MW1 C STATION TRAINING AND INCIDENT CASE STUDIES

FILE NO. SR/ 06 .

ROCKDALE PETROL TANKER FIRE

"Learning from Excellence…

To Protect the Irreplaceable."

The overturned tanker burns fiercely against a row of shops with residential units above. Battling fierce radiant heat, firefighters are directing life-saving streams into a unit where persons remain trapped.

ROCKDALE PETROL TANKER FIRE

Incident Video

Special Thanks: The report author is very grateful to Mr Ted H. Schaefer M Chem Tech, ME, BSc for his knowledge, assistance and expertise in preparing technical detail relating to foam firefighting operations contained in this report.

Incident Summary:

Few scenarios could be as bad as the one that confronted firefighters during the early hours of Sunday 25th August 2002 at Rockdale. If this "*worst-case*" scenario was set as an exam question, few people would believe that such a multifaceted situation could ever happen; however, this is precisely the type of situation that confronted firefighters at Rockdale and the type of scenario firefighters must be prepared for every day. As a result of that preparation in 2002 at Rockdale, lives were saved in the most extraordinary of circumstances. The response by firefighters to that fire was as if it had been taken straight from the text book.

In the middle of the night a fully petrol laden tanker crashed and overturned within the Sydney inner-city suburb of Rockdale. The tanker came to rest beside a group of shops with residential apartments above. Within the apartments, 13 persons, including several elderly persons, six children and a baby were asleep. Immediately following the crash large quantities of fuel began to pour from the tanker, forming a large flammable vapour cloud over the crash scene. One resident reported fuel was pouring into the base of his access

stairwell. As a result of the crash, damaged pole-mounted electrical equipment located above the tanker began to arc violently. A short time later the vapour cloud ignited, followed by the outbreak of a major fire involving the tanker, several parked cars, a delivery truck and the building containing the shops and apartments. All persons inside the apartments were trapped and unable to escape. Assisted by members of the public some of the trapped occupants managed to escape through a side window (away from the area of the fire) to the ground and safety. A 68 year old female could not escape and took shelter in her bathroom as the fire continued to grow in size.

First arriving firefighters were confronted with an inner city inferno, involving flames that extended 60 metres into the sky, a thick, black, rolling and spiralling smoke plume that extended to at least 1,000 metres in height, four ground level shops well alight, several second level residential apartments alight, multiple vehicles alight, plate glass shop fronts shattering on the opposite side of the street due to fierce radiant heat, fire burning in the drains beneath the roads, road drain covers exploding, an expanding fire and reports of unknown persons still trapped in the building. It is harder to think of a more difficult scenario, although worse was still to come.

First arriving firefighters resisted the temptation to start fighting the tanker fire. Aware that there could be persons trapped inside the apartments above the inferno, firefighters directed multiple 70 mm hose streams into these apartments in the hope that any persons who remained trapped could be protected. Heat from the inferno was so intense heavy shopfront plate glass windows *behind* firefighters on the opposite side of the street began to shatter. Despite these fiercely punishing and ferocious conditions, firefighters remained in position and continued to direct hose streams into the building being impacted by the tanker fire while later arriving stations prepared to conduct a major foam attack. In a desperate and courageous operation, search and rescue crews gained access to the awning above the blazing tanker by ladder and went along the awning checking second level apartments for trapped occupants. Their progress was only halted by 40-metre-high flames roaring through an opening in the destroyed awning adjacent to the tanker.

Firefighting operations were extremely complex. The intensity of the fire was threatening the structural integrity of the three level brick wall at the rear of the building and there were concerns it could collapse onto 4 track electric railway line. From the front of the building the fully involved tanker was preventing hose streams from reaching the building. In an attempt to control the building fire, aerial appliances were positioned on the adjoining railway overbridge and utilised to attack the fire. Water relays were established to supply the aerials and the fireground.

A major foam attack was conducted in a coordinated, planned and disciplined manner, with multiple 70 mm foam lines attacking the fire. At the height of firefighting operations firefighters operating 70 mm attack lines noticed a hand moving at a window within an apartment above the tanker fire and a short time later a desperate rescue was carried out, saving the life of the woman trapped in her apartment by the fire.

Thousands of litres of burning fuel had entered the drains was travelling underground beneath streets and roads towards the Botany Bay marine environment. Hazmat crews conducted a rapid response and working with multiple agencies were able to contain the escaped fuel, firefighting foam and other contaminant, preventing an ecological disaster from happening.

Drawing from the importance of the lessons shown by the firefighting operations at Rockdale, this report also includes a section containing information relating to foam firefighting operations at flammable liquid fires, specifically petrol tanker fires. These fires are not straight forward, however an understanding of the principles of foam firefighting operations will greatly assist to improve operations at these types of fires.

This incident consisted of many dimensions, had many challenges and contained numerous hazards. When firefighters first arrived on scene, the incident was uncontained and rapidly expanding. The potential for large loss of life and property was significant. The actions of the first responding firefighters were exceptional, placing lines in operation in the face of an expanding inferno, which laid the foundation for the first stage of major incident containment. As the incident progressed, subsequent operations strengthened initial incident containment strategies, enabling a large-scale foam attack to take place that resulted in the tanker fire being extinguished. Firefighters fought the fire with strong determination in the face of horrendous conditions. The tactics and strategies applied by fireground commanders were outstanding, particularly given the very complex, challenging and hazardous nature of the incident. The application of pure and professional firefighting skills resulted in lives being saved and a major catastrophe being averted. There are important lessons to be learned from Rockdale, where the work of firefighters was beyond excellent.

Key Learning Points:

1. Fires Involving Flammable Liquids.

2. Fires Involving Flammable Liquid Road Tankers.

3. Foam Firefighting Operations.

4. Firefighting Operations Near the Rail Corridor.

5. Complex Firegrounds.

6. Complex Search and Rescue.

7. Hazmat Operations.

Incident Type: Petrol Tanker Fire.

Learning/Subject References:

Tanker Fires, Aerial Operations, Incident Command Structure, Water Supply, Fireground Communications, Foam Operations, Rescues.

