act.

The EIS is required to demonstrate that the proposed project complies with the relevant requirements of applicable NSW water legislation, in particular:

- *Water Management Act 2000*, and
- *Water Act 1912*.

For further information, see http://www.water.nsw.gov.au/Water-management/Law-and-Policy/default.aspx

2. Water Sharing Plans

Water sharing plans (WSPs) are legally enforceable statutory plans under the *Water Management Act 2000*. WSPs provide rules for the sharing of water between the environment and water users, and also between different types of water users such as town water supply, rural domestic supply, stock watering, industry and irrigation.

The proposed project is located within the Newcastle Water Source under the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009*.

The EIS is required to demonstrate how the proposed project is consistent with the rules in this WSP.

3. Orders

The EIS is required to demonstrate that the proposed project complies with the relevant requirements of applicable orders made pursuant to NSW water legislation.

The following orders may be relevant to the proposed project:

- Harvestable Rights Orders – see http://www.water.nsw.gov.au/Water-licensing/Basic-water-rights/Harvesting-runoff/default.aspx, and
- embargo orders applying to coastal alluvial groundwater outside water sharing plan areas - see http://www.water.nsw.gov.au/Water-management/Water-availability/Groundwater/avail_ground_embago/default.aspx.

4. Policies and Guidelines

The EIS is required to identify state and federal water management policies and guidelines that are relevant to the proposed project. The EIS must detail the extent to which the proposed project is consistent with relevant policies and guidelines, and justify any inconsistencies.

The following water management policies and guidelines may be relevant to the proposed project:

- *The NSW State Rivers and Estuaries Policy* (1993),
- *The NSW State Groundwater Policy Framework Document* (1997) and its component policies, consisting of:

- *The NSW Groundwater Quality Protection Policy* (1998), and
- *The NSW State Groundwater Dependent Ecosystems Policy* (2002),

- *NSW Wetlands Policy* (2010),
- *NSW Coastal Policy* (1997),
- *NSW Water Extraction Monitoring Policy* (2007),
- *NSW Guidelines for Controlled Activities*, consisting of:
  - *Guidelines for in-stream works* (2010),
  - *Guidelines for laying pipes and cables in watercourses* (2010),
  - *Guidelines for outlet structures* (2010),
  - *Guidelines for riparian corridors* (2011),
  - *Guidelines for vegetation management plans* (2010), and
  - *Guidelines for water crossings* (2010),
- *National Water Quality Management Strategy*, including:
  - *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (2000),
  - *Australian and New Zealand Guidelines for Water Quality Monitoring and Reporting* (2000), and
  - *Guidelines for Groundwater Protection in Australia* (1995).

These water management policies and guidelines are available at: http://www.water.nsw.gov.au/Water-Management/Law-and-Policy/Key-policies/default.aspx.

Water management policies and guidelines which are relevant to specific assessment requirements are also cited below.

5. Strategies

The EIS is required to demonstrate that the proposed project is consistent with the following strategies:

- *NSW Water Conservation Strategy* (2000), and
- *NSW Salinity Strategy* (2000).

These strategies are available at: http://www.water.nsw.gov.au/Water-Management/Law-and-Policy/Key-policies/default.aspx.

6. Surface water

6.1 Water licences to take surface water

The EIS must identify all proposed surface water extraction.

The EIS must provide details of the purpose, location and expected annual extraction volumes of all proposed surface water extraction.

The EIS must detail the extent to which all proposed surface water extraction is consistent with *NSW Water Extraction Monitoring Policy* (2007).

The EIS must provide analysis of the proposed water supply arrangements against the rules for access licences and other applicable requirements of the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009*.

6.2 Water supply works

For water supply works which are proposed to be constructed or used for the purpose of taking water from a surface water source (such as a water pump[3]), the EIS must provide details regarding purpose, location, construction and expected annual extraction volumes.

For flood works,[4] drainage works[5] and water supply works which capture, store, convey, divert or impound water (such as a tank, dam, water pipe, irrigation channel, bank, levee, or weir),[6] the EIS must provide the following details:

- purpose, location, and construction,
- whether the work is on a watercourse,
- size, storage capacity and expected annual extraction volumes,
- whether the work is affected by flood flows,
- details of any proposal for shared use, rights and entitlement of the work, and
- for existing works:
    - date of construction,
    - legal status (i.e. approval status),
    - details of any proposal to change the purpose of the work,
    - whether the work may be affected by any changes in the hydraulic and/or energy regime occurring as a consequence of the proposed project, and
    - details of any remedial work required to maintain integrity.

If the proposed project involves the use of new or existing dams, the EIS must include a calculation of the maximum harvestable right dam capacity for the site - see http://www.water.nsw.gov.au/Water-licensing/Basic-water-rights/Harvesting-runoff/default.aspx.

Although State Significant Development does not require a water supply work approval (section 89J of the *Environmental Planning and Assessment Act 1979*), if the proposed project includes water supply works then the EIS must detail the extent to which the proposed project is consistent with the approval requirements for water supply works prescribed in section 97 of the *Water Management Act 2000*.

6.3 Surface water protection

The EIS must include an assessment of the impact of the proposed project on surface water sources.

In particular, the EIS should provide the following:

- Identification of all surface water sources within and adjacent to the proposed project area, including watercourses and wetlands, and details of conservation status (for example, SEPP 14 wetland, Ramsar wetland).
- Baseline monitoring of surface water quality and quantity for all watercourses within and adjacent to the proposed project area (minimum fortnightly data).
- Detailed description of any proposed development on watercourses including construction, clearing, draining, excavation, diversion and filling; an evaluation of the proposed methods

[3] As defined in the *Water Management Act 2000*, Dictionary section, paragraph (a).
[4] As defined in the *Water Management Act 2000*, Dictionary section.
[5] As defined in the *Water Management Act 2000*, Dictionary section.
[6] As defined in the *Water Management Act 2000*, Dictionary section, paragraphs (b)-(e).

of development; and detailed assessment of potential impacts in terms of vegetation, sediment movement, channel stability, water quality and hydraulic regime.

- Detailed description of surface water dependent ecosystems and existing surface water users within the area, and detailed assessment of any potential impacts on surface water dependent ecosystems and existing surface water users.
- Details of ongoing monitoring programs for surface water quality and quantity.
- Details of critical thresholds for negligible impacts to surface water sources.
- Detailed description of any measures to be incorporated into the proposed project to avoid or minimise long-term actual and potential impacts, particularly in respect of the natural hydrological regime, sediment movement patterns, riparian buffers and stormwater management.
- Contingency strategies to remediate, reduce or manage potential impacts, in particular:
    - reporting procedures for ongoing monitoring programs, including mechanism for transfer of information to the Office of Water,
    - identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency strategies would be initiated,
    - detailed description of the remedial measures or contingency strategies proposed, and
    - any funding assurances covering the anticipated post development maintenance cost, for example, stream rehabilitation maintenance, ongoing monitoring.
- Details of the extent to which the proposed project is consistent with *The NSW State Rivers and Estuaries Policy* (1993), *NSW Wetlands Policy* (2010) and the *Guidelines for Controlled Activities*.

Although State Significant Development does not require a controlled activity approval (section 89J of the *Environmental Planning and Assessment Act 1979*), if the proposed project involves controlled activities then the EIS must detail the extent to which the proposed project is consistent with the water management principles and approval requirements for controlled activities prescribed in section 5(7) and 97(4) respectively of the *Water Management Act 2000*.

7. Groundwater

7.1 Water licences to take groundwater

The EIS must identify all proposed groundwater extraction.

The EIS must provide details of the purpose, location and expected annual extraction volumes of all proposed groundwater extraction.

The EIS must detail the extent to which all proposed groundwater extraction is consistent with *NSW Water Extraction Monitoring Policy* (2007).

7.2 Water supply works to take groundwater

For all water supply works which are proposed to be constructed or used for the purpose of taking water from a groundwater source (such as water bores for the purpose of investigation, testing, extraction, dewatering and monitoring), the EIS must provide details regarding purpose, location, construction and expected annual extraction volumes.

Although State Significant Development does not require a water supply work approval (section 89J of the *Environmental Planning and Assessment Act 1979*), if the proposed project includes water supply works then the EIS must detail the extent to which the proposed project is consistent

with the approval requirements for water supply works prescribed in section 97 of the *Water Management Act 2000*.

7.3 Aquifer interference activities which intercept groundwater

For all proposed aquifer interference activities which may intercept groundwater (including activities which involve the penetration of an aquifer (such as an excavation) or the interference with water in an aquifer), the EIS must provide details regarding purpose, location, construction and expected annual extraction volumes.

The EIS must also detail the extent to which the proposed project is consistent with the water management principles and approval requirements for aquifer interference activities prescribed in section 5(8) and 97(6) respectively of the *Water Management Act 2000*.

7.4 Groundwater protection

The EIS must include an assessment of the impact of the proposed project on groundwater sources.

In particular, the EIS should provide the following:

- Identification of all groundwater sources which will be intersected or connected with as part of the proposed project.
- Baseline monitoring of groundwater quality and quantity within and adjacent to the proposed project area (minimum fortnightly data).
- Description of flow directions and rates, physical and chemical characteristics, and highest predicted groundwater table for aquifers within and adjacent to the proposed project area.
- Extent of alluvium within the proposed project area and details on the connectivity of aquifers to watercourses within the proposed project area.
- Details of any potential works likely to result in pollutants infiltrating into the groundwater.
- Details of proposed methods of waste water disposal and approval from the relevant authority.
- Identification of any groundwater source or aquifer that may be sterilised as a consequence of the proposed project.
- Detailed description of existing groundwater users within the area, and detailed assessment of any potential impacts on existing groundwater users.
- Detailed description of any measures to be incorporated into the proposed project to avoid or minimise long-term actual and potential environmental impacts, particularly in respect of groundwater pollution.
- Details of ongoing monitoring programs for groundwater quality and quantity.
- Details of critical thresholds for negligible impacts to groundwater sources.
- Contingency strategies to remediate, reduce or manage potential impacts, in particular:
    - reporting procedures for ongoing monitoring programs, including mechanism for transfer of information to the Office of Water,
    - identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency strategies would be initiated,
    - detailed description of the remedial measures or contingency strategies proposed, and
    - any funding assurances covering the anticipated post development maintenance cost, for example, ongoing groundwater monitoring.

- Details of the extent to which the proposed project is consistent with *The NSW State Groundwater Policy Framework Document* (1997) and *The NSW Groundwater Quality Protection Policy* (1998).

7.5 Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) rely on groundwater for their species composition and their natural ecological processes. Examples of ecosystems which depend on groundwater are wetlands, terrestrial vegetation such as red gum forests, ecosystems in streams fed by groundwater (gaining streams), limestone cave systems, springs, and hanging valleys and swamps.

The EIS should provide the following:

- Identification of GDEs (including potential GDEs) within and adjacent to the proposed project area, and details of conservation status (for example, high priority listing in WSP, SEPP 14 wetland, Ramsar wetland).
- Details of current GDE condition.
- Details of groundwater quality and quantity requirements for all GDEs.
- Details of a flora and fauna assessment for all GDEs, including macroinvertebrate and macrophyte diversity and abundance assessments.
- Detailed assessment of any potential impacts on GDEs.
- Detailed description of any measures to be incorporated into the proposed project to avoid or minimise adverse impacts on GDEs, including measures to:
    - avoid pollution or causing adverse changes in groundwater quality, and
    - rehabilitate degraded groundwater systems where practical.
- Details of ongoing monitoring and protection programs for potential offset areas.
- Critical thresholds for negligible impacts.
- Contingency strategies to remediate, reduce or manage potential impacts, in particular:
    - reporting procedures for ongoing monitoring programs, including mechanism for transfer of information to the Office of Water,
    - identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency strategies would be initiated,
    - detailed description of the remedial measures or contingency strategies proposed, and
    - any funding assurances covering the anticipated post development maintenance cost, for example, ongoing groundwater monitoring.
- Details of the extent to which the proposed project is consistent with *The NSW State Groundwater Dependent Ecosystems Policy* (2002) and *NSW Wetlands Policy* (2010).

8. Rehabilitation

The EIS must provide the following:

- Details of proposed rehabilitation measures to restore any land, water sources and dependent ecosystems which are degraded by the proposed project.
- Justification of criteria regarding completion of any rehabilitation program.

- Details of the measures to be undertaken to ensure that sufficient resources are available to implement the proposed rehabilitation program.
- Details of measures for the ongoing management of the site following the cessation of the proposed project.

