

# Fume Management Process

From Planning to Firing



## Process summary

- Mine planning
- Preblast activities
- Design, planning and preparation
- Geology
- Product selection
- Documentation
- Loading
- Managing a fume zone
- Pre Firing
- Managing a fume event
- Fume Management Plan requirements



## Mine planning

- Allocates ground for drilling
- Plan to provide ground for blasting
  - Use schedule to reduce potential to produce fume.
  - Recognise soil conditions and effect on confinement.
  - Assess the impact of water in blastholes on fume.
  - Suitability of explosive for soil and water conditions.
  - Ensure that the user needs specification for the explosives includes the conditions in the shot.
  - Avoid the need for deep, wet box cuts.
  - Ensure a free face to allow face movement.



## Preblast activities - Checks and planning

- Accept that fume can breach the exclusion zone.
- Ensure procurement provides suitable products.
- Good logistics to prevent raw material shortages.
- Maintenance, calibration and availability of vehicles.
- Ensure sufficient people resources and support requirements.
- Adequate bench preparation prior to hand-off to D&B.
- Use planning as a tool to handle scheduling pressures and communications.



## Blast planning and preparation

- Define clear blast objectives
  - Safety
  - Hazards, risk assessments and controls
  - Blasting is part of an overall task – does not stand alone
  - End to end controls established
  - Review process to achieve objectives



## Blast design

- Process feedback to blast designer prior to loading
  - Drilling accuracy
  - Variations reporting
  - Recording of ground conditions
- Design to reflect:
  - Weather conditions
  - Ground water
  - Ground conditions
  - Explosives selection
- Preblast review
  - Loaded condition of blast prior to firing
  - Assess for fume generation



## Geology

- Understand impact of geology
  - Burden and spacing
  - Blast timing
- Impact of rock mass strength
  - Not just point rock strength



## Product selection

- Explosive type suitability
  - Dry ground
  - Wet holes
  - Soil water content
  - Rock strength
- Clear definition of wet holes
- Initiation sequence





## Documentation

- Ensures information is available to the blast superintendent or SSE to support the pre firing decision.
- If a fume event occurs there is sufficient information available to enable the investigation to find the variable or variables that contributed to the fume event.