Station Training Program References:

STP Drill 1 - Flammable Liquids and Gases
STP Drill 2 - Special Fires (Bulk Storage, Dust, Cladding, Plastics, Metal, and Rubber Fires)
STP Drill 3 - Transport: Aircraft, Ships, Trains, Trucks, Special Vehicles (Cars, Motorbikes, Gas, Hydrogen, Electric, DG)
STP Drill 4 - Psychological Preparedness
STP Drill 5 - Physical Preparedness
STP Drill 6 - Personal Safety and Risk Management
STP Drill 7 - Pumps/Pumping Operations
STP Drill 8 - Operational Entry and Use of Hoses and Branches
STP Drill 9 - Hose Handling, Branches and Portable Ladders
STP Drill 10 - Community Fire Safety
STP Drill 13 - Fire Behaviour
STP Drill 14 - Search and Rescue during Firefighting Operations
STP Drill 15 - Salvage and Overhaul
STP Drill 16 - Incident Management
STP Drill 17 - Incident Communications
STP Drill 21 - Basic Life Support
STP Drill 22 - Hazardous Atmospheres – Self Contained Breathing Apparatus
STP Drill 26 - HAZMAT Theory and Practical
STP Drill 27 - HAZMAT Equipment
STP Drill 28 - Hazardous Materials
STP Drill 32 - Electricity and Fire Involving Electrical Hazards
STP Drill 33 - Methods of Construction and Structural Collapse

Relevant Terms/Definitions used in this Report:

Near-side: Passenger or kerb side of the vehicle.
Off-side: Driver's side of the vehicle.

Abbreviations/Acronyms Used in this Report:

BA – Breathing Apparatus.
FIRU – Fire Investigation and Research Unit.
IC – Incident Controller (the same as Incident Commander).
ICP – Incident Command Point.
NSWFB – New South Wales Fire Brigades.
OSC - Operational Safety Coordinator.
SAR – Search and Rescue.
SCBA – Self Contained Breathing Apparatus.
SFF – Senior Firefighter.
SO – Station Officer.
TIC – Thermal Imaging Camera.
RTA – Roads and Traffic Authority.
EPA – Environmental Protection Authority.
SRA – State Rail Authority.

Time, Date and Place of Call:

0135 hours on Sunday 25th August 2002, Railway Street, Rockdale.

FRNSW Response:

Pumpers 29 (Rockdale), 21 (Kogarah), 20 (Hurstville), 28 (Marrickville), 33 (Engadine), 52 (Campsie), 48 (Mortdale), 35 (Botany), 56 (Matraville), 64 (Lakemba), 26 (Mascot), 10 (Redfern) and 14 (Ashfield), Aerial Pumper 45 (Miranda), Hydraulic Platforms 13 (Alexandria) and 21 (Kogarah), Ladder Platform 1 (City of Sydney), Rescue 20 (Hurstville), 9 (Greenacre) Hazmats 1, 2 and 3, 9 CO2 (Greenacre), Incident Control Vehicle 1, Trucks South and South West and Technical Support Vehicle 1.

Operational Commander South 2 Inspector Tom Keelty, Operational Commander South 6 Inspector Kevin Cooper, Zone Commander South 2 Superintendent Michael Guymer, Regional Commander South Chief Superintendent Roger Bucholtz, Manager State Operations Superintendent Glenn Sheedy, Hazmat 1 Inspector John Bedford, Operational Safety Coordinator S.O. Paul Bailey, Fleet Operations Officer S.O. Len Griffiths, FIRU Duty Officer Inspector Ross Brogan, Brigade Chaplain Bob Garven, Community Risk Management Officer South S.O. Ian Boorman and Brigade Operational Photographer Senior Firefighter Kernin Lambert.

Additional Agencies/Services in Attendance:

NSW Police, NSW Ambulance, Electricity authority, State Rail Authority, Mobil (product supplier), Linfox (product carrier), Cleanaway (waste disposal contractor), Sydney Port Authority, EPA, National Parks and Wildlife Service, RTA, Sydney Airport and Rockdale Council.

Fireground Description:

The incident occurred within the busy inner-city Sydney suburb of Rockdale, on a section of roadway known as “The Seven Ways”. This section of road consisted of a series of turns facilitating access on and off a railway over-bridge that spans the main southern Illawarra railway line.

At the point where the incident occurred the road was 20.0 metres wide, consisting of a dual lane carriageway and parking lanes in both directions. Railway Street intersected The Seven Ways 15 metres to the north of the incident site and Frederick Street intersected The Seven Ways 10 metres to the west of the incident site.

A building containing a group of shops, offices and residential apartments was located immediately to the east of The Seven Ways at the location of the incident at 102-120 Railway Street. The building is of irregular shape, 13.0 metres wide (at the southern end), 3.0 metres wide at the northern end and is 110 metres long. This building was formed of brick walls, concrete floors, timber frame and iron sheet roof. The building consisted of two above ground levels and one level below ground level. The building was occupied by retail shops on level one (ground), residential apartments and offices on level two and residential apartments and offices on the basement level. A 2.5 metre wide metal awning was attached to the front of the building and located above the footpath.

N.B., For the purpose of this report, the above building will be referred to as “*the fire building*” for the remainder of this document.

Four residential apartments (Nos. 114, 115, 118 and 119) were located on level two above five ground level shops (Nos 112 – 120) at the southern end of the fire building. Access to Apartments 114 and 115 was via a shared stairwell to ground level and street door entrance, 35 metres from the southern end of the building. Access to Apartments 118 and 119 was via a shared stairwell to ground level and street door entrance, 15 metres from the southern end of the fire building.

N.B., From the front of the fire building on The Seven Ways the building appears to be two levels in height. It is only from the rear of the building (railway line side) that a basement level is visible.

An electrical sub-station was located to the east of the fire building, at the southern end.

An area of parking 25 metres long was located immediately in front of the fire building, at the building’s southern end. At the time of the incident, two motor vehicles were parked and unoccupied at the southern end of this parking lane. A light delivery truck was parked at the northern end of the parking lane.

A four-track overhead electric 1500 Volt DC railway line was located to the east of the fire building. Rockdale railway station was located 110 metres to the north of the incident site.

The railway was in continuous use 24 hours a day, due to the passage of coal and heavy freight trains in both directions.

A retail clothing store, 25 metres x 30 metres, single level, brick construction with a large glass frontage was located on the western side of The Seven Ways, 25 metres to the west of the incident.