END ATTACHMENT A

9 February 2012

Annex B

Hazard Analysis

HEALTH & SAFETY essentials

Crawford Freightlines Pty Ltd

CRAWFORDS Freightlines Pty Ltd

Lot 12 Old Maitland Road, Sandgate (NSW)

Ammonium Nitrate Storage Facility

HAZARD ANALYSIS

REVISION 4

(Storage in Shed A, Shed B, Shed C & Shipping Containers)

12 December 2012

Prepared by:

Janelle Adrain

Principal Consultant

Health & Safety Essentials Pty Ltd

PROJECT DETAILS

Crawfords Freightlines Pty Ltd: Hazard Analysis	
Client:	Crawfords Freightlines Pty Ltd
Facility Address:	Lot 121 Old Maitland Road Sandgate NSW 2304
Client Contact:	Paul McGrath Compliance Manager Crawfords Freightlines Pty Ltd
HSE Contact:	Janelle Adrain Principal Consultant Health & Safety Essentials Pty Ltd

DOCUMENT HISTORY

Revision	Date	Description	Distribution
0	20 July 2011	Hazard Analysis for review	Paul McGrath, Crawfords Jacinta Coulin, ERM
1 (DRAFT)	17 April 2012	Storage in Shed A, Shed B, Shed C and Outdoor Compound. Draft issued for comment.	Paul McGrath, Crawfords Jacinta Coulin, ERM
1	22 May 2012	Minor updates based on comments.	Paul McGrath, Crawfords Jacinta Coulin, ERM
2	22 May 2012	Storage in Shed A, Shed B, Shed D and Outdoor Compound.	Paul McGrath, Crawfords Jacinta Coulin, ERM
3 (DRAFT)	3 Dec 2012	Update to incorporate revised locations for storage and truck operations, and to incorporate requirements of Department of Planning & Infrastructure.	Paul McGrath, Crawfords Steve O'Connor, ERM
3	7 Dec 2012	No changes to draft.	Paul McGrath, Crawfords Claire Burnes, ERM
4	12 Dec 2012	Minor updates for Final EIS for Exhibition.	Paul McGrath, Crawfords Claire Burnes, ERM

EXECUTIVE SUMMARY

Crawfords Freightlines Pty Ltd operate a storage and distribution depot at Lot 12 Old Maitland Road, Sandgate (NSW). At this depot, Crawfords store and distribute ammonium nitrate on behalf of customers, including Dyno Nobel Asia Pacific Pty Ltd (Dyno Nobel), Downer EDI Mining – Blasting Services Pty Ltd (Downer) and Orica Mining Services (Orica).

The maximum quantity of ammonium nitrate stored at the site will be 13 500 tonne. All ammonium nitrate will be stored in flexible bags (flexible bags) of approximately 1 tonne capacity. There will be no storage of ammonium nitrate in tanks, silos, bunkers or loose bulk.

The Crawfords depot is located on industrial premises owned by Sierra Sun. Crawfords currently lease Shed A, Shed B, Shed C and Shed D and all outdoor storage areas. The only other tenant at the site is Scafflink Australia who occupy a small fenced off yard area and associated offices in the eastern corner of the site.

Ammonium nitrate is received in flexible bags through the Port of Newcastle (truck deliveries), the Port of Sydney (rail-container deliveries) or direct from manufacturing facilities (eg Orica, Kooragang Island) by truck. Ammonium nitrate is to be stored indoors in three locations at the site (Shed A, Shed B and Shed C). Ammonium nitrate in shipping containers is to be stored outdoors awaiting export.

Ammonium nitrate is distributed in flexible bags, and is also decanted from flexible bags into bulk trucks for distribution to Hunter Valley and other NSW mining areas. The site is also used for general freight storage and distribution, but no other dangerous goods are stored.

The three main hazards associated with ammonium nitrate are fire due to its oxidising properties, decomposition and the release of NO_x gases, and explosion. Temperatures approaching the melting point of pure ammonium nitrate (169^0C) represent a significant hazard due to increased shock sensitivity of molten ammonium nitrate and potential for self-sustained decomposition reaction. Confinement, in combination with high temperatures, increases the risk of explosion due to a build-up of pressure caused by the gases produced by the decomposition reaction. Contamination, particularly with catalysts such as chlorides or other oxidising agents such as sodium nitrate, sodium nitrite and sodium perchlorate, increases the risk of heat generation and the potential for self-sustaining decomposition, with the possibility of detonation.

Various risk assessments have been completed by Crawfords to meet the operational requirements of the site. These risk assessments, together with the hazards of ammonium nitrate, have been reviewed in order to identify those events which have the potential for significant consequences. Based on this analysis, the following scenarios have been considered in this hazard analysis:

- Storage: Explosion and Sustained release of decomposition products.
- On vehicle / truck: Explosion and Sustained release of decomposition products.
- Transfer conveyor / auger: Explosion.

The distance to a range of explosion overpressures has been calculated using the TNT equivalency method. The release and dispersion of decomposition gases has been considered using an approach developed by the UK Health & Safety Executive, and modelled using Ausplume, developed by the Victorian Environment Protection Authority. These results have been combined with the likelihood of occurrence for each event based on approaches acceptable to the Department of Planning & Infrastructure. The resulting contours for individual fatality risk, injury risk (explosion overpressure and toxic exposure) and risk of property damage and accident propagation have been determined.

Findings and Recommendations

The following findings are made in relation to the level of risk based on the approach required by the NSW Department of Planning & Infrastructure:

- The individual fatality risk at a level of 50 in a million per year (50×10^{-6} per year) is contained within the boundaries of the site.
- The individual fatality risk in the area in use by the nearest sporting complex or active open space is no more than 20 chances in a million per year (20×10^{-6} per year).
- The individual fatality risk at the property boundaries of the nearest sporting complex or active open space is less than 30 chances in a million per year (30×10^{-6} per year).
- The individual fatality risk at the nearest commercial developments is less than five in a million per year (5×10^{-6} per year).
- The individual fatality risk at the nearest residence is less than one in a million per year (1×10^{-6} per year).
- The individual fatality risk at the nearest sensitive land use is less than half in one million per year (0.5×10^{-6}).
- The risk of injury due to explosion overpressure exceeding 7kPa at the nearest residence or sensitive land use is less than 50 chances in a million per year (50×10^{-6} per year).
- The risk of serious injury due to a relatively short exposure period to toxic concentrations at the nearest residence or sensitive land use is less than 10 in a million per year (10×10^{-6} per year).

- The risk of irritation to eyes or throat, coughing or other acute physiological responses in sensitive members of the community at the nearest residence or sensitive land use is less than 50 in a million per year (50×10^{-6} per year).
- The risk of property damage and accident propagation due to explosion overpressure exceeding 14kPa at the nearest potentially hazardous installations, or land zoned to accommodate such installations or the nearest public building is less than 50 in a million per year (50×10^{-6} per year).

Societal Risk has been calculated and presented as an FN-curve, by plotting the frequency (F) at which such events result in the fatality of N or more people, against N. The level of Societal Risk meets the indicative set by NSW Department of Planning and Infrastructure.

Reference should be made to the remainder of the Environmental Impact Statement for details of the potential environmental risks of the operation.

Details are provided on the controls to be implemented, the safety management system, emergency plan and security plan; providing a demonstration that risk has been reduced to 'As Low As Reasonably Practicable'.

This Hazard Analysis demonstrates compliance with the qualitative principles for land use safety outlined in the New South Wales Department of Planning and Infrastructure's *Hazardous Industry Planning Advisory Paper No. 4: Risk Criteria for Land Use Planning* (HIPAP 4). The quantitative criteria are met, except for sporting complexes and active open space areas in relation to the adjacent Golf Driving Range. The usage of this facility is relatively low and it is unlikely that any single individual would be present for more than several hours at a time, with typical attendance being no more than several times per week. The risk to an individual based on the time they are present is likely to be lower than most risks experienced by the general community, and therefore can be considered as tolerable.

Under the Newcastle Local Environment Plan 2012, hazardous storage establishments are permitted with consent in the Heavy Industry Zone in which the Crawfords facility is located. The objectives of this Heavy Industry Zone are to:

- Provide suitable areas for those industries that need to be separated from other land uses.
- Encourage employment opportunities.
- Minimise any adverse effect of heavy industry on other land uses.
- Support and protect industrial land for industrial uses.

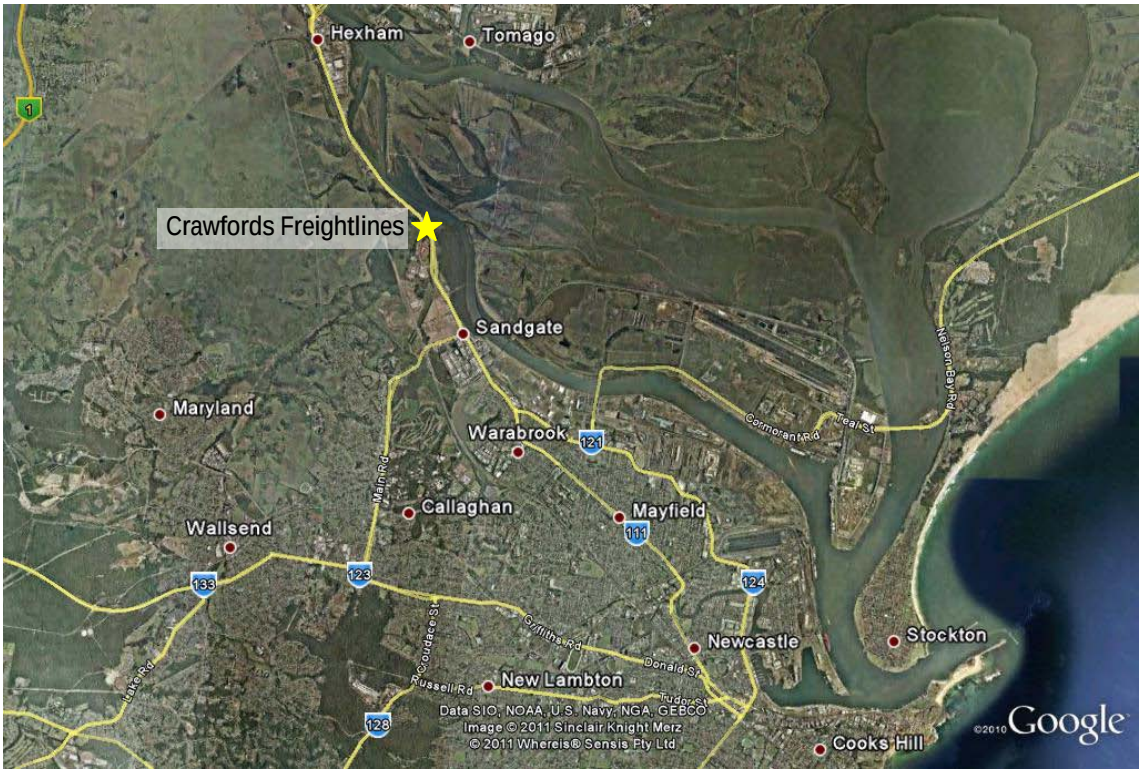
It is therefore considered that the proposed operation of the Crawfords facility as storage and distribution centre for ammonium nitrate is an appropriate use for this land, and that consent should be given for the proposed development.

TABLE OF CONTENTS

1. INTRODUCTION

Crawfords Freightlines Pty Ltd (Crawfords) operate a storage and distribution depot at Lot 12 Old Maitland Road, Sandgate (NSW).

Figure 1: Site Location



At this depot, Crawfords store and distribute ammonium nitrate on behalf of customers, including Dyno Nobel Asia Pacific Pty Ltd (Dyno Nobel), Downer EDI Mining – Blasting Services Pty Ltd (Downer) and Orica Mining Services (Orica). The maximum quantity of ammonium nitrate stored at the site will be 13 500 tonne.

All ammonium nitrate will be stored in flexible bags (flexible bags) of approximately 1 tonne capacity. There will be no storage of ammonium nitrate in tanks, silos, bunkers or loose bulk.

This Hazard Analysis has been prepared in support of a Development Application being lodged by Crawfords in relation to this site.

1.1 Company History

Peter Crawford started in the transport business approximately 40 years ago, initially transporting produce. The business developed into general transport 20 years later, with Crawfords Freightlines Pty Ltd becoming a registered company in April 1995.

Transport of ammonium nitrate commenced approximately 10 years ago for CBS Mining (now Downer). Over the last 3-4 years, Crawfords has also been transporting ammonium nitrate for Dyno Nobel, Orica, Yara Australia Pty Ltd and Blue Ribbon International Pty Ltd.

The company currently has operations in New South Wales, with depots in Sandgate and Singleton; and in Gracemere, Queensland. The company has approximately 80 employees, with more than 60 of these based in New South Wales. The majority of these employees (more than 50%) are drivers.