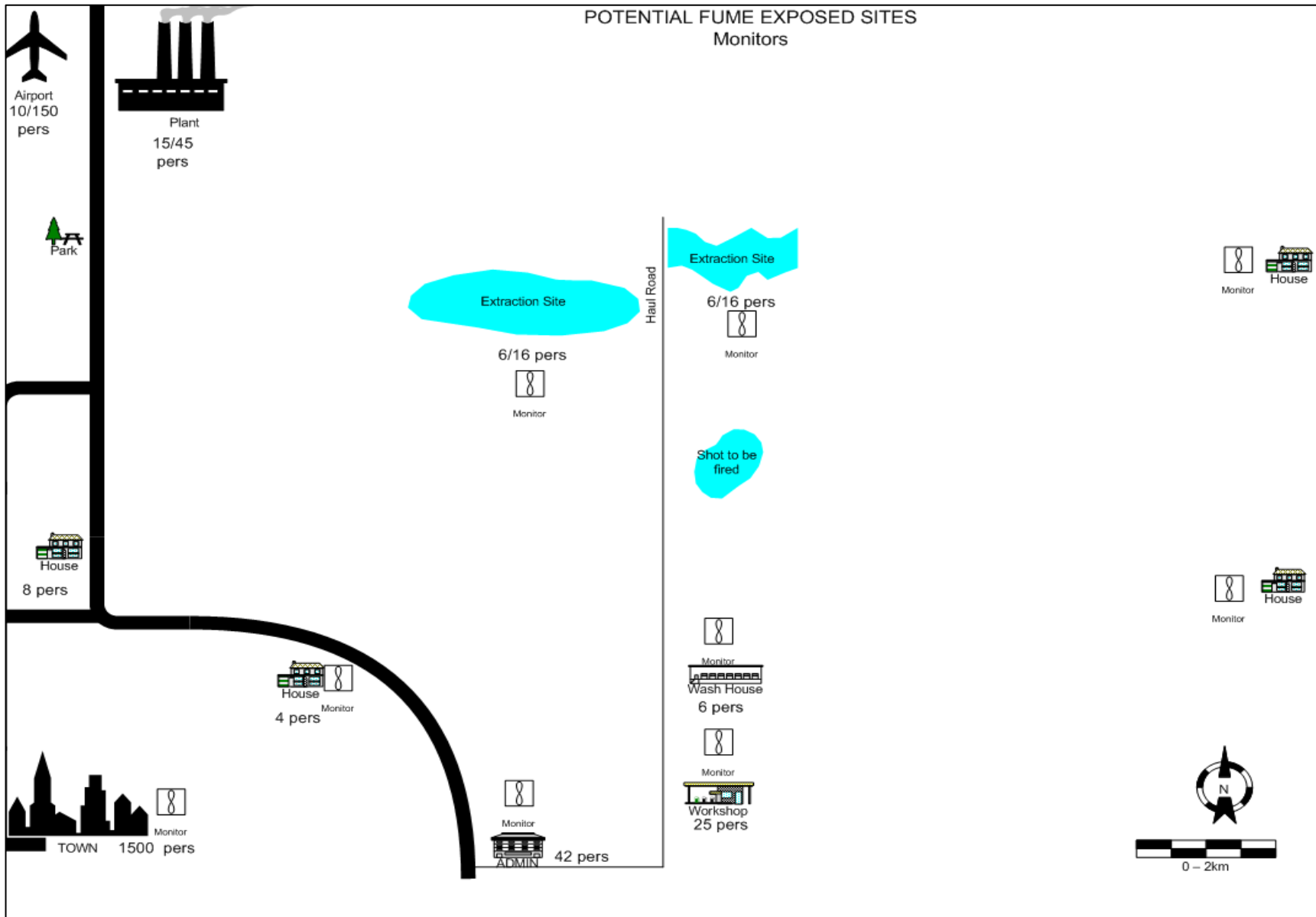
## Documentation details

- TDS and MSDS
- Blast mudmap
- Tonnage calculation
- Blast markout report
- Face hole profiles
- Load sheets
- Tie up plan
- Firing sequence
- Timing contours map
- Explosives quantities
- Delivery dockets
- Issues log
- Blast design
- Vibration
- Air blast printouts
- NOx monitor records
- Prefiring
- Post firing reviews



## Loading

- Effect of variations from design must be included in risk assessment
- Deal with specific issues in an agreed manner;
  - surface or sub surface water
  - incorrectly drilled holes,
  - missing holes,
  - collapsed holes,
  - amount of product loaded,
  - density of product,
  - use of air bags
  - etc





## Pre-firing review

- Determine if there is increased likelihood of fume.
- Review must be thorough
- Identifies;
  - Variation from design
  - Drilling/loading variations
  - Weather conditions
  - Safeguards in place or required
- The Fume Management Plan has to be in place before firing
  - Predicted FMZ, evacuations, radio communications, controller, vehicles etc.
  - Note expect and plan to have some fume at every blast!



## Managing a fume event

- Immediate actions are required, and
- Incident reporting requirements



## Managing an event – Immediate actions

- Remove yourself from danger
  - Fresh air
  - Wash eyes and clear nose/throat
- Medical check
  - Observation for 4-6 hours may be needed.
- Pass gas monitoring information to medical personnel
- Use a standard letter to inform medical staff



## Managing an event – Investigation

- Fume cloud outside blast exclusion zone must be reported to Explosives and Mines Inspectorate
  - Fume rating
  - % of blast area emitting fume
  - Size of NOx cloud
  - Wind
  - Stability class
  - Pre firing review summary
  - Post firing review summary
- Routine blast fume survey requirements





## Managing a fume zone

- Systems must be established
- Potential for exposure needs to be understood
  - Actions can be taken without delay
- Pre-firing review mandatory for all blasts
  - Identified risks and mitigation strategy must have SSE approval.
- Account for fume likelihood on every blast
- Use pre-firing review to deal with all blast hazards
- Assess factors that could produce fume at pre-firing review
  - Refer to appendix G in Guidance Note.