A 24-hour petrol station and convenience store was located 35 metres to the north west of the incident.

Immediately to the south of the incident, a bridge (13.0 metres wide) facilitating two dual lane carriageways spanned the railway line. This bridge is part of The Seven Ways.

Involved Petrol Tanker:

The vehicle involved in the collision and fire was a petrol tanker, carrying 36,019 litres of unleaded petrol. Only one person was within the vehicle at the time of the collision, the driver, a male approximately 35 years-of-age.

Fireground Installed Firefighting Systems: Nil.

Weather at Time of Call:

Temperature 9.0°C (apparent 7.7°C), relative humidity 67%, winds north 13 km/h, nil rain, cloud 0/8 and mean sea level pressure 1030.0 hPa recorded at Bureau of Meteorology Sydney International Airport automatic weather station (approximately 5.0 km from the fireground).

Situation Prior to NSWFB Arriving on Scene:

1. The occupants of 102-120 Railway Street, Rockdale.

During the early morning of Sunday 25th August 2002, **thirteen persons were present within the fire building** at 102-120 Railway Street, Rockdale. These persons consisted of:

Apartment 114 – a female person, Mrs Le Vano, 68 years of age, who was awake and reading a book in her front bedroom facing Railway Street.

Apartment 118 - a male person approximately 35 years of age who was asleep.
- a female person approximately 30 years of age who was asleep.
- a child 13 years of age who was asleep.
- a child 14 years of age who was asleep.
- a child 16 years of age who was asleep.
- a toddler 4 years of age who was asleep.

Apartment 119 - a male person, Mr Joe Noredeen, 25 years of age, who was awake and in his study.
- a male person approximately 65 years of age who was asleep.
- a female person approximately 55 years of age who was asleep.
- a child 11 years of age who was asleep (on a mattress in the living room).
- a child 8 years of age who was asleep (on a mattress in the living room).
- a child 5 years of age who was asleep (on a mattress in the living room).

Three of the occupant's nephews and nieces were visiting for the night and sleeping on mattresses on the floor of the living room.

All persons within 102-120 Railway Street were located on the second level of the building above shops.

2. The Collision and Fire.

During the early morning of Sunday 25th August 2002, a petrol tanker had filled with 36,019 litres of unleaded petrol at the Banksmeadow terminal. At about 0130 hours, the fully laden tanker was travelling in an easterly direction along Frederick Street Rockdale, when it entered the intersection with The Seven Ways and began to turn to the right. As the tanker was turning to the right it rolled and overturned (onto its near side).

During the process of rolling and collision, the following occurred:

1. The tanker collided with two parked and stationary motor vehicles, causing significant collision damage to these vehicles.

2. Fuel began rapidly escaping from the tanker onto the road surface, the footpath and into doorway of the stairwell to the residential apartments. Descriptions from witnesses suggest the fuel was escaping from the clamped inspection hatches normally located on top of the tanker. The tanker was now on its side, allowing fuel to escape through these hatches, which could have been damaged, dislodged or loosened as a result of the collision.

3. Part of the tanker struck a timber power pole (located on the footpath of The Seven Ways) supporting overhead electricity lines. Collision impact to the pole caused damage to electrical equipment on the pole that resulted in the power lines arcing. The arcing was described by various persons as being similar to explosions occurring, consisting of extremely bright flashes of light accompanied by sharp loud bangs.

The tanker came to rest on its near-side, located on the roadway adjacent to the northern end of the fire building at 102 -120 Railway Street. Large volumes of fuel were pouring from the tanker onto the road. Some of the fuel was flowing along gutters towards drains on account of the slope of the road. Some fuel was pooling beneath two parked stationary unoccupied motor vehicles, located immediately to the north of the tanker.

The driver was temporarily trapped inside the cabin of the tanker prime mover due to briefly being concussed. The driver was then able to escape from the cabin unassisted to safety.

Almost immediately after the tanker came to rest a number of persons including passers-by, staff at the 24-hour petrol station, the tanker driver and nearby residents telephoned ‘000’ emergency services to report the crash. At the time, conflicting information and confusion by some callers resulted in the ‘000’ calls being diverted to different emergency services (i.e., Police, Fire and Ambulance). Some callers were reporting a truck crash, other callers were reporting leaking fuel and some callers were reporting a crash involving a trapped person.

More fuel continued to pour from the tanker. Within a very short period of time of the tanker coming to rest and the driver escaping, a large flammable vapour cloud from the escaping fuel had begun to form over the crash scene. The damaged electricity equipment was continuing to arc violently. The flammable vapour cloud reached the location of the arcing powerlines. Without warning, the vapour cloud ignited. Witnesses reported “***the petrol tanker erupted into a huge fireball***” when the fire broke out. Almost instantaneously, the tanker became heavily involved in fire.

Almost immediately following the ignition of the fuel vapour the following events occurred either simultaneously or within a short time of each other:

a. Fuel that had pooled on the ground ignited, causing the two stationary parked cars and a parked light delivery truck to become heavily involved in fire.

b. Fuel flowing into the drains ignited, resulting in numerous explosions within the drains occurring (for up to one kilometre from the crash scene) and heavy steel drain lids located on roadways were being lifted into the air.

c. The tanker became heavily involved in fire, producing flame heights of up to 60 metres and a large column of thick, black and acrid smoke.

d. Intense radiant heat caused the front windows of Apartment 119 to shatter, allowing fire to rapidly enter the bedroom of the apartment at this location.

e. Intense radiant heat from fire burning at ground level caused the glass frontage of four ground level shops to fail, allowing fire to enter and start to involve these four shops.

f. Fire was completely blocking the egress paths of all persons located in the apartments above the shops.

3. The Actions of Occupants Within 102-120 Railway Street, Rockdale.

The occupant of Apartment 114, Mrs Le Vano, heard a loud crash from Railway Street. She heard further "*loud bangs and bright flashes*" (due to electrical equipment arcing). She looked out the window and saw a "*huge explosion*" followed by flames that covered the entire front of the building.

Mrs Le Vano went to the door of her apartment to escape. When she opened the apartment door she saw flames at the base of the stairwell and then closed the door and retreated to the bathroom where she took shelter.