2. SITE DESCRIPTION & LOCATION

2.1 Site layout & proposed storage quantities

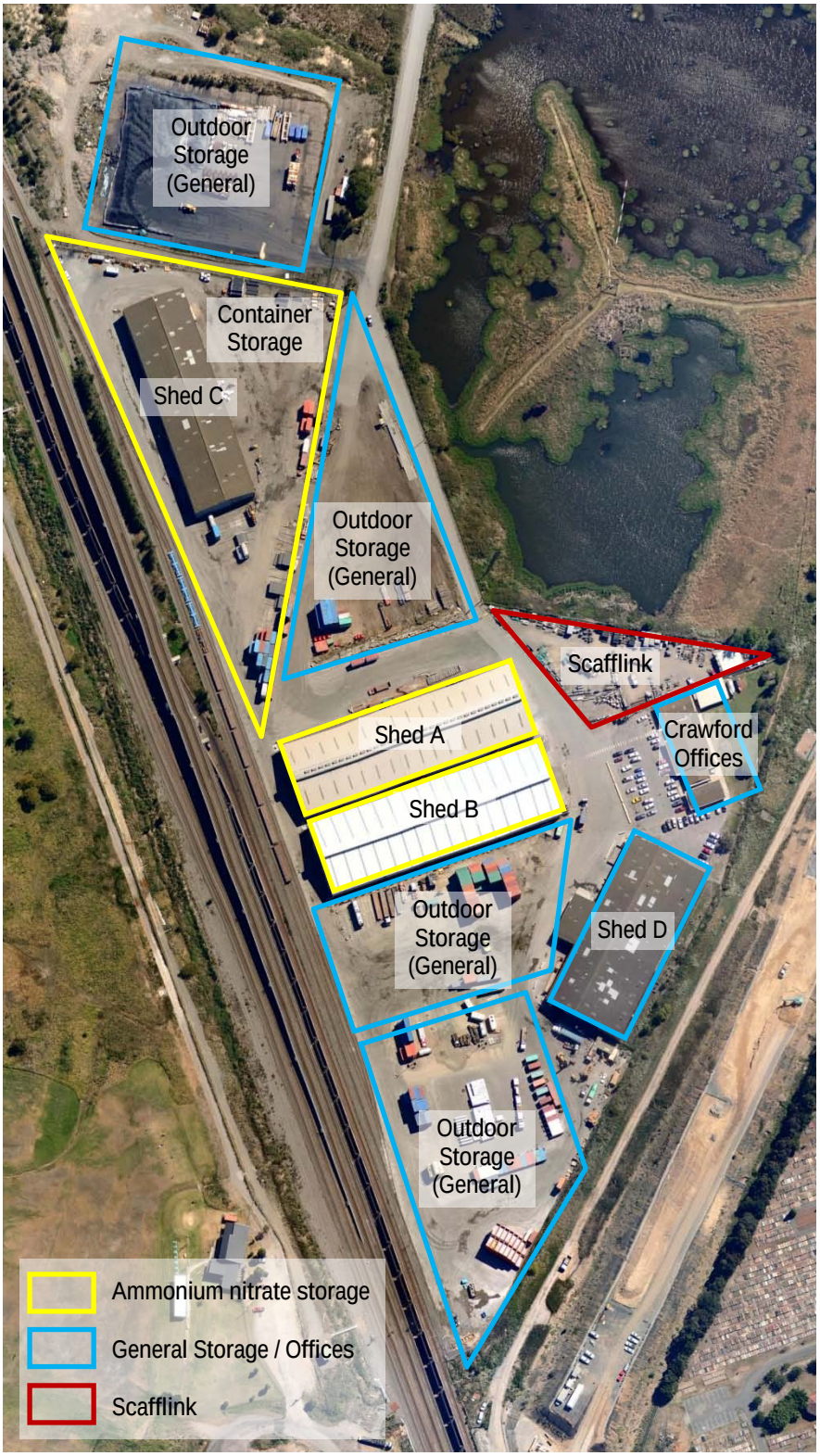
The Crawfords depot is located on industrial premises owned by Sierra Sun. Crawfords currently lease Shed A, Shed B, Shed C and Shed D and all outdoor storage areas. The only other tenant at the site is Scafflink Australia who occupy a small fenced off yard area and associated offices in the eastern corner of the site.

Figure 2 shows the location of Crawfords storage buildings ("sheds"), outdoor storage areas and offices. The location of Scafflink operations is also marked.

The table below summarises the proposed storage quantities of ammonium nitrate at the different locations at the site.

PRODUCT STORAGE				
Location	Product stored	UN No.	DG Class & PG	Quantity (max)
Shed A	Ammonium Nitrate	1942	Class 5.1 PG III	4 500 tonne
Shed B	Ammonium Nitrate	1942	Class 5.1 PG III	4 500 tonne
Shed C	Ammonium Nitrate	1942	Class 5.1 PG III	4 000 tonne
Container Storage	Ammonium Nitrate	1942	Class 5.1 PG III	500 tonne
TOTAL SITE STORAGE	Ammonium Nitrate	1942	Class 5.1 PG III	13 500 tonne

Figure 2: Site Layout



2.2 Site history and development

Crawfords first occupied the site in early-2008 and occupied Shed D, the Outdoor Storage Area adjacent to Shed B, open areas and the office facilities. Crawfords initially undertook general freight storage and transport, with no storage of ammonium nitrate or any other dangerous goods.

During this period, Toll Resources (Toll) occupied Shed C & Compound and stored ammonium nitrate on pallets awaiting export for Orica (licence for 2 600 tonne); Impact Fertilisers occupied Shed A & Shed B; and Scafflink occupied the small area at the east of the site.

Crawfords obtained a licence in December 2008 for the storage of 10 000 tonne of ammonium nitrate (5 000 tonne in Shed D and 5000 tonne in the Outdoor Storage Area adjacent to Shed B).

Toll vacated Shed C & Compound in August 2010 and Crawfords took on the lease for this area in addition to already occupied site areas. At this time, Crawfords submitted an application to increase their licensed storage of ammonium nitrate to 13 500 tonne (5 000 tonne in Shed D; 5000 tonne in Shed C & Compound; 3 500 tonne in the Outdoor Storage Area adjacent to Shed B). WorkCover NSW issued a licence in September 2010.

In late-2011, Orica requested storage space for containerised ammonium nitrate. As the Outdoor Storage Area adjacent to Shed B was no longer being used for storage of ammonium nitrate, this containerised storage was located in this area.

In early-2012, Impact Fertilisers vacated the site. Crawfords now hold the lease for Shed A and Shed B. Proposed storage is ammonium nitrate in Shed A, Shed B, and Shed C & Compound with general storage and/or workshop in Shed D, and general storage in outdoor storage areas.

Orica have recently requested that Crawfords undertake the packing of ammonium nitrate into shipping containers for export. These shipping containers will be stored in the Shed C Compound prior to export.

This information is summarised on the following page.

SITE HISTORY	
Early-2008	Crawfords commence operations at the site. • Crawfords: General storage only (Shed D, Outdoor Storage Area adjacent to Shed B, Outdoor storage areas, offices). • Toll: Shed C & Compound (2 600 tonne of ammonium nitrate on pallets) • Impact Fertilisers: Shed A & Shed B (non-dangerous goods fertiliser storage). • Scafflink: Storage area and associated offices.
December 2008	Crawfords commence storing ammonium nitrate. • Crawfords: – Shed D (5000 tonne ammonium nitrate) – Outdoor Storage Area adjacent to Shed B (5000 tonne ammonium nitrate) – General storage (outdoor storage areas) • Toll: Shed C & Compound (2 600 tonne of ammonium nitrate on pallets). • Impact Fertilisers: Shed A & Shed B (non-dangerous goods fertiliser storage). • Scafflink: Storage area and associated offices.
September 2010	Toll vacate the site. Crawfords take-over lease of Shed C & Compound. • Crawfords: – Shed C & Compound (5000 tonne ammonium nitrate) – Shed D (5000 tonne ammonium nitrate) – Outdoor Storage Area adjacent to Shed B (3 500 tonne ammonium nitrate) – General storage (outdoor storage areas) • Impact Fertilisers: Shed A & Shed B (non-dangerous goods fertiliser storage). • Scafflink: Storage area and associated offices.
Early-2012	Impact Fertilisers vacate the site. Shed A & Shed B no longer in use.
Mid-2012	Crawfords take-over lease of Shed A & Shed B.
Proposed (2012)	Crawfords increase storage to 13 500 tonne. • Crawfords: – Shed A (4 500 tonne ammonium nitrate) – Shed B (4 500 tonne ammonium nitrate) – Shed C (4 000 tonne ammonium nitrate) – Shed C Compound (500 tonne ammonium nitrate in containers) – General storage (Shed D, outdoor storage areas) • Scafflink: Storage area and associated offices.

2.3 Storage and handling activities

2.3.1 Receipt of Ammonium Nitrate

Port of Newcastle: Ammonium nitrate is received in flexible bags (1-1.25 tonne per flexible bag) through the Port of Newcastle as a break-bulk shipment (ie flexible bags transported in hold of ship with no pallets and no shipping containers).

The maximum shipment is 3 000 tonne which is the maximum berth-limit at the Port.

Unloading is completed in approximately 5 x 8-hour shifts using single and double flat-bed trailers.

Port of Sydney: Ammonium nitrate is received in flexible bags in shipping containers (1-1.25 tonne per flexible bag; 20 tonne per container) by rail from the Port of Sydney.

The maximum shipment received is 400 tonne which is the maximum berth-limit at the Port.

The container-wagons are delivered to the rail-siding at the site, lifted off by container-forklift and unpacked immediately so that empty containers can be returned as quickly as possible.

Standard unloading time is one working day.

Orica, Kooragang Island: Ammonium nitrate is received in flexible bags on single and double flat-bed trailers on timber pallets (Orica do not have flexible bag-handling capabilities and all flexible bags must be transferred to trucks at the Orica facilities on pallets).

2.3.2 Storage of Ammonium Nitrate

Ammonium nitrate is to be stored in flexible bags indoors in Shed A, Shed B and Shed C. (Flexible bags arriving from Orica on timber pallets are removed from pallets prior to storage).

Storage is in a maximum storage stack of 500 tonne. Stacks are separated by a minimum of 3 metres. Stacking height is maintained below 4 metres.

Product is stored in the Shed C fenced compound in shipping containers awaiting export.

2.3.3 Loading shipping containers with Ammonium Nitrate

Flexible bags are transferred from storage to pallets (if required), and then loaded into shipping containers which are stored in the Shed C fenced compound awaiting export.

2.3.4 Distribution of Ammonium Nitrate

Ammonium nitrate is distributed from the site in flexible bags on flat-top trucks direct to Hunter Valley and other NSW mining areas (currently the furthermost site is located at Boggabri, NSW). Single trailer vehicles carry up to 20 flexible bags (approximately 25 tonne) while B-double vehicles (2 trailers) carry up to 30 flexible bags (approximately 37.5 tonne). The number of trucks per day varies, but 3-4 vehicles per day is typical.

Ammonium nitrate is also distributed in bulk directly to mine sites in the Hunter Valley and other NSW mining areas (currently the furthermost site is located in Boggabri, NSW). Flexible bags are emptied into a hopper and transferred by conveyor or auger into bulk trailers. Approximately 5 bulk trailers per day are distributed in this manner with B-double vehicles carrying approximately 35 tonne in total, and single trailer vehicles carrying approximately 23 tonne.

Interstate distribution occurs irregularly (no more than once per fortnight) and is generally only required if local depots (eg Gracemere, Qld) are unable to supply product.

Shipping containers of ammonium nitrate are distributed by road or rail to the Port of Newcastle or the Port of Sydney for export.

2.3.5 Other storage and distribution activities

The site is also used for general freight storage and distribution. This currently includes:

- Receipt of timber (logs) by road and packing into containers for export through the Port of Sydney (dispatched from the site by train).
- Locally produced aluminium finished product (ingots, billets, round bar) is received and then packed into containers for export through the Port of Sydney (dispatched from the site by train).
- Receipt of containerised steel products (pipes, bars, etc) from Port of Sydney by train. Containers are unpacked and product is distributed by truck to One Steel in Newcastle.
- General freight (no dangerous goods), receipt, storage and distribution, as required by clients.

2.3.6 Future development

Based on current customer requirements, the quantity of ammonium nitrate stored at the site will remain relatively constant. However the specific clients may alter over time (currently product is stored for Dyno, Downer and Orica).

Other storage and distribution activities at the site may vary over time depending on contracts and client requirements. However, they are likely to be similar to the activities currently undertaken at the site.

2.4 Site Location

The site is located at the southern apex of a small industrial area and is bounded by the Newcastle-Maitland (Hunter) railway line (to the west of the site) and the new Newcastle Inner City Bypass (to the east of the site).