## Fume management plan components

- Meteorological
- Firing time
- Fume exposure map
- Fume modelling
- Fume monitoring



## Meteorological risk

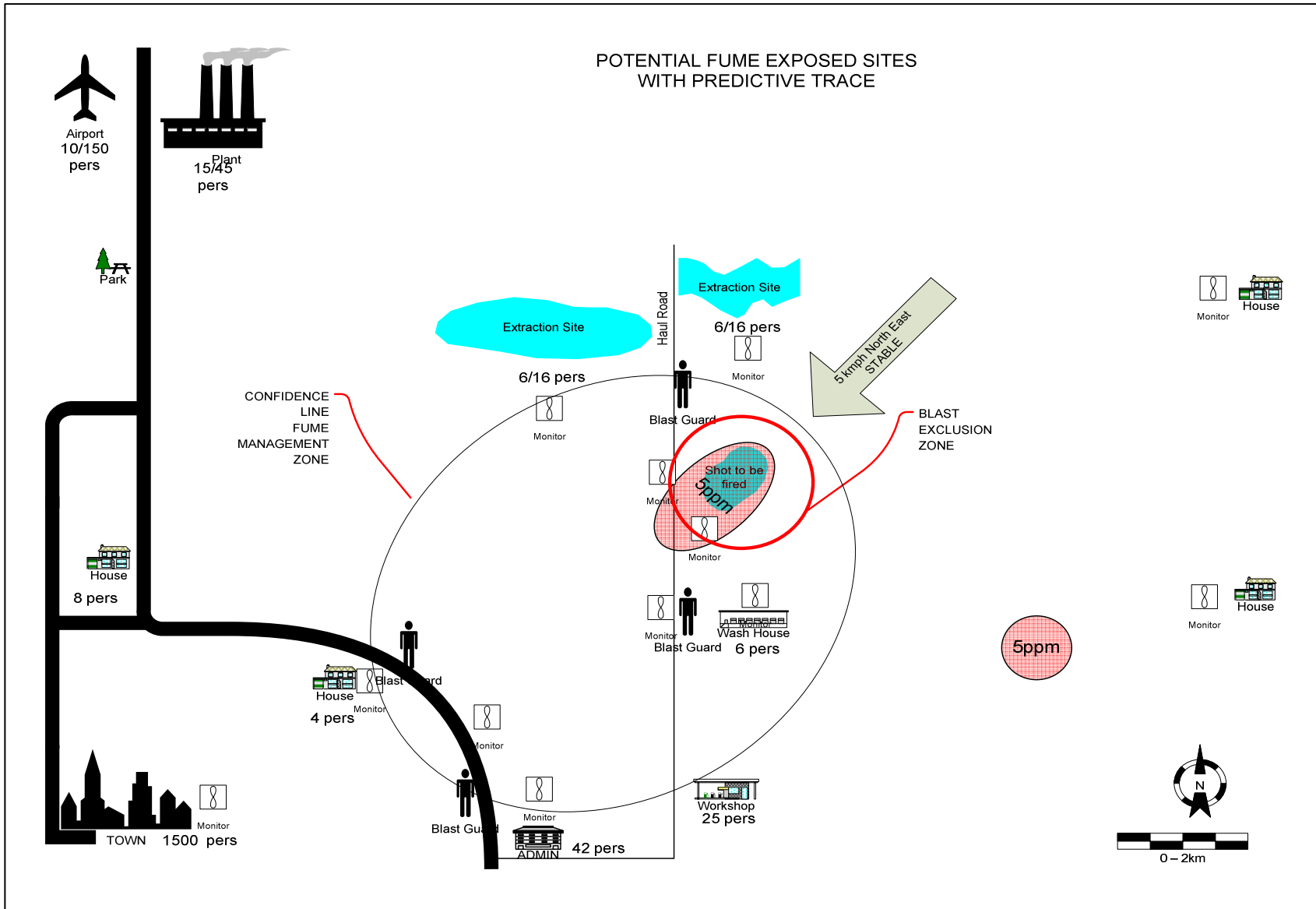
- Meteorological conditions will have a significant impact
- If fume is likely, local weather will affect potential exposure sites.
- Consider;
  - Blasting and exposure sites locations
  - Meteorological conditions
    - Inversion
    - Wind direction/speed
    - Atmospheric stability
    - Cloud cover
    - Time
    - Temperature
    - Humidity