The 25-year-old male occupant of Apartment 119, Mr Joe Noredeen, was alerted to the incident by the sound of the collision. Mr Noredeen advised he heard "*a loud skid followed by a thunderous bang.*" He stated the whole building shook "*similar to an earthquake*". A short time later Mr Noredeen's bedroom "*erupted in flames*".

Mr Noredeen ran to his parent's room to wake them up and alert them of the emergency. He then went to Apartment 118 to alert his sister and her family of the emergency. As Mr Noredeen crossed the landing between apartments, he made the following observation at the base of the stairwell:

"*I looked down the stairs and saw an overturned petrol tanker with petrol leaking from the tank half way up. The petrol was gushing into the stairway, with flames in the background.*"

Mr Noredeen opened the door to Apartment 118, where he met his brother-in-law. Mr Noredeen told his brother-in-law to get his wife and four children (4, 13, 14 and 16 years of age) and go into his parent's bedroom (This bedroom was inside Apartment 119 at the southeast corner of the building and at the furthest point from the fire). Mr Noredeen then guided all persons (12 in total) into his parent's bedroom. At this time, all 12 persons were in complete darkness and the apartment was full of thick smoke. Outside the apartment numerous explosions were occurring. With the exception of Mr Noredeen, all persons were highly distressed, hysterical and paralysed by fear. Mr Noredeen made a '000' call to NSWFB Fire Communications to report his situation.

Mr Noredeen located a short fibreglass extension ladder that he kept in the apartment. He opened a window at the southern end of the building and attempted to place the ladder outside the window to street level on The Seven Ways. During this process glass in the window was smashed. At this time, four passers-by (three adult males and one adult female) had been driving along King Edward Street when they saw the tanker crash and ran to the scene to help. Two of the males helped to stabilise the ladder while the family escaped from the level one window to ground level. Two children were dropped from the window and caught by passers-by. The female passer-by carried the two young children under her arms and escorted other members of the family to Princes Highway and safety. The first fire appliance was just crossing the railway bridge, arriving on scene. The female passer-by gave her coat to the children for warmth and used a jumper to wrap the lacerated hand of the

children's mother which was cut on broken glass as she exited the window. Police and Ambulance arrived a short time later.

Throughout the entire period of the 12 occupants making their escape from the building, Mrs Le Vano remained sheltering in her bathroom at the rear of her apartment. Mrs Le Vano placed wet towels on the ground, covering the gap between the floor and the door to keep the heat and smoke out. Her attempts to raise the alarm by telephone did not work due to a telephone outage. At one point, Mrs Le Vano tied sheets together which she hung out the back windows of her apartment, in an attempt to form a makeshift escape rope. She did not continue with this attempt because of her height above ground.

Initial Call and Response:

At 0136 hours, NSWFB Sydney Communications Centre received a number of '000' calls reporting a truck had rolled and was leaking fuel. Pumper 29 was initially assigned to the incident. As reported above, there were conflicting reports as the nature of the incident. At 0137 hours Pumper 21 was additionally assigned to the incident due to reports of leaking fuel. Several callers were reporting the driver was trapped and therefore these '000' calls were diverted to the Police SOO (Senior Operations Officer/Rescue Coordinator). At 0138 hours Pumper 20 and Rescue 20 were assigned to the incident. At 0141 hours 9 Hazmats 1 and 3 were assigned due to reports the fuel spill was coming from a petrol tanker.

Response Increased:

Pumper 29, under the command of S.O. Colin Taylor, was responding north along Bay Street Rockdale, towards the call address. At this time, the crew aboard Pumper 29 believed they were simply responding to a "truck alight".

As the appliance reached The Seven Ways railway overbridge firefighters observed a large column of black smoke. From the railway bridge S.O. Taylor realised the fire was much larger than simply a truck alight and sent a **RED** message at 0143 hours to make Pumps three.

N.B., By this time, all of the occupants of Apartments 118 and 119 and the bystanders who had helped them had crossed the railway overbridge on foot and were making their way towards Princes Highway. The occupant of Apartment 114, Mrs Le Vano, remained trapped, sheltering in her bathroom on the eastern side of her apartment.

First Crews Arrive on Scene:

Pumper 29 crossed The Seven Ways overbridge and continued to follow the curve of the road to the right. As they turned the corner, the involved tanker became visible. S.O. Taylor describes the scene on his arrival:

"*After we turned the corner, I saw what it was; I saw a petrol tanker on its side fully involved in fire. Flames were impinging on the building.* ***The fire was enormous; massive fireballs were erupting 40 metres, 50 metres and 60 metres into the sky above the tanker.*** *It was very spectacular. The building was also burning. The slope of the road was causing burning fuel to flow back down the street. My initial concern was the initial positioning of appliance, ensuring we would be in a safe area and would have a safe egress path.*"

Upon arrival, S.O. Taylor became the Incident Controller and sent the following **RED** message at 0145 hours:

"SYDNEY COMS PUMPER 29 RED! RED! RED! FROM RAILWAY STREET ROCKDALE, WE HAVE A PETROL TANKER THAT HAS ROLLED AND IS WELL ALIGHT. FOUR SHOPS ARE ALSO ALIGHT. MAKE PUMPS 6, OVER."