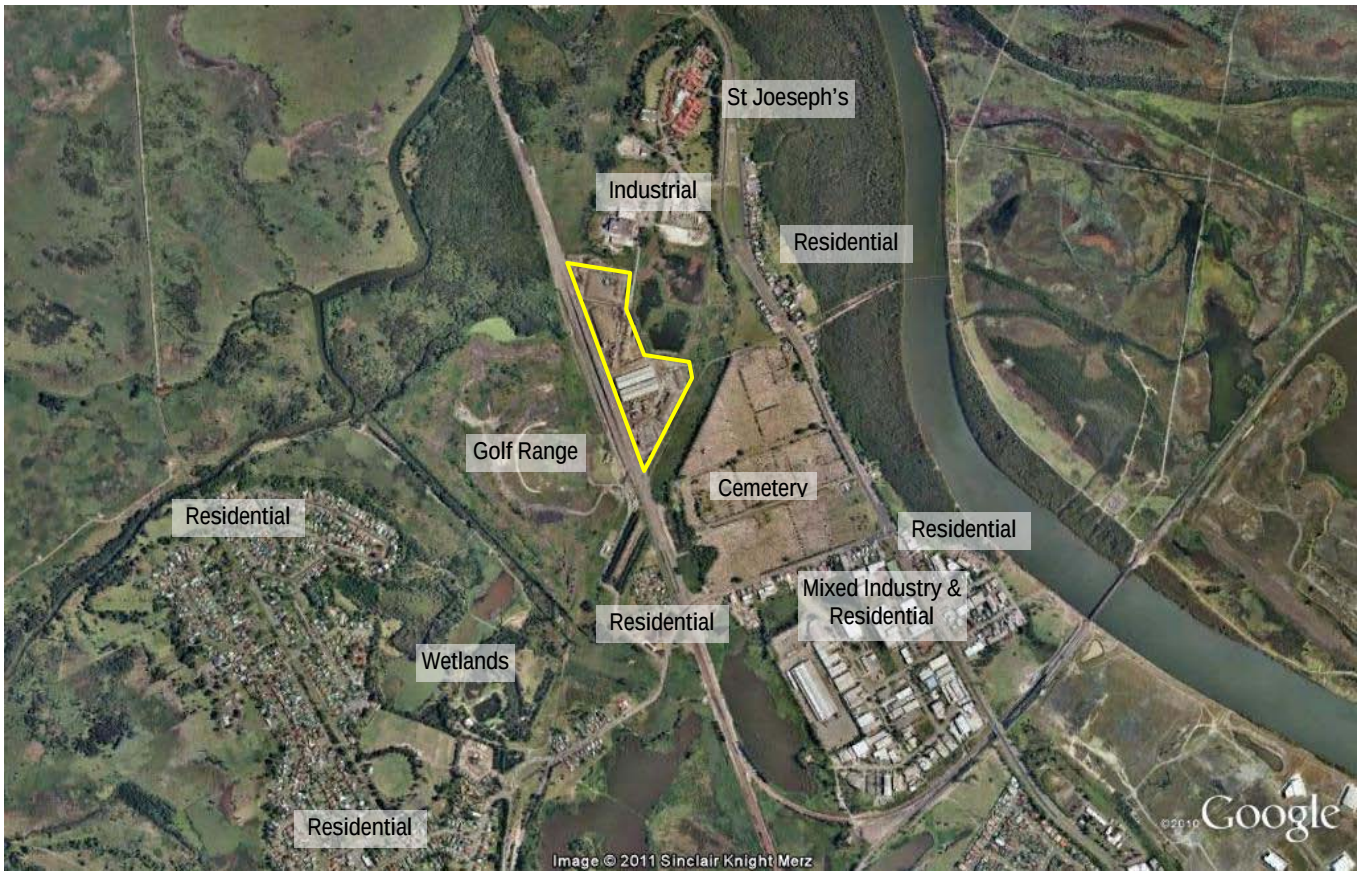
Further to the east are the Pacific Highway, including a strip of residential / commercial development along the highway, and the south channel of the Hunter River.

To the north of the site are other industrial premises and the St Joseph's Home (Residential Aged Care) and St Joseph's Village (Independent Living).

Residential areas are located to the south-west of the site (beyond the Hunter Wetlands area) and to the south-east of the site (beyond the Sandgate Cemetery).

Below is a locality map showing surrounding land uses. The following page presents a table outlining the distance from the closest storage area to nearby premises and facilities.

Figure 3: Surrounding Land Uses



3. HAZARDS OF AMMONIUM NITRATE[1,2,3,4]

From the 1870s ammonium nitrate was widely used as a supplementary oxidising agent in dynamites. While it had been demonstrated that it behaved as a powerful explosive when blended with organic material, ammonium nitrate was largely ignored as an explosive in its own right because of its extreme insensitivity.

It was only following major explosions at Oppau (Germany) in 1921 and Texas City (USA) in 1947 involving fertiliser grade ammonium nitrate, and the subsequent development of safe practices for storage and handling, that the commercial potential of ammonium nitrate as an explosive was recognised. Since the 1950s ammonium nitrate blasting agents have been introduced into most large scale explosives applications – they are considered to be much safer than traditional explosives (such as dynamites) as they require large amounts of energy to initiate the explosion, and they are economical.

3.1 Key hazards of ammonium nitrates

The three main hazards associated with ammonium nitrate are fire due to its oxidising properties, decomposition and explosion. The key factors that govern the hazards of ammonium nitrate are particle size, bulk density or porosity, presence of contaminants, nitrogen content and confinement.

3.1.1 Fire

Ammonium nitrate is an oxidising agent and will support fires involving combustible material by providing oxygen, but it will not burn itself. Gases emitted include nitrogen oxides and ammonia. In its pure form, ammonium nitrate melts at 169°C and in a fire can flow away from the fire location.

3.1.2 Decomposition

Ammonium nitrate can undergo thermal decomposition if it receives enough energy. Gases emitted include nitrogen oxides and ammonia. A key parameter is the temperature at which the ammonium nitrate based products begin to self-heat through a runaway exothermic decomposition (decomposition onset temperature). Self-heating occurs when the rate of heat generation is greater than the rate of heat loss to the environment.

Once the decomposition onset temperature is reached, the decomposition proceeds exothermically at a rate that is an exponential function of the temperature. However, there is a secondary mechanism which has the potential to interrupt the self-accelerating

decomposition and limit the temperature rise. This secondary reaction is the endothermic dissociation of ammonium nitrate into ammonia and nitric acid.
Therefore, at moderate temperature, the exothermic decomposition is balanced by endothermic dissociation. Provided the gases produced can escape freely and no heat is being added to the system (eg through a fire) a steady state is reached.

The decomposition can also become self-sustaining in the presence of contaminants which catalyse the reaction (eg chlorides), in the presence of combustible materials which generate heat as they are oxidised, of if the initial temperature is high enough.

3.1.3 Explosion

An explosion of ammonium nitrate can occur by three different mechanisms:

- ***Heating and confinement:*** If there is insufficient ventilation, decomposition due to heating can result in a build-up in pressure and a subsequent explosion. Molten ammonium nitrate is more sensitive to initiation than solid ammonium nitrate.
- ***Run-away reaction:*** This occurs when the heat generated by the decomposition reaction exceeds the heat loss. For pure ammonium nitrate, this is difficult to achieve when unconfined.
- ***Detonation:*** Neither flame, nor spark, nor friction can cause detonation of uncontaminated ammonium nitrate. Initiation by shock wave requires large amounts of energy, and is strongly dependent on the presence of voids (ie the bulk density). Contamination by organic matter or fuel increases the risk of detonation.

3.2 Accident history

The most memorable recent incident occurred in Toulouse, France (2001). An explosion occurred in a warehouse for storage of "off-spec" ammonium nitrate. The cause has not been conclusively identified however there is speculation that incompatible products also stored at the site may have been brought into contact with the off-spec ammonium nitrate. It has also been speculated that an underground electric arc may be been the energy source which triggered the blast. [4,5]

Other notable incidents are listed in the following table.[4,6,7]

SUMMARY: Significant Accidents Involving Ammonium Nitrate – Post 1950			
Date	Location	Product	Likely Causes
1954	Red Sea	AN fertiliser + paper, organic/copper product	Fire and explosion in ships hold.
1960	Traskwood, USA	Hydrocarbons, nitric acid, AN fertiliser	Train derailment and fire followed by explosion.
1963	Traskwood, USA	Oil, AN fertiliser	Train derailment and fire. No explosion.
1966	USA	AN fertiliser, combustibles, pesticides	Fire in storage followed by explosion.
1967	USA	AN fertiliser in paper bags	Fire in rail wagons with wooden interior. No explosion.
1972	Taroom, Qld	Low density AN and oil	Fire on semi-trailer with low density AN and oil. Explosion.
1972	France	AN Solution	Tanker lagging contaminated with organics and AN, explosion.
1973	USA	AN fertiliser	Fire in store of wooden structure. Explosion of <1% of storage quantity.
1978	USA	AN fertiliser	Fire in warehouse. No explosion.
1982	UK	AN fertiliser, timber furniture	Fire involving AN fertiliser. Explosion (deflagration).
1997	Brazil	AN and fuel	AN truck stopped due to fire. Fuel tanker passing caught fire and exploded. AN explosion, possibly triggered by exploding propane cylinder.
1998	Kentucky, USA	AN fertiliser	Fire in basement storage area. Explosions involving propane cylinders.
2000	Florida, USA	AN fertiliser and fuel	Collision between AN truck and fuel tanker. Fire. No explosion.
2001	Toulouse, France	AN	400 tonne of ammonium nitrate exploded (likely due to contamination.

SUMMARY: Significant Accidents Involving Ammonium Nitrate – Post 1950			
Date	Location	Product	Likely Causes
2004	North Korea	Ammonium nitrate and fuel oil	During shunting, train wagons carrying ammonium nitrate came into contact with wagon containing fuel oil and exploded.
2004	Glenden, Qld	Ammonium nitrate	Truck fire on vehicle carrying containerised ammonium nitrate. Melting of some AN. No explosion.
2004	Romania	Ammonium nitrate fertiliser	Truck overturned and exploded.
2007	Mexico	Ammonium nitrate explosive	Fire and explosion following collision of two vehicles.

3.3 Summary of hazardous conditions

3.3.1 Temperature

Temperatures approaching the melting point of pure ammonium nitrate (169^{0}C) represent a significant hazard due to increased shock sensitivity of molten ammonium nitrate and potential for self-sustained decomposition reaction.

3.3.2 Confinement

Confinement, in combination with high temperatures, increases the risk of explosion due to a build-up of pressure caused by the gases produced by the decomposition reaction.

3.3.3 Contamination

Contamination, particularly with catalysts such as chlorides or other oxidising agents such as sodium nitrate, sodium nitrite and sodium perchlorate, increases the risk of heat generation and the potential for self-sustaining decomposition, with the possibility of detonation.

4. SAFE STORAGE OF AMMONIUM NITRATE

4.1 Types of ammonium nitrate

In recent years, ammonium nitrate has had two key uses – as a fertiliser and an explosives precursor. While chemically similar, the physical structure of the products differs:

- Fertiliser grade ammonium nitrate (often referred to as FGAN) is generally manufactured as high-density, non-porous prills or granules. This structure helps preserve the physical properties from production to crop spreading. These products present a low absorption potential for contaminants and a high resistance to detonation.
- Technical grade ammonium nitrate (often referred to as TGAN) is produced predominantly for use as an explosive precursor. It has a physical structure that is low density and high porosity, and is manufactured as prills or granules. This lower density ammonium nitrate is relatively much more sensitive to detonation.

  Terminology varies depending on the country of manufacture – alternatives to the term TGAN (Technical Grade Ammonium Nitrate) include PPAN (Porous-Prilled Ammonium Nitrate), LDAN (Low Density Ammonium Nitrate) and IGAN (Industrial Grade Ammonium Nitrate). In some cases, the low-density product sourced by mining companies for use as an explosives precursor is still referred to as FGAN (Fertiliser Grade Ammonium Nitrate) even though it may have the low density, high porosity properties preferred for use as an explosives precursor.

With the classification of ammonium nitrate in Australia as a "security sensitive" product, and the recent mining boom, the predominant market in Australia for ammonium nitrate is as an explosives precursor. Product stored at Crawfords is stored on behalf of companies supplying to the mining industry (Downer, Dyno Nobel, Orica).

Therefore, regardless of the name or term used by the manufacture for individual products stored, the product is generally low density, high porosity prills or granules of ammonium nitrate to be used as an explosives precursor.

4.1.1 Dangerous goods classification

Ammonium nitrate used as an explosive precursor is classified under the Australian Dangerous Goods Code (ADG Code)[8] as:

United Nations Number:	1942
Proper Shipping Name:	AMMONIUM NITRATE, with not more than 0.2% total combustible material, including any organic substance, calculated as carbon to the exclusion of any other added substance.
Dangerous Goods Class:	5.1
Packing Group:	III
Special Provisions:	(306) This entry may only be used for substances that do not exhibit explosive properties of Class 1 when tested in accordance to Test Series 1 and 2 of Class 1 (United Nations Manual of Tests and Criteria, Part 1). *Test Series 1: To* determine if a substance has explosive properties *Test Series 2:* To determine if a substance is too insensitive for inclusion in Class 1

Based on this classification, the characteristics of the products stored at Crawfords include:

- No explosives properties.
- Too insensitive to be classified as a Class 1 explosive.
- No more than 0.2% combustible material as contaminants.

These products have been manufactured in Australia or overseas and have been packaged and transported by road, rail and/or sea as UN 1942. For every shipment received, Crawfords require a Certificate of Analysis verifying that the properties of the ammonium nitrate supplied meet the required specification for classification as UN 1942. Copies of these Certificates of Analysis are available for inspection at the Crawfords site.

4.2 Australian Standards and Codes of Practice

4.2.1 AS 4326-2008 The storage and handling of oxidizing agents[9]

This standard was prepared by the Standards Committee CH-009, Safe Handling of Chemicals. It was approved on behalf of the Council of Standards Australia on 26 June 2008 and published on 29 August 2008.

The previous version of this standard was released in 1995.[10] Revision of this Standard was commenced as part of a review of all standards relating to the storage and handling of dangerous goods to update them to reflect changes in regulatory requirements and control philosophies.

In June 2004, the Council of Australian Governments (COAG) introduced principles for the storage of ammonium nitrate which have been adopted by the states and territories. Because of some differences in the regulatory requirements between the states (eg in terms of security, separation distances), the Standard refers users to State regulators for advice on the location, operation and security of a store for ammonium nitrate.

In New South Wales, licensing of ammonium nitrate storage facilities is conducted by the WorkCover Authority of NSW under the *Explosives Act 2003*. WorkCover apply the requirements of AS 4326 in considering an application for a license. The Crawfords site currently holds a licence from WorkCover for the storage of 13 500 tonne of ammonium nitrate. As part of this Development Application, changes are proposed to the storage locations and arrangements, however these will continue to be consistent with the requirements of AS 4326.