## Firing time

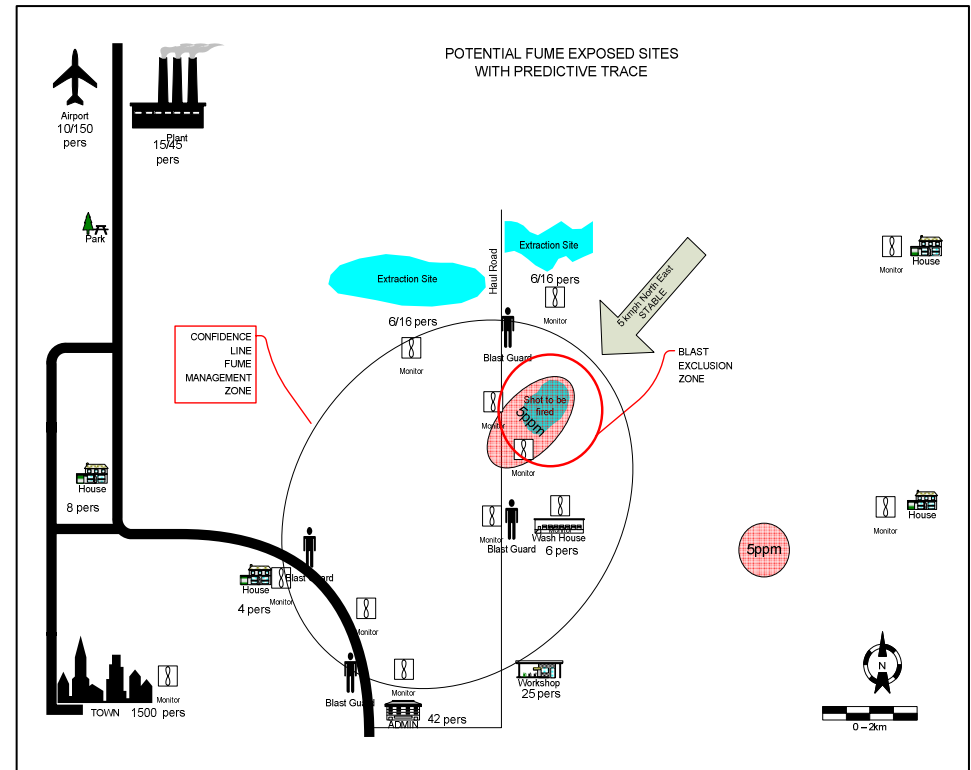
- Atmosphere is stable in early morning and late afternoon
- Wind likely to be light at these times.
- Cloud dissipation can be slow.

### POTENTIAL FUME EXPOSED SITES WITH PREDICTIVE TRACE



## Fume exposure map

- Map needs to be developed & maintained for each site
- Use to identify potential monitoring sites, both permanent and temporary.





## Fume modelling

- Guidance Note Table 4.1 provides estimates of downwind and cross wind exclusion zones based on atmospheric stability.

Note this is an indicative table.

### Example:

No cloud, 32 C, wind NE at 10kmph. Some issues with minor under fuelling on a truck (4%). Expect Category 3



## Fume monitoring

- Monitor before and during an event
  - Establishes background levels
  - Trigger to take action to prevent exposure
  - Increases the amount of information available for investigators.
  - Provides indicative exposure levels to treating medical personnel
  - Exposure records may be a basis for legal claim or defence of claims.
  - Identifies exposure at susceptible sites.





## Monitoring equipment

- Target gases must be specified when purchasing equipment.
- Equipment must remain in calibration
- A warning of gas levels and monitoring over time may be provided.
- Monitor positions must be recorded by GPS
- Multiple gas monitors should record NO<sub>2</sub>, NO and CO



## Monitoring plan

- Must be in place
  - Identify potentially exposed sites under mine control
  - Identify potentially exposed sites not under mine control
- Monitors need to be time-synchronised
- Monitoring measurements should be used to verify modelling.
- A standard method for recording data must be used
- Use the pre-firing review to refine the standard monitoring plan.
- Use of PPE should be considered as a control of last resort.



# Questions and comments