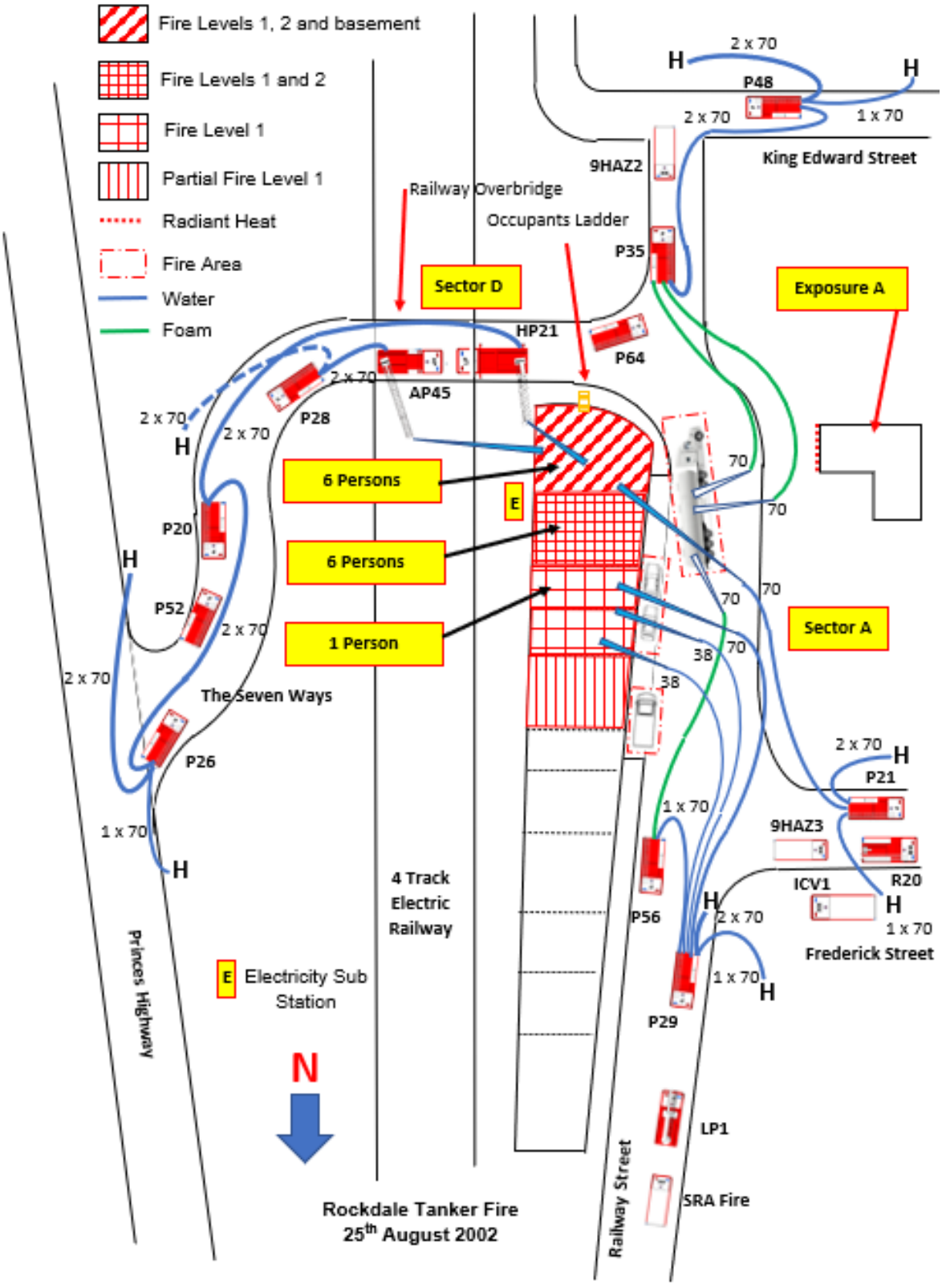
Initial Firefighting Operations:

Pumper 29 was initially positioned in Railway Street, approximately 40 metres to the north of the fully involved tanker. As Pumper 29 was driving into position, the appliance driver Firefighter Nathan Goodsell observed a hydrant marker plate and positioned the appliance nearby. Initial attempts to access the hydrant were unsuccessful due to the hydrant being covered over by recent road surfacing works. Firefighter Goodsell then used a lump hammer to start breaking up the bitumen surface around the hydrant cover, enabling it to be opened and a standpipe shipped. S.O. Taylor commenced to conduct a size-up and made the following observations:

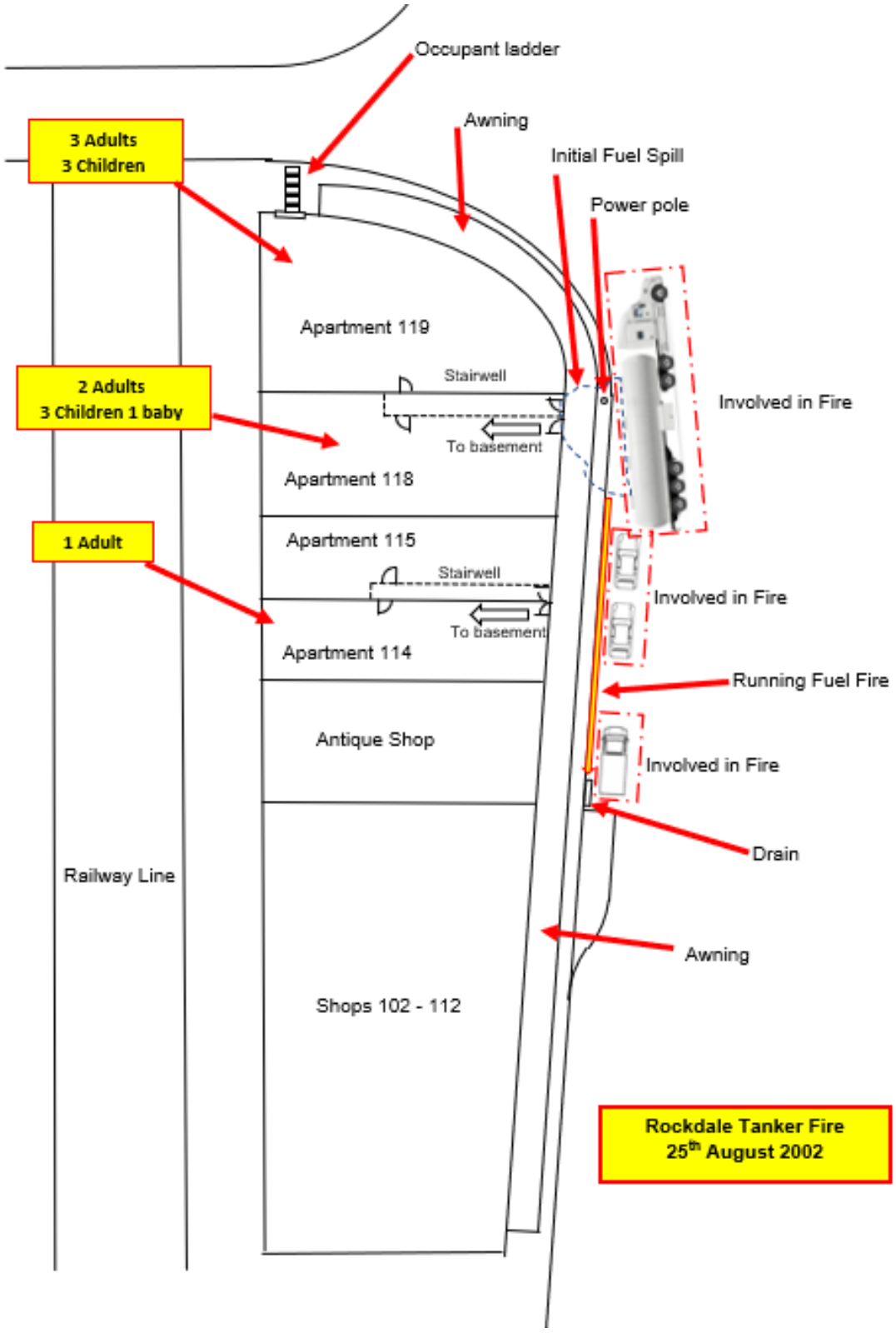
"*As soon as we pulled up my first thoughts were 'where is everyone?' The fire was incredibly fierce. It was burning all the way along the shop front. It was impossible to get anywhere near the fire. Even with full structural PPC and breathing apparatus on,* ***you couldn't get within 20 metres of the tanker****. The heat was that intense*."