Relevant requirements relating to the store construction and storage arrangements of AS 4326 include:

- Locate stores on a floor that has immediate access from outside the building. Stores should be single storey only.
- Construct of non-combustible materials that are resistant to attack by the oxidizing agents. Where appropriate, surfaces should be treated so that they are resistant to attack by the oxidizing agents.
- Provide adequate lighting.
- Prevent accumulation of harmful dusts or vapours by providing adequate natural or mechanical ventilation.
- In stores where there is a risk of corrosion, electrical installations should have a rating of not less than IP 65.
- Stores with floor area greater than 250m^2 should have at least two means of egress.
- Stores should have an area clear of vegetation or combustible material of at least 5 metres wide around the entire store.

- Standing trees should be cleared for at least 15 metres, or a distance equivalent to 1.5 times the height of the trees (whichever is the greater).
- Security fencing, meeting the specified requirements, should be provided.
- Stores should be dry and free of water seepage through the roof, walls or floor.
- Kerbing or grading should be provided so that, in the event of a fire, molten ammonium nitrate will flow clear of all other storage areas, buildings and combustible materials, and be retained on the premises.
- Vehicles powered by internal combustion engines (eg forklifts)operated within the store should be diesel-powered, fitted with a battery isolation switch and insulated cover over the battery, and be fitted with a spark arrestor and dry-powder fire extinguisher. Vehicles should be kept outside the store when not in use, be started outside the store and be garaged at least 10 metres from the store.
- Maximum stack capacity is 500 tonne. If stacked on combustible pallets, the maximum capacity is 200 tonne.
- Maximum capacity of an individual store is 5000 tonne (2000 tonne if stacked on combustible pallets).
- Stacks should be separated by an air space of at least 3 metres (8 metres if stored on combustible pallets), with at least 1.2 metres between the outer wall of the building and the nearest stack. Stacks should not be closer than 1.2 metres to the lowest support beam of the roof.
- Powder or carbon-dioxide extinguishers should be provided to respond to fires in electrical or mechanical equipment. Hose reels and a fire hydrant system should also be provided.

AS 4326 refers users to State regulators for specification of separation distances to boundaries and protected places. It is understood that NSW WorkCover (the State regulatory authority) apply those distances contained in the previous edition of the Standard, ie 8 metres from protected places and boundaries.

4.2.2 New South Wales

NSW does not have a specific publication specifying requirements for storage of ammonium nitrate. Sites are licensed by WorkCover who require compliance with AS 4326. Where the current version of AS 4326 (2008) does not specify detail regarding ammonium nitrate (eg separation to boundaries), reference is made to the earlier 1995 version for guidance.

4.2.3 Queensland

In Queensland, ammonium nitrate storage facilities are licensed by Mining and Safety, Department of Employment, Economic Development and Innovation. *Information bulletin No. 53 (Version 3) Storage requirements for security sensitive ammonium nitrate (SSAN)* released on 21 November 2008[11] outlines requirements for storage of ammonium nitrate in Queensland. The bulletin refers to the requirements of AS 4326 (1995 edition), and provides additional detail regarding security requirements and separation distances.

For 500 tonne stacks of ammonium nitrate, this bulletin presents 8 metres as being adequate spacing between stacks to prevent propagation of an explosion from one stack to another. The stack separation distance is reduced to 5 metres for stacks of 100 tonne or less. The bulletin states that these distances are based on information researched with other regulators and research agencies.

This bulletin uses a TNT equivalency of 32% to calculate safety distances to protected works, public infrastructure and vulnerable facilities, as is done for explosives, ie based on consequence distances. The largest required separation distance (based on a 500 tonne stack) is 966 metres to vulnerable facilities (calculated to an overpressure level of 7 kPa).

4.2.4 Western Australia

In Western Australia, storage of ammonium nitrate is regulated by Resources Safety, Department of Petroleum and Mines (previously part of Department of Consumer and Employer Protection). A code of practice, *Safe Storage of Solid Ammonium Nitrate Code of Practice* was released in 2008[12]. Again, this document provides similar requirements to AS 4326, with additional specification for determining the required separation distance to protected works, vulnerable facilities and critical infrastructure. A TNT equivalency of 25% is used, and a similar methodology to that used for explosives is applied. The largest required separation distance (based on a 500 tonne stack) is 1,110 metres to vulnerable facilities (calculated to an overpressure level of approximately 5 kPa).

No guidance is provided on required stack separation, except that it must be adequate to prevent sympathetic detonation between stacks. It is understood that the AS 4326 separation distances between stacks (ie 3 metres) are applied.

4.3 International Standards and Codes of Practice

4.3.1 United Kingdom

The UK Health and Safety Executive first published *INDG230 Storing and Handling Ammonium Nitrate* in 1996. The current version was released in November 2004.[13] This document recommends maximum stack size of 300 tonne, with low density ammonium nitrate stacks limited to 2m high and 3m wide, with a space of at least 1 metres between stacks, walls and the roof. However, these limits may be exceeded in purpose-built stores.

Large stores are regulated according to COMAH Regulations (Control of Major Accident Hazards Regulations). A TNT equivalency of 14% is recommended in the *COMAH Safety Report Assessment Guide: Chemical Warehouses*.[14]

4.3.2 United States

Guidance in the United States on the storage of hazardous materials is provided in Chapter 11 of the National Fire Protection Authority publication *NFPA 400 Hazardous Materials Code* (2010 Edition).[15] Permits are required for storage of more than 454 kg (1000 lb).

The capacity of individual stacks is defined as no more than 20 feet x 50 feet (approximately 90 m^2), with a maximum height of 20 feet (6 metres). This equates to approximately 270 tonne. These stacks are required to be separated by approximately 1 metre (3 feet) , with at least one slightly larger main access aisle of 4 feet.

Automatic sprinkler systems are required for storage of 2268 tonne (2500 tons) unless approved otherwise by the regulator.

4.3.3 Canada

The requirements for storing ammonium nitrate are outlined in the *Ammonium Nitrate Storage Facilities Regulations* under the *Canada Transportation Act*. Applications for consent are required for storage of over 180 000 kg (200 tons).

Similar requirements to those in AS 4326 are specified in terms of building construction. Minimum distances to nearby facilities are specified, with the largest distance being approximately 100 metres (300 feet) for vulnerable facilities such as schools and hospitals.

The capacity of individual stacks is defined as no more than 20 feet x 50 feet (approximately 90 m^2). For 1 tonne flexible bags stacked 3-high, this equates to approximately 200 tonne. These stacks are required to be separated by approximately 1 metre (3 feet) , with at least one slightly larger main access aisle of 4 feet.

4.3.4 SAFEX

In September 2010, SAFEX International (a non-profit organization of manufacturers of explosives and pyrotechnics) released the document *Good Practice Guide for the Safe Storage of Solid Technical Grade Ammonium Nitrate*.[16] This document was prepared by a Working Group lead by Dr Noel Hsu, Orica Mining Services.

Guidance, similar to that provided in AS 4326, is given for the design and construction of the storage facility. This guide recommends the use of Quantified Risk Assessment to determine the suitability of a storage location for storages above 2 500 tonne.

The recommended separation distance between stacks varies from 1 metre for high density ammonium nitrate (850-900 kg/m^3) to 16 metres for low density ammonium nitrate (< 750 kg/m^3) stored in a stack where each layer is set back by a half-bag. In stating these requirements, the guide refers to "Yara International publications" and "Nygaard, E, *Storage of Technical (Porous) Ammonium Nitrate*, Proceedings of ISEE Conference 2008 which is also based on research commissioned by Yara International.

This document presents a range of TNT equivalency factors (5% to 32%) based on the cause of the explosion.

This document provides guidance on separation distances between stacks based on experimental research. This research appears to be from a single source, commissioned by a single company, and the details are not widely available in the public domain. From a review of the published papers available,[17] it is unclear as to whether the experimental research is directly applicable to the types of products and storage conditions in Australia. Only limited tests have been conducted, and the outcomes, in terms of specifying required separation distances, have not been validated or verified by any other research or regulatory body.

The approach taken by Queensland, requiring 8 metres separation distances between stacks seems to be adopting the belief that larger separation distances than currently specified in Australian and overseas standards are required, but does not adopt the separation distances specified in the SAFEX document. Queensland information also suggests that the stack separation distance of 8 metres has been determined amongst Australian regulators, and would be adopted in the 2008 version of AS 4326, however this has not been the case. All other regulators, and AS 4326, currently require a stack separation of 3 metres.

The requirements of the SAFEX document have not been adopted in the US, Canada or the UK. In these jurisdictions a much smaller stack separation distance of only 1 metre is required.

It is apparent that this is an area where there is significant uncertainty. The scientific basis for requiring 3 metres (AS 4326 and most Australian jurisdictions) or 8 metres (Queensland) or even 1 metre (UK, USA, Canada) is unknown. The experimental testing conducted by Yara International that specifies stack separation distances of up to 16 metres has not been verified or validated, nor is sufficient detail available in the public domain to allow for a critical analysis of the experimental research project.

Based on the acceptance by NSW WorkCover (and most other Australian jurisdictions) and the information presented in AS 4326 (developed by a cross-section of industry, government and emergency service organisations), it will be assumed as the basis for this report that a 3 metre separation distance between stacks of ammonium nitrate is sufficient to prevent propagation of an explosion from one stack to another under most circumstances.

5. PROPOSED STORAGE ARRANGEMENTS

While the exact properties of the ammonium nitrate stored vary, it is to be used in the mining industry as an explosive precursor. Therefore, it is assumed that all product stored has low bulk-density and high porosity; and is provided in a prilled or granular form. This lower density ammonium nitrate is relatively more sensitive to detonation than higher density products, so conducting the analysis on this basis represents "worst-case" scenario.

A typical Material Safety Data Sheet for the product stored is provided in ***Attachment A***.

The facility consists of warehouse buildings and outdoor storage areas. The only equipment used is forklifts, trucks, and a screw-conveyor (auger) and belt-conveyor for transferring ammonium nitrate to bulk trailers.

5.1 Buildings and storage areas

Buildings used for storing ammonium nitrate are large, open, single-story warehouses located at ground level with multiples means of access and egress. The buildings are used solely for storing ammonium nitrate – there are no offices within these buildings, flexible bags are not opened within the stores, and no transfer of ammonium nitrate occurs within the stores.

The buildings are constructed of non-combustible material:

- ***Shed A:*** Walls of corrugated metal sheeting (existing timber to be coated with concrete). Roof is corrugated metal sheeting. Floor is concrete.
- ***Shed B:*** Walls of corrugated metal sheeting (existing timber is to be coated with concrete). Roof is a gel-coated polyester sheeting reinforced with heavy gauge woven glass matting suitable for use in corrosive environments. Floor is concrete.
- ***Shed C:*** Walls of corrugated metal sheeting. Roof is fibrous asbestos sheeting. Floor is concrete.

Stores are provided with electrical lighting. Natural ventilation is available through gaps in walls, roof-joins, etc (ie the buildings are not well-sealed), and doors are kept fully open when persons are working the stores.

No opening of flexible bags occurs within the store, and no transfer of ammonium nitrate is conducted within the store. No dust generation will occur, and therefore no significant risk of electrical corrosion is expected. Existing electrical installations are not IP 65 rated, and no evidence of corrosion is apparent even after storage of ammonium nitrate in some sheds for several years.

In the event of a fire or external heat source that may cause the ammonium nitrate to melt, it is important that the molten ammonium nitrate drains away from stored product and does not flow towards any combustible materials. Once removed from the source of heat, the molten ammonium nitrate will quickly re-solidify and present no higher hazard than stored solid ammonium nitrate. The buildings being used have not been purpose-built to provide directed flows within the store. However, all stores are provided with concrete flooring and will be provided with openings at ground level to allow any molten ammonium nitrate to drain to outside the store.

Any molten ammonium nitrate, or firewater run-off would follow site stormwater drainage. Crawfords have commissioned external consulting engineers to review stormwater management at the site as part of the environmental impact assessment. The hazards of molten ammonium nitrate, and the importance of allowing it to drain freely away from any source of heat will be considered as part of this review.

5.1.1 Product storage arrangements

Storage will be conducted in accordance with of AS 4326, as required by NSW WorkCover. The following storage arrangements will be in place:

- Maximum stack size of 500 tonne.
- Flexible bags stacked 3-high (less than 4 metres), with each layer set-back by a half-bag from the layer below on all sides of the stack.
- Separation between stacks of at least 3 metres.
- Separation between outer wall of the building and the nearest stack of at least 1.2 metres.
- Maximum store capacity is less than 5000 tonne (Shed A & Shed C = 4 500 tonne; Shed B = 4 000 tonne; Container Storage = 500 tonne).
- Stores separated from the boundary by at least 8 metres, as required by NSW WorkCover.

5.1.2 Proximity of combustible materials

Stores will be kept clear of vegetation and any other combustible materials for a distance of at least 5 metres around the external perimeter of the stores. Due to the location of the stores, and the proximity of the railway line to the west and the new bypass road to the south, the nearest vegetation is 30 metres from Shed A, with other storage areas being separated from vegetated areas by more than twice this distance.