Firefighter Goodsell was connecting a 70 mm supply line from the hydrant to the pumper. Firefighters Neil Everitt and Brendan Mooney were placing a 70 mm attack line in operation. While firefighters were getting ready to commence fire attack, S.O. Taylor deployed a 38 mm attack line, which he intended to use for the protection of any persons who might have attempted an escape from windows at the front of the building. Firefighters were using the appliance as a shield from the fierce radiant heat being produced by the fire.

Burning fuel from the tanker was pouring into the drains, causing numerous explosions to occur within the drains. All around firefighters, heavy iron drain covers were lifting off the road surface due to the multiple explosions that were continuously occurring. Although two motor vehicles were totally involved in fire, these were not visible to firefighters because of the size and intensity of flames being produced by the burning tanker. Overhead powerlines were also burning. Large plumes of thick black smoke were venting 40-50 metres into the air from open drain holes on the roadway at Bestic Street Rockdale (700 metres from the tanker) due to explosions from the burning fuel lifting the covers off the drains.



Fireground drawing of Rockdale Tanker Fire – Wide View.



Fireground drawing of Rockdale Tanker Fire – Close View.

S.O. Taylor instructed Firefighters Everitt and Mooney to direct the 70 mm stream directly into the second level windows immediately to the north of the involved tanker. The initial firefighting strategy of S.O. Taylor was to direct the 70 mm stream straight into the fire building, with the intention of reducing the fire intensity to make the building more survivable for any persons who might be trapped inside. During this firefighting operation S.O. Taylor occasionally gave instructions to the fire attack crew to re-position the stream (into the top floor, into the bottom floor, over the tanker etc). S.O. Taylor discusses the initial firefighting plan:

"*Our basic strategy was to try and establish the most effective cut-off as possible. We did not want to waste water putting it onto the tanker. We were trying to put as much water as possible on the boundary between the fire and the non-affected side of the building. This would also provide as much protection as possible for any persons who still might have been inside the building. We knew there were occupied residences above the shops.*"

Pumper 21 under the command of S.O. Kevin Baxter was the second appliance to arrive on scene. Upon arrival, the appliance was positioned on Frederick Street, to the north of the fire. The Incident Controller directed S.O. Baxter to commence protection on exposures that were under immediate threat and in imminent danger. Fire intensity was fierce and the fire was spreading rapidly along the row of shops in a northerly direction (at this time four level one shops were totally involved and fire was starting to enter an antique furniture shop, containing large quantities of polished timber furniture). Pumper 21 was placed in operation and firefighters directed a 70 mm attack line stream into the involved shops on the northern side of the tanker to establish a cut-off point and stop the fire spreading. The front floor to ceiling plate glass window of the antique furniture shop had shattered due to radiant heat and fire was beginning to spread into the shop. The attack stream was able to extinguish this fire, resulting in minimal fire spread into the antique shop (the antique furniture shop remained under threat over the following hours as the fire continued to burn, requiring constant protection from firefighters).

Third arriving Pumper 20 firefighters helped lay 70 mm supply lines to Pumpers 21 and 29, securing water supplies from hydrants. S.O. Baxter noticed steam starting to pour off the surface of a clothes making shop located on the opposite side of the road to the burning tanker. The shop had a number of plate glass windows that were beginning to crack and shatter due to intense radiant heat. Firefighters redirected the 70 mm stream from Pumper 21 onto this shop to protect it from the fierce radiant heat of the tanker fire.

Trains Stopped:

Thick black smoke was blowing across the railway line. The railway line was also in a potential collapse zone, due to heavy fire impact to the rear brick wall of the fire building. A request was sent from NSWFB Fire Communications to the railway control centre to stop all trains running on the tracks near the incident and to isolate the 1500 Volt railway overhead electricity supply. The railway control centre informed Fire Communications trains would be stopped and power isolated as soon as possible.

Worsening Fire Situation:

The fire had reached the size of a conflagration and was burning completely out of control. The tanker, two cars, a small delivery truck and shops on the ground level were totally involved in fire, producing flames that extended 20 to 30 metres into the sky and a large plume of spiralling thick black smoke that extended to over 1,000 metres with a flickering orange glow at its base that could be seen across most of Sydney. Numerous explosions were occurring. Fireballs were erupting from the tanker up to 60 metres into the sky. Beneath the ground explosions continued to occur within the drains. Heavy smoke was pouring out from beneath the awnings along the 110-metre length of the building. The intensity of the fire was so severe that air was being drawn into the fire with intensity. Radiant heat was ferocious and pyrolysis gases (appearing like steam) were pouring off buildings opposite the fire, as large plate glass windows began to shatter. Firefighters were attempting to control a worsening inferno that was rapidly in danger of developing into an urban firestorm.

Initial Search and Rescue Operations:

The Incident Controller had significant concerns that persons may still be trapped in the units above the fire. S.O. Taylor walked to the railway overbridge to view the eastern side of the building to try to identify if there were any people still trapped in their apartments. He could not see any persons inside the apartments. For the first time S.O. Taylor realised that the building was three levels, not two levels high.