Combustible products are also stored and transported by Crawfords (eg timber logs). These will always be located at least 30 metres from any storage area for ammonium nitrate.

5.2 Mechanical equipment

5.2.1 Conveyors

A diesel-powered belt conveyor and an electric screw-conveyor (auger) are used to transfer ammonium nitrate from flexible bags to bulk transport trailers. This is conducted outdoors, generally in the fenced compound surrounding Shed C.

A number of Standards and Codes relating to the handling of ammonium nitrate, and the mixing of explosives, specify requirements for belt-conveyors and/or screw-conveyors (augers) used for ammonium nitrate. These include:

- AS 4326-2008 The storage and handling of oxidizing agents
- Australian Explosives Industry And Safety Group (AEISG): Code of good practice – Precursors for explosives, 1999 (Section 6).
- AS 2187.2-2006 Explosives – Storage and use – Use of explosives. (Section 3.4.1 provides general guidance on the design of mixing units, including those used for ammonium nitrate).

The design of the belt-conveyor and screw-conveyor meet the requirements of these standards. A conveyor compliance audit was conducted in early-2011 by Downer (*Downer – Reload Equipment and Amenities Compliance Audit*). Areas of concern identified in this audit have been rectified to ensure ongoing compliance with the required standards.

Maintenance of the conveyors is scheduled after 100 hours-of-use. This results in inspection and maintenance being completed approximately every 1-2 months.

5.2.2 Forklifts

Three diesel-powered forklifts are used at the site to transfer ammonium nitrate flexible bags from vehicles and shipping containers to storage, and vice-versa.

AS 4326 specifies requirements for forklifts handling of ammonium nitrate.

A forklift compliance audit was conducted in early-2011 by Downer (*Downer – Reload Equipment and Amenities Compliance Audit*). Areas of concern identified in this audit have been rectified to ensure ongoing compliance with the required standards.

Maintenance of the forklifts is scheduled after 250 hours-of-use and is conducted by Crawfords mechanics. Prestart checks are conducted daily for each forklift.

5.2.3 Vehicles

Crawfords operates its own fleet of vehicles and conducts maintenance of these vehicles under the National Heavy Vehicle Accreditation Scheme (NHVAS). The accreditation scheme is a formal process for recognising operators who have good safety and management systems in place. As an accredited operator, Crawfords are required to:

- Develop an in-house assurance system.
- Document the procedures that staff must follow to achieve compliance.
- Produce (and keep for audit) sets of documents that prove compliance.
- Undergo independent audits from time to time.

Crawfords are accredited in two of the four available modules: Mass Management and Maintenance Management. This requires vehicles to be adequately maintained and comply with all applicable vehicle standards at all times, and provides Crawfords with an exemption of the requirement to have vehicles inspected annually for the purposes of registration.

Trailers used for the transport of ammonium nitrate are licensed for the transport of dangerous goods by the NSW Office of Environment and Heritage.

5.3 Site fire protection

Fire extinguishers are provided in buildings and on all vehicles. The primary purpose of these is for the fighting of fires in electrical or mechanical equipment.

The site is provided with firewater system with a booster station located close to the Crawfords office and outside Shed C.

A series of three hydrants are located between Shed A & Shed B. The location of these hydrants is currently being reviewed, as access to them is through the corridor between Shed A & Shed B, which may present hazards to firefighters in the event of an emergency. It is likely that these hydrants will be relocated (or decommissioned and new hydrants installed) to allow for water application in the vicinity of Shed A and Shed B.

Shed C is fitted with an external hydrant, and four internal hydrants (one located on each wall).

5.4 Site security

The site is secured against unauthorised access, and a Site Security Plan has been prepared and reviewed by Inspector Marilyn Hamilton, the NSW Police representative on the WorkCover Major Hazard Facilities team.

6. HAZARD IDENTIFICATION

Various risk assessments have been completed by Crawfords to meet the operational requirements of the site. These risk assessments, together with the hazards of ammonium nitrate, have been reviewed in order to identify those events which have the potential for significant consequences. The table on the following pages provides an overview of the hazards, causes and contributing factors, and controls in place for significant incidents associated with this site.

Based on this analysis, the following scenarios will be considered further for consequence and likelihood analysis:

Incident Scenarios		
Ref	Description	Locations
Ammonium Nitrate Explosions		
1	Ammonium nitrate explosion (storage)	Shed A Shed B Shed C Container Storage
2	Ammonium nitrate explosion (truck)	East of Shed A&B (centre) North of Shed A (centre) East of Shed C (centre) East of Shed C (southern end)
3	Ammonium nitrate explosion (auger)	North of Shed A (centre) East of Shed C (southern end)
Release of Ammonium Nitrate Decomposition Products		
4*	Sustained release of ammonium nitrate decomposition products (storage) (A) Area of release = 100% of storage stack (B) Area of release = 10% of storage stack	Shed A Shed B Shed C
5*	Sustained release of ammonium nitrate decomposition products (truck) (A) Area of release = 100% of truck (B) Area of release = 10% of truck	East of Shed A&B (centre) North of Shed A (centre) East of Shed C (centre) East of Shed C (southern end)

* Refer to *Section 8.2 Release rate of ammonium nitrate decomposition gases* (page 38) for discussion on methodology relating to the "area of release".

Hazard Identification					
Location / Activity	Hazard	Causes & Contributing Factors	Controlling risk	Potential Consequences	Scenario
Storage: Shed A	Temperature	• External fire. • Rail incident (railway line runs along rear of building). • Building fire. • Forklift / Vehicle fire. • Electrical fault. • Lightning.	• No vegetation or combustible materials near store. • Fire extinguishers and hydrants with hose and branch pipes. • Forklifts meet requirements of AS 4326. • Forklifts are not garaged in the store, or started in the store. • Dedicated AN storage – no combustible materials stored. • Store construction steel frame with metal cladding, corrugated metal sheeting roof. • Lightning risk managed according to AS/NZS 1768.	• Heating and decomposition of ammonium nitrate. • Release of decomposition gases. • Potential for explosion.	• Sustained release of decomposition gases. • Explosion of ammonium nitrate.
	Confinement	Nil.			
	Contamination	• Oil leak or spill from vehicle / forklift. • Product supplied contaminated. • Organic flood debris. • Historical contamination within building. • Diesel leak or spill from sump pump used during 1% AEP flood.	• Pre-start forklift checks for oil leaks. • Dedicated AN storage – no organic materials stored. • Product arrives from ports – product must meet UN 1942 in order to meet requirements for IMDG code to allow transport by sea. Certificate of Analysis provided for each shipment. • Any product identified as potentially contaminated is isolated. • Stores protected against ingress of flood waters. • No evidence of historical contamination. • Sump pump used during 1% AEP flood located in internal seepage dam constructed of sandbags and polyethylene sheeting, with all ammonium nitrate located outside this seepage dam.		

Hazard Identification					
Location / Activity	Hazard	Causes & Contributing Factors	Controlling risk	Potential Consequences	Scenario
Storage: Shed B	Temperature	• External fire. • Rail incident (railway line runs along rear of building). • Building fire. • Forklift / Vehicle fire. • Electrical fault. • Lightning.	• No vegetation or combustible materials near store. • Fire extinguishers and hydrants with hose and branch pipes. • Forklifts meet requirements of AS 4326. • Forklifts are not garaged in the store, or started in the store. • Dedicated AN storage – no combustible materials stored. • Store construction steel frame with metal cladding, gel-coated fibreglass roof. • Lightning risk managed according to AS/NZS 1768.	• Heating and decomposition of ammonium nitrate. • Release of decomposition gases. • Potential for explosion.	• Sustained release of decomposition gases. • Explosion of ammonium nitrate.
	Confinement	Nil.			
	Contamination	• Oil leak or spill from vehicle / forklift. • Product supplied contaminated. • Organic flood debris. • Historical contamination within building. • Diesel leak or spill from sump pump used during 1% AEP flood.	• Pre-start forklift checks for oil leaks. • Dedicated AN storage – no organic materials stored. • Product arrives from ports – product must meet UN 1942 in order to meet requirements for IMDG code to allow transport by sea. Certificate of Analysis provided for each shipment. • Any product identified as potentially contaminated is isolated. • Stores protected against ingress of flood waters. • No evidence of historical contamination. • Sump pump used during 1% AEP flood located in internal seepage dam constructed of sandbags and polyethylene sheeting, with all ammonium nitrate located outside this seepage dam.		

Hazard Identification					
Location / Activity	Hazard	Causes & Contributing Factors	Controlling risk	Potential Consequences	Scenario
Storage: Shed C	Temperature	• External fire. • Rail incident (railway line adjacent to building). • Building fire. • Forklift / Vehicle fire. • Electrical fault. • Lightning.	• No vegetation or combustible materials near store. • Fire extinguishers and hydrants with hose and branch pipes. • Forklifts meet requirements of AS 4326. • Forklifts are not garaged in the store, or started in the store. • Store construction steel frame, metal cladding, fibrous asbestos roof. • Dedicated AN storage – no combustible materials stored. • Lightning risk managed according to AS/NZS 1768.	• Heating and decomposition of ammonium nitrate. • Release of decomposition gases. • Potential for explosion.	• Sustained release of decomposition gases. • Explosion of ammonium nitrate.
	Confinement	Nil.			
	Contamination	• Oil leak or spill from vehicle / forklift. • Product supplied contaminated. • Organic flood debris. • Historical contamination within building. • Diesel leak or spill from sump pump used during 1% AEP flood.	• Pre-start forklift checks for oil leaks. • Dedicated AN storage – no organic materials stored. • Product arrives from ports – product must meet UN 1942 in order to meet requirements for IMDG code to allow transport by sea. Certificate of Analysis provided for each shipment. • Any product identified as potentially contaminated is isolated. • Stores protected against ingress of flood waters. • No evidence of historical contamination. • Sump pump used during 1% AEP flood located in internal seepage dam constructed of sandbags and polyethylene sheeting, with all ammonium nitrate located outside this seepage dam.		

Hazard Identification					
Location / Activity	Hazard	Causes & Contributing Factors	Controlling risk	Potential Consequences	Scenario
Storage: Shipping Containers	Temperature	• External fire (eg adjacent storage, bushfire). • Rail incident (railway line adjacent to storage area). • Forklift / Vehicle fire. • Lightning.	• No vegetation or combustible materials nearby. • Fire extinguishers and hydrants with hose and branch pipes. • Forklifts meet requirements of AS 4326. • Stored in shipping containers.	• Heating and decomposition of ammonium nitrate in confined shipping container, with potential for explosion.	• Explosion of ammonium nitrate in shipping containers.
	Confinement	Nil.			
	Contamination	• Oil leak or spill from vehicle / forklift. • Product supplied contaminated. • Historical contamination within shipping container.	• Pre-start forklift checks for oil leaks. • Product arrives from ports – product must meet UN 1942 in order to meet requirements for IMDG code to allow transport by sea. Certificate of Analysis provided for each shipment. • Any product identified as potentially contaminated is isolated. • Inspection of shipping containers prior to loading.		

Hazard Identification					
Location / Activity	Hazard	Causes & Contributing Factors	Controlling risk	Potential Consequences	Scenario
Transfer (conveyor / auger into bulk trailer): North of Shed A; East of Shed C.	Temperature	• Overheating of bearing. • Spark – metal-on-metal. • Friction.	• Design requirements for AN conveyor / auger. • Pre-start checks. • Recent audit by Downer.	• Heating and decomposition of ammonium nitrate in confined area. • Release of decomposition gases. • Potential for explosion.	• Explosion of 50 kg ammonium nitrate. (Note: 50 kg is estimated quantity of AN in auger).
	Confinement	• Potential in bearing housing. • Blockage.	• Design requirements for AN conveyor / auger. • Recent audit by Downer.		
	Contamination	• Oil leak from bearings.	• Design requirements for AN conveyor / auger. • Pre-start checks. • Recent audit by Downer.		

Hazard Identification					
Location / Activity	Hazard	Causes & Contributing Factors	Controlling risk	Potential Consequences	Scenario
Loading flexible bags on/off flat-bed truck trailer: East of Shed A; North of Shed A; East of Shed C. Unloading / loading of shipping containers: Shed C Compound.	Temperature	• Vehicle fire (tyre fire; engine fire; electrical fault). • External fire (trees, vegetation). • Rail / Road incident. • Adjacent building fire. • Forklift fire. • Lightning.	• Vehicles licensed as dangerous goods vehicles. • Maintenance of vehicles under NHVAS. • Fire extinguishers and hydrants with hose and branch pipes. • Forklifts meet requirements of AS 4326. • Store construction steel frame, metal cladding, asbestos / metal / coated fibreglass roof.	• Heating and decomposition of ammonium nitrate. • Release of decomposition gases. • Potential for explosion.	• Sustained release of decomposition gases. • Explosion of 37.5 tonne of ammonium nitrate (maximum trailer load).
	Confinement	Nil.			
	Contamination	• Oil leak or spill from vehicle / forklift. • Product supplied contaminated. • Contamination on trailer bed.	• Pre-start forklift checks for oil leaks. • Product arrives from ports – product must meet UN 1942 in order to meet requirements for IMDG code to allow transport by sea. Certificate of Analysis provided for each shipment. • Dedicated Crawfords vehicles.		

Hazard Identification					
Location / Activity	Hazard	Causes & Contributing Factors	Controlling risk	Potential Consequences	Scenario
All locations	Security Breach (sabotage / vandalism)	• Security breach of site.	• Site security in accordance with requirements of NSW Police.	• Heating and decomposition of ammonium nitrate. • Release of decomposition gases. • Potential for explosion.	• Sustained release of decomposition gases. • Explosion of ammonium nitrate.

7. CONSEQUENCES ANALYSIS – EXPLOSIONS

The effects of explosions are due to the damage caused by the blast overpressure and projectiles. The following table describes the effects at different explosion overpressures as presented in *Hazardous Industry Planning Advisory Paper No. 6 – Hazard Analysis*, New South Wales, 2011 (HIPAP 6).[18]

Impacts of Explosion Overpressure	
Explosion Overpressure	Effect
3.5 kPa (0.5psi)	90% glass breakage No fatality and very low probability of injury from overpressure.
7 kPa (1 psi)	Damage to internal partitions and joinery, but can be repaired. Probability of injury is 10%. No fatality.
14 kPa (2 psi)	House uninhabitable and badly cracked.
21 kPa (3 psi)	Reinforced structures distort. Storage tanks fail. 20% chance of fatality to a person in a building.
35 kPa (5 psi)	House damaged beyond repair. Wagons and plant items overturned. Threshold of eardrum damage. 50% chance of fatality for a person in a building. 15% chance of fatality for a person in the open.
70 kPa (10 psi)	Threshold of lung damage 100% chance of fatality for a person in a building or in the open. Complete demolition of houses.

The most appropriate method for determining the distance to a particular overpressure for ammonium nitrate explosions, is through the use of the TNT equivalency method. This method equates the quantity of material involved in the explosion to TNT, based on the relative energy and efficiency of the two products. The distance to a certain overpressure can then be calculated using formulas developed for TNT explosions.

These formulas are taken from graphs developed from available experimental data using TNT. These charts plot "scaled distance" (x-axis) against "peak overpressure" (y-axis), where

"scaled distance" = actual distance / $Q^{1/3}$ where Q is the quantity of TNT

To calculate the distance to the overpressure of interest, the constant for the "scaled distance" can be read from the graphs, and used to calculate the actual distance to this overpressure depending on the quantity of explosives (TNT equivalent) involved in the explosion.

Graphs can be found in references such as:

- DEOP 103 – Defence Explosive Ordnance Manual, Department of Defence (Australia).[19]
- Publication Series on Dangerous Substances (PGS 2): Methods for the calculation of physical effects due to releases of hazardous materials (liquids and gases), VROM (Netherlands), 2005.[20]

The following formulas (based on the graph presented in DEOP 103, refer to ***Attachment B***) have been used to determine the distance to these peak overpressures:

Distance (m) to 3.5 kPa	=	30.5 $Q^{1/3}$	where Q is the equivalent quantity of TNT (kg)
Distance (m) to 7 kPa	=	17.8 $Q^{1/3}$	
Distance (m) to 14 kPa	=	10.4 $Q^{1/3}$	
Distance (m) to 21 kPa	=	8 $Q^{1/3}$	
Distance (m) to 35 kPa	=	6 $Q^{1/3}$	
Distance (m) to 70 kPa	=	4 $Q^{1/3}$	

As presented previously, numerous values are documented for the TNT equivalency of ammonium nitrate. These are summarised in the table below:

Ammonium Nitrate: TNT Equivalency		
Source	TNT Equivalency	Mechanism of Explosion
SAFEX (Good Practice Guide)	5%	Fire - Molten AN Detonation from "Low Energy" Radiation and/or Confinement
UK Health & Safety Executive (COMAH Safety Report Assessment Guide – Chemical Warehouses)	14%	Not specified
SAFEX (Good Practice Guide)	16%	Detonation due to chemical contamination
WA (Code of Practice)	25%[21]	Not specified
Qld (Explosives Information Bulletin No. 53)	32 %	Not specified
SAFEX (Good Practice Guide)	32%	Detonation from High Velocity Projectiles "High Density Energy"

7.1 Quantity involved in an explosion

The UK Health and Safety Executive is currently in the process of reviewing their methodology for the assessment of ammonium nitrate storage sites for land use planning purposes.[22] Available information indicates that the approach involves starting with a base level frequency for fires and then using event trees to distribute this base frequency to a number of incident scenarios including release of toxic decomposition products and explosions of varying severity. The maximum quantity involved in any explosion incident considered is the entire storage stack (300 tonne limit), together with a much more likely explosion of 10% of the storage stack (30 tonne).

Adoption of this approach was the preferred method originally presented to the NSW Department of Planning & Infrastructure, with three scenarios modelling (entire store, single stack, 105 of single stack). However, this approach was rejected by the NSW Department of Planning & Infrastructure, and based on their advice, the consequences calculations in this Revision 4 of the Hazard Analysis are based on the following:

- Explosion involving the entire store quantity if total storage is less than 2 500 tonne (Shipping Containers).
- For stores holding more than 2 500 tonne (Shed A, Shed B, Shed C), two explosion scenarios have been modelled with each scenario involving 50% of the store inventory.

It is believed that this approach is highly over-conservative and is not consistent with the approach adopted by the UK Health & Safety Executive. As a result, it is believed that the risk contours generated using this assumption represent a significant over-estimation.

Details regarding the allocation of event frequency to each of these scenarios are provided in the ***Section 9 Frequency Analysis – Explosions*** (page 45).

7.2 Consequence analysis results – Explosions

The tables provided in ***Attachment C*** show the calculated distance to various overpressures based on each of the reported TNT equivalencies.

8. CONSEQUENCE ANALYSIS – TOXIC GAS

As ammonium nitrate decomposes it releases oxides of nitrogen, including nitrogen dioxide (NO_2), nitrous oxide (N_2O) and nitric oxide (NO). As the gases are released they will be dispersed and diluted in the atmosphere according to weather conditions at the time. The concentration of the gases in the air will decrease as they move away from the source of release. Each of these gases has various toxicity characteristics, and the effects that an exposed person will experience will depend on the concentration and duration of exposure.

8.1 Toxicity of ammonium nitrate decomposition gases

The United States Environmental Protection Agency has developed Acute Exposure Guideline Levels (AEGLs) to provide guidance in situations where there can be a rare, typically accidental exposure to a particular chemical that can involve the general public.[23] They are based on acute toxicology data and not subchronic or chronic data, and they are designed to protect the general population including the elderly and children, groups that are generally not considered in the development of workplace exposure levels.

AEGLs represent threshold exposure limits for the general public and are applicable to emergency exposure periods ranging from 10 minutes to 8 hours. The three AEGLs have been defined as follows:

AEGL-1 is the airborne concentration (ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience ***notable discomfort, irritation, or certain asymptomatic nonsensory effects***. However, the effects are ***not disabling and are transient and reversible*** upon cessation of exposure.

AEGL-2 is the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience ***irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape***.

AEGL-3 is the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience ***life-threatening health effects or death***.

Nitrogen dioxide is an irritant to the mucous membranes and may cause coughing, difficulty in breathing and shortness of breath. Symptoms may persist for several hours before subsiding. High levels of exposure can cause spasms and swelling of tissues in the throat and upper respiratory tract, reduced oxygenation of body tissues, a build-up of fluid in the lungs, and death. AEGLs have been set as shown in the table below.

AEGLs for Nitrogen Dioxide (NO_2)					
	10 min	30 min	60 min	4 hr	8 hr
AEGL-1 (irritation)	0.5 ppm	0.5 ppm	0.5 ppm	0.5 ppm	0.5 ppm
AEGL-2 (irreversible injury)	20 ppm	15 ppm	12 ppm	8.2 ppm	6.7 ppm
AEGL-3 (life-threatening)	34 ppm	25 ppm	20 ppm	14 ppm	11 ppm

Nitrous oxide is used as an anaesthetic and analgesic in medicine, dentistry and veterinary medicine. Effects of short-term exposure are generally related to the euphoric effect, hence the term "laughing gas". No significant health effects are associated with short-term exposure and no AEGLs have been set for nitrous oxide.

Nitric oxide affects the respiratory system in a similar way to nitrogen dioxide, but is considerably less toxic. AEGLs for nitric oxide have not been set due to insufficient data. Short-term exposures below 80ppm nitric oxide should not constitute a health hazard. It is recommended that AEGLs for nitrogen dioxide should be used for emergency planning.

8.2 Release rate of ammonium nitrate decomposition gases

A release rate of 15 $g/m^2/s$ for NO and 3 $g/m^2/s$ for NO_2 has been used based on the methodology developed by the UK Health & Safety Executive.[24]

The approach adopted by the UK Health & Safety Executive is to model decomposition involving 10% and 100% of the largest storage stack. In this Hazard Analysis, a similar approach has been adopted. In determining the area of ammonium nitrate releasing NO and NO_2, the following assumptions have been made:

- AN Stack: Area of release equals floor area of single stack (length x width of stack)
- Truck: Area of release equals floor area of single trailer (length x width of trailer)

The following table summarises release rates for the incidents modelled.

Release rates of toxic decomposition products				
	Single stack	10% Stack	Truck	10% Truck
Estimated surface area	15m x 15m = 225 m^2	22.5 m^2	3m x 6m = 18m^2	1.8m^2
Release rate of NO_2 (3 g/s per m^2)	675 g /s	67.5 g/s	54 g/s	5.4 g/s
Release rate of NO (15 g/s per m^2)	3375 g/s	337.5 g/s	270 g/s	27.0 g/s

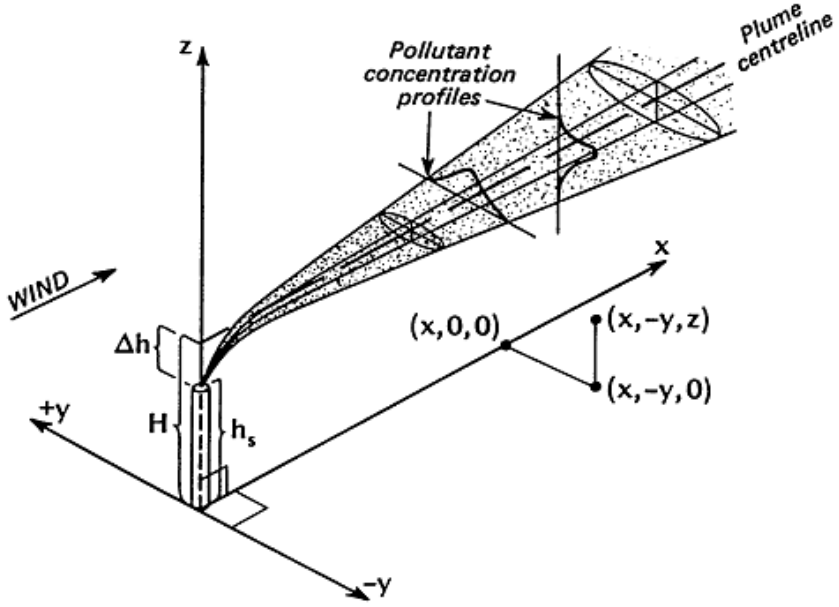
8.3 Dispersion of ammonium nitrate decomposition gases

Once the release rate has been determined, it is then necessary to model the dispersion of this product in the atmosphere.

Following release, the density of the gas relative to the density of the ambient air determines whether it acts like a heavy gas (a gas that is denser than air), neutrally buoyant gas (a gas that is about as dense as air) or a buoyant gas (a gas that is less dense than air).

Releases that are neutrally buoyant or buoyant are modelled using a Gaussian model. In this model, wind and atmospheric turbulence are the dominant forces causing dispersion of the gas, with the wind dispersing the gas downwind and the atmospheric turbulence causing dispersion in the crosswind and vertical direction. Concentrations are modelled according to a Gaussian (or normal) distribution, with the highest concentrations along the centreline, and concentrations reducing in the crosswind direction according to a bell-shaped curved (ie a Gaussian or normal distribution).

For releases at elevated temperature (ie buoyant plumes), the temperature will reduce to ambient as the higher temperature gas mixes with the ambient temperature air. For buoyant plumes, the height of the plume centreline above ground level can be calculated based on the plume temperature at distances downwind from the source.



A release of a heavy gas is affected by forces other than just wind and atmospheric turbulence. A heavy gas cloud first slumps away from the source in all directions, then flows downwind. Dispersion is affected by the wind, gravitational slumping and its forward momentum. As it moves downwind, the cloud mixes with air, becoming less dense until eventually it behaves as a neutrally buoyant gas. Dispersion of heavy gases can result in higher ground level concentrations than predicted by the Gaussian model, and heavy gas modelling techniques should be used.

The decomposition gases of ammonium nitrate all have a molecular weight greater than air.[1] However, the gases are generated due to decomposition at a temperature above ambient, and therefore should be modelled as a buoyant gas. The release also differs from many industrial accident scenarios in that it is not from a pipe or a tank which results in an initially high concentration localised release point, but from a chemical decomposition over the surface of the ammonium nitrate – a more diffuse release source. Due to these release conditions, at no time will the release act as a "heavy gas", even though the molecular weight of the decomposition gases are greater than air.

[1] Nitrogen dioxide (NO_2): Molecular weight = 46; Nitrous oxide (N_2O): Molecular weight = 44; Nitric oxide (NO): Molecular weight = 30; Air (21% O2, 79% N2): Molecular weight (approximate) = 29

Based on the above, Ausplume, a Gaussian plume dispersion model developed by the Victorian Environment Protection Authority has been selected to model the release of ammonium nitrate decomposition gases.

Ausplume is designed to predict ground-level concentrations or dry deposition of pollutants emitted from one or more sources, which may be stacks, area sources, volume sources, or any combination of these. The mathematical basis derives from the Victorian Environment Protection Authority's "Plume Calculation Procedure"[25], which is itself an extension of the ISC model of Bowers et al. (1979)[26].

Ausplume is an approved method for the modelling and assessment of air pollutants in NSW (NSW Office of Environment and Heritage).

The advantage of using Ausplume in this case, is that it allows for the modelling of elevated-temperature, buoyant plumes while taking into account the presence of an inversion layer. Many other dispersion models for accidental releases allow only for the modelling of neutrally-buoyant or heavier-than-air gases, and do not make allowances for the presence of an inversion layer.

In terms of pollutant modelling, Ausplume is the Australian equivalent of the UK ADMS (Atmospheric Dispersion Modelling System) which is used by the UK Health and Safety Executive for the modelling of dispersion of buoyant plumes from fires involving ammonium nitrate.

8.3.1 Weather conditions

When modelling dispersion, a range of weather conditions needs to be considered. The wind speed, the atmospheric stability and the height of an inversion layer affect the rise of a buoyant plume. For buoyant plumes, the highest ground level concentrations often occur at high wind speeds.[27] At these high wind speeds, the wind tends to overcome the buoyancy of the plume, and therefore its vertical rise, resulting in higher ground level concentrations.

Weather data has been obtained for Williamtown Airport (approximately 15km from the site). The weather data is presented as a full year of hourly weather observations (8,760 data points) including:

- Air temperature (degrees Celsius)
- Wind speed (metres / second)
- Wind direction (degrees)
- Pasquil-Gifford stability category
- Mixing height or Inversion layer height (metres)

This weather data can be used directly in Ausplume, without the need for creating discrete weather categories as is traditionally done for dispersion modelling of accidental releases. This provides a more representative model, by considering 8760 realistic combinations of the weather parameters used by the model. An analysis of this hourly data is shown on the following page and provides a summary of the frequency of different types of weather conditions, based on wind direction.

While Ausplume, and other models like it, are traditionally used to determine the long-term impacts of continuous release sources, the outputs can be analysed to determine:

- The frequency per year that endpoint concentrations are exceeded at each grid point. This can be converted to a probability (number of times endpoint concentration exceeded divided by 8760 hourly weather data sets per year).
- The maximum downwind concentration and location for longer duration releases, based on representative weather data.

8.3.2 Release velocity

For warehouse fires, the UK Health and Safety Executive indicates that the flow velocity from small vents in warehouses during a serious fire is likely to be of the order of 10 m/s, with velocities up to 20 m/s possible if the roof collapses.[14] A release velocity of 10m/s has been used for ammonium nitrate stored indoors; a release velocity of 20m/s has been used for ammonium nitrate stored on trucks.

8.3.3 Release temperature

Production of decomposition gases can commence at relatively low temperatures (80-90^{0}C) when ammonium nitrate begins to decompose in an exothermic reaction. The heat generated by this reaction is absorbed by a simultaneous endothermic dissociation into ammonia and nitric acid. The decomposition is self-limiting, and once the external heat source is removed, the temperature of the ammonium nitrate reduces rapidly.

The melting point of ammonium nitrate is 169^{0}C. Beyond this temperature, the exothermic decomposition of ammonium nitrate dominates resulting in increased production of nitrous oxides. It is at these temperatures that significant releases of toxic gases can occur.

Dispersion of buoyant plumes is dependent on the initial release temperature. Very high initial plume temperatures can be generated by well-ventilated fires. However, the release temperature of nitrous oxide gases from decomposition of ammonium nitrate is likely to be much lower due to the temperatures at which the chemical reactions occur.

Based on the approach taken by the UK Health and Safety Executive, a release temperature of 100^{0}C has been used in modelling the dispersion.[24]

Weather Data							
	B3	D3	D6	D12	E3	F2	
	(all Stability Category A & B)	(Stability Category C & D, wind speed <4m/s)	(Stability Category C & D, wind speed 4-10m/s)	(Stability Category C & D, wind speed >10m/s)	(all Stability Category E)	(all Stability Category F)	
Ambient temp (min)	6^{0}C	2^{0}C	3^{0}C	8^{0}C	3^{0}C	2^{0}C	
Ambient temp (max)	34^{0}C	32^{0}C	36^{0}C	33^{0}C	31^{0}C	28^{0}C	
Ambient temp (average)	20.8^{0}C	16.1^{0}C	18.2^{0}C	16.9^{0}C	16.0^{0}C	13.2^{0}C	
Mixing / Inversion height (min)	141 m	141 m	674 m	1793 m	393 m	141 m	
Mixing / Inversion height (max)	2405 m	2542 m	2555 m	3662 m	1658 m	1137 m	
Mixing / Inversion height (average)	968 m	716 m	1481 m	2653 m	846 m	472 m	
Wind speed (min)	0.6 m/s	0.6 m/s	4.2 m/s	10.7 m/s	2.2 m/s	0.6 m/s	
Wind speed (max)	4.7 m/s	3.6 m/s	9.7 m/s	16.4 m/s	4.7 m/s	2.5 m/s	
Wind speed (average)	2.9 m/s	2.7 m/s	6.3 m/s	11.7 m/s	3.6 m/s	1.9 m/s	
N	1.23 %	2.66 %	0.42 %	0.00 %	1.32 %	3.14 %	8.77 %
NE	0.90 %	3.15 %	3.08 %	0.00 %	3.34 %	3.17 %	13.64 %
E	0.42 %	2.08 %	3.89 %	0.01 %	1.04 %	1.08 %	8.52 %
SE	0.57 %	1.29 %	7.53 %	0.17 %	0.89 %	0.55 %	11.00 %
S	0.43 %	1.55 %	7.04 %	0.32 %	0.40 %	0.61 %	10.35 %
SW	0.55 %	2.23 %	3.43 %	0.13 %	0.53 %	0.66 %	7.53 %
W	1.43 %	4.73 %	10.21 %	1.11 %	2.31 %	1.97 %	21.76 %
NW	2.30 %	6.06 %	3.58 %	0.64 %	2.25 %	3.60 %	18.43 %
TOTAL	7.83 %	23.75 %	39.18 %	2.38 %	12.08 %	14.78 %	

8.3.4 Surface roughness

The rougher the ground over which a gas is dispersing the more rapid is the rate of air entrainment and the shorter is the hazard range. A ground roughness value of 0.1 corresponding to elements on the ground about 0.5-1 metre high is recommended for dispersion over agricultural land. A roughness value of 0.3 should be used for dispersion over a suburban area. Although higher roughness values may be assigned to some industrial sites, their use results in a reduced hazard range that could, under certain circumstances, be optimistic.[14] A roughness value of 0.3 has been used.

8.3.5 Averaging time

Due to the variability of atmospheric conditions a dispersing gas plume meanders and the concentration at a fixed point downwind of a release fluctuates. Dispersion models account for this phenomena by introducing an averaging period. The longer this is, the more allowance is made for the variations in wind direction and the smaller is the predicted concentration. There is no consensus on the most appropriate averaging period for dispersion calculations, but widespread support exists for use of 600 seconds for continuous releases and 10 seconds for instantaneous releases.[14] An averaging period of 10 minutes (600 seconds) has been used.

8.4 Consequence analysis results – Toxic gas

The results of this modelling for the decomposition of a single stack of ammonium nitrate (Scenario 4) a single vehicle trailer of ammonium nitrate (Scenario 5) are presented in ***Attachment D***.

9. FREQUENCY ANALYSIS – EXPLOSIONS

9.1 Frequency – Explosion incidents

The SAFEX[16] document presents a series of baseline event frequencies based on historical events for ammonium nitrate explosions at manufacturing sites. Frequencies for ammonium nitrate bags or containers are:

- Contamination: 25×10^{-6} per year
- Fire (with pallets): 50×10^{-6} per year
- Fire (no pallets): 25×10^{-6} per year
- High energy impact: 5×10^{-6} per year

The reference for these frequencies simply states "Derived from historical incident data".

SAFEX have provided further details on the basis of these frequencies:[28]

- Frequencies are based on a selection of causes related to fire, contamination or high energy projectile impact (or some combination of these).
- Frequencies are specifically for ammonium nitrate storage associated with ammonium nitrate manufacturing sites that produce low density prill as a significant proportion of their manufactured product.
- Since 1918 there have been a total of eight (8) accidental explosions involving ammonium nitrate at storage facilities reported from around the world.
- Of these eight (8) accidental explosions, four (4) were caused by deliberately using explosives to break up caked ammonium nitrate, which is not a credible accident scenario for current and future ammonium nitrate storage. These incidents have been excluded.
- The frequencies have been derived from those incidents that have occurred in the last 40 years as it is believed that incidents occurring within this period relate to similar product type and quantity, and similar safety management practices that are in place today.
- The two (2) incidents that remain credible today, and are considered in developing the baseline frequencies are the 2001 Toulouse disaster (chemical reaction), and the 1973 Cherokee explosion (fire event in a highly combustible warehouse).
- The number of ammonium nitrate facilities, and therefore operating years, for the past 40 years was based on industry judgement, and estimated to be 400 sites (correlated with the number of manufacturing sites with associated storage) over each of the last 40 years.

Further enquiries were made to obtain additional clarification on the basis of these frequencies. SAFEX have not provided any further details.

In analysing the information provided by SAFEX (2 incidents in 400 x 40 operating years), a simplistic frequency of explosion of 1.25×10^{-4} per year is obtained. By summing all the frequencies presented by SAFEX, an explosion frequency of 2.25×10^{-4} per year is obtained.

Given that only two incidents have been considered in determining the frequency, it is not apparent on what basis the value was distributed between different storage types and mechanisms of explosion. Nor is it apparent why this total frequency does not add up to the calculated frequency of 1.25×10^{-4} per year.

The VROM *Publication Series on Dangerous Substances (PGS 3): Guidelines for quantitative risk assessment* (December 2005)[29]provides some guidance on the frequency of incidents. In particular, a frequency of 1×10^{-5} per year is specified for a mass detonation of explosives (not ammonium nitrate) in storage. Ammonium nitrate is much less likely to detonate than explosives and so a lower frequency of explosion would be expected for ammonium nitrate.

This expectation is not reflected in the values calculated by SAFEX. This may be due to historical awareness regarding the potential for an explosion of the different products, and therefore the safety practices adopted (ie for explosives, an explosion has always been known to be possible and a relatively high level of control has been implemented to prevent explosions; whereas for ammonium nitrate, this level of awareness has not always been present within all sectors of industry, and historical controls may not have been as stringent as would be implemented today).

This perhaps suggests that the frequencies provided by SAFEX are conservatively high based on historical safety controls (or lack thereof), and may not reflect current approaches to safe storage of ammonium nitrate. Therefore, it is believed that these frequencies represent an overly conservative approach.

The validity of these SAFEX frequencies is also doubtful given the questionable statistical significance of taking two incidents to define eight different event frequencies.

However, following discussions with the NSW Department of Planning and Infrastructure, the adoption of the SAFEX frequencies, modified to account for the proposed safety controls and practices at the site, have been applied in this Hazard Analysis. It is believed that this approach is highly over-conservative. As a result, it is believed that the risk contours generated using this assumption represent a significant over-estimation.

The frequency analysis conducted for each of the scenarios considered is provided in ***Attachment E***.

10. FREQUENCY ANALYSIS – TOXIC GAS

Based on a study into ammonium nitrate storage fires, the UK Health and Safety Executive propose a frequency of 6 x 10^{-4} per year as a cautious best estimate for fires occurring at ammonium nitrate storage facilities.[24]

The explosion frequency initiated by fire for storage of ammonium nitrate bags or containers (with pallets) presented by SAFEX[16] is 5 x 10^{-5} per year. Comparing these two frequencies suggests a probability of explosion following a fire start of approximately 10%.

The value presented by the UK Health and Safety Executive has been used as the incident frequency for decomposition events involving ammonium nitrate in storage (Incident Reference 4). Due to the increased risk of fire associated with vehicles, a factor of 10 has been applied to this frequency for decomposition on vehicles (Incident Reference 5).

TOXIC GAS INCIDENTS: Frequencies			
Incident	Base Frequency (UK-HSE)	Factor	Incident Frequency
(4) Storage	6 x 10^{-4}	100%	6 x 10^{-4}
(5) Truck	6 x 10^{-4}	10 x	6 x 10^{-3}

Based on the results of the consequence modelling, the following conclusions can be made regarding the risk of fatality, injury and irritation due to the sustained release of ammonium nitrate decomposition products:

- There is no risk of fatality due to the sustained release of ammonium nitrate decomposition products. These incidents do not contribute to the individual risk of fatality.
- There is no risk of injury due to the sustained release of ammonium nitrate decomposition products.
- This is a risk of irritation from nitrogen dioxide (NO_2) due to the sustained release of ammonium nitrate decomposition products from incidents in storage (Incident Reference 4A) and on vehicles (Incident Reference 5A).