S.O. Taylor instructed Officer in Charge of third arriving Pumper 20, S.O. Glen Mole, to put a ladder up to the second level awning at the northern end of the building awning and starting at the northern end of the building, work back as far as possible to the south, attempting to locate any residents who could still be in apartments above the shops. The situation was extremely desperate and the concern for possible persons trapped was immense. In the face of the worsening inferno, the Incident Controller's exact instructions to S.O. Mole were to "*Put a ladder up to the awning, commence search and rescue operations and* ***go as far as you can***."

The fire was burning ferociously and continuing to expand. Firefighter Anthony Williams placed a ladder against the awning and S.O. Glen Mole and Firefighters Steve Shields and Anthony Williams ascended the ladder and started to walk along the awning, going from window to window, banging on windows and calling out loudly to any persons that still might have been inside. They were assisted by Pumper 52 firefighters Mark Carruthers and Geoff Love. Firefighters reported only light smoke within the units and visibility was good, assisting the search. The search crews could not access the awning near the fully involved tanker, due to 20-metre-high flames that were venting through the middle of the awning. Rescue 20 Firefighter Tony Williams stated:

"*We were working our way along the awning, knocking on windows and trying to alert anyone who still might have been inside the units. We got as close as we could until we were stopped by the fire.*"

Firefighters battle ferocious and intense fire conditions, directing large 70 mm hose streams into the apartment building where an occupant remains trapped. These operations stopped the fire spreading and saved the building. More importantly, they saved a life.

During this search firefighters could not locate any persons within the level two units. Immediately following completion of the search, firefighters exited the awning and returned to street level, to assist firefighting operations.

Response Increased:

Firefighters from 29, 21 and 20 Stations were continuing to direct two 70 mm attack streams into the involved building being impacted by the burning tanker. At 0156 hours S.O. Taylor sent a **RED** message requesting the response of two aerial appliances and two foam pumpers. Additional stations were beginning to arrive on scene.

Transfer of Command:

Operational Commander South 2 Inspector Tom Keelty arrived at the incident. Following a handover briefing, command was transferred to Inspector Keelty. At the completion of a size-up, Inspector Keelty sent the following informative message at 0157 hours:

"SYDNEY COMS OPERATIONAL COMMANDER SOUTH RED! FROM RAILWAY STREET ROCKDALE, WE HAVE A PETROL TANKER WELL ALIGHT THAT IS ON ITS SIDE. THE TANKER HAS CRASHED INTO A ROW OF SHOPS AND FOUR SHOPS ARE ALIGHT. WE CURRENTLY HAVE TWO PUMPS AT WORK ATTACKING THE FIRE WITH TWO LINES OF 70 MM HOSE. TWO MORE PUMPS ARE GETTING TO WORK. MAKE PUMPS 10, OVER."

Inspector Keelty advised that the firefighting strategy was to direct water onto the buildings and apply foam to the burning tanker.

Residential Tower Building Evacuated:

Large plumes of thick, black acrid smoke were impacting a nine-level residential tower building 75 metres to the southeast of the tanker fire. Wind direction was from the northwest, pushing the heavy smoke plume directly into the tower building. Residents were initially instructed to shelter in place after closing all doors and windows and switching off air conditioning systems, however numerous persons were contacting '000' reporting smoke entry into their units. After receiving this information, the I.C. issued an instruction for the entire building (containing approximately 300 persons) to be evacuated.

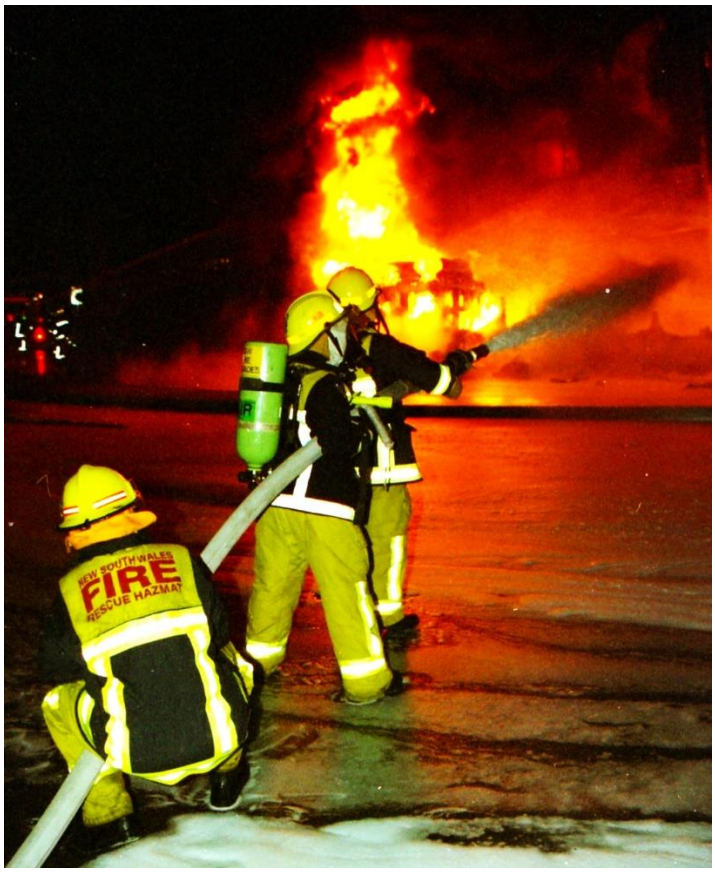
Foam Attack Commences:

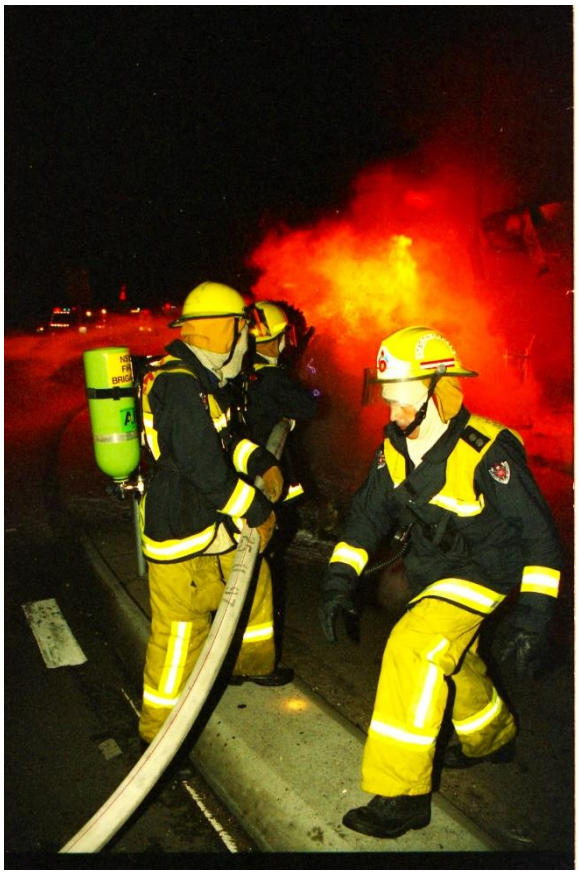
Pumper 35, under the command of S.O. John Miller, was the fourth appliance to arrive on scene and positioned on an un-named access road to the south of the tanker and to the north of King Edward Street. Firefighters began to lay a 70 mm attack line from Pumper 35, with the intention of commencing a foam attack. No hydrants were available on the access road. Pumper 48, under the command of Captain Wayne Challinor was located on King Edward Street. Firefighters located two hydrants on King Edward Street and established a water supply with three 70 mm supply lines to Pumper 48. A water relay was established between Pumper 48 and Pumper 35.

Foam crews attack the fire from 48 (upper) and 35 (lower) stations. The combined “massed” streams of the two foam lines were highly successful, resulting in the fire being extinguished, in conjunction with a third foam line from Pumper 56.

Firefighters battled ferocious conditions to stop the fire spreading, protect exposures and ultimately extinguish the burning tanker.

“Massing” of foam streams onto one point on the surface of the burning flammable liquid achieved placement of a foam blanket and extinguishment.





Foam attack operations Sector A.

Firefighters from 20 and 21 stations protect the second level units with a 70 mm line (top left). Pumper 29 pump operator FF Nathan Goodsell provided attack lines for initial firefighting operations (top right, lower left), Pumper 20 supplied the second 70 mm attack line (lower right).

Firefighters then commenced a foam attack on the tanker fire using one 70 mm attack line, flowing water at 475 litres per minute. Foam concentrate consisted of B Class foam and was proportioned at 6%.

N.B., Pumper 35 was designated as a ***specialist foam pumper*** because it carried an appliance tank containing 200 litres of B Class foam concentrate.

Pumper 35 S.O. Miller describes conditions being encountered by firefighters as they attacked the tanker fire:

"*The heat was intense. Plate glass windows in shops **behind** us were cracking. Steam was coming off the jackets of firefighters. The firefighter's **BA tallies were melting**. The heat was causing the foam stream to evaporate. We had to get close to the tanker to enable any foam to reach the fire.*"

A second 70 mm foam attack line was placed in operation from Pumper 35, being utilised by the crew of Pumper 48. S.O. Miller noted that once the second foam line commenced operation, the foam application was much more effective.

S.O. Miller advised that two eductors and pickup tubes were connected to the 70 mm deliveries of Pumper 35, enabling two 70 mm foam attack lines to be placed in operation simultaneously. The appliance 200 litre tank of foam concentrate was used up very quickly, necessitating the use of foam concentrate within 20 litre drums carried on the foam trailer.

When the bulk supply of foam arrived on the foam trailer, S.O. Miller advised foam firefighting was far more effective.

Initial Hazmat Operations:

9 Hazmat 1 and 9 Hazmat 3 were part of the initial assignment of appliances once it was identified a fuel tanker was involved in the incident. S.O. Trevor Bosher was the Officer-in-Charge of 9 Hazmat 1. After Hazmat arrived at the incident, S.O. Bosher was appointed Hazmat Commander by the I.C. The initial priority of S.O. Bosher was to ensure SCBA was being worn where it was required.

S.O. Bosher realised a significant unseen problem could be developing due to the large quantities of fuel that were entering the drainage system and would need to be dealt with. S.O. Bosher requested the attendance of 9 Hazmat 2 and 9 CO2 to manage hazmat issues at the location of the tanker fire, which would enable 9 Hazmat's 1 and 3 to respond to the escaping fuel situation.

N.B., details of the hazmat response and major operations associated with containment and recovery of the escaping fuel are contained within the section further in this report titled "*Major Hazmat Operations*".

S.O. Bosher advised clouds of petrol vapour were rolling downhill towards firefighters. He organised for 9 Hazmat 2 to establish area atmospheric monitoring at various locations around the fireground deemed to be at risk, to ensure firefighters were not working in areas containing hazardous flammable gas clouds. 9 CO2 was tasked with establishing Main BA Control and assisted site atmospheric monitoring. Hazmat crews also provided bottled water to firefighters to ensure firefighters maintained proper levels of hydration.

Incident Sectorised:

The I.C. formally established incident sectors as follows:

Sector A: Front of the building, including Railway Street, Frederick Street and part of The Seven ways.
Sector C: Rear of the building.
Sector D: Southern side of the building, including the railway overbridge.

Exposure A: Tailor's shop on western side of The Seven Ways opposite the tanker.
Exposure B: Shops to the north of the four shops alight.
Exposure C: The railway line and high voltage railway sub-station.
Exposure D: Residential tower to the southeast of the tanker.

Incident Command Structure:

At this point in the incident, the Incident Command structure was established as follows:

Incident Controller: Operational Commander South 2 Inspector Tom Keelty.
Safety Officer: Operational safety Coordinator S.O. Paul Bailey.
Sector A Commander: Pumper 29 S.O. Colin Taylor.
Sector D Commander: Pumper 28 S.O. Mark McFarlane
Hazmat Commander: S.O. Trevor Bosher.

N.B., At this time the only active sectors at the fireground were A and D.

Protection of Exposure A:

Exposure A was the clothes tailor located on the opposite side of The Seven Ways, 25 metres to the west of tanker. Fierce radiant heat had caused the shop front plate glass windows to crack and shatter, allowing internal contents to be directly exposed to heat from the tanker fire and ignite. As well as directing 70 mm lines onto the fire building at 102-120 Railway Street, firefighters also directed 70 mm cooling streams onto the tailor's shop which was heavily pyrolysing. Pumper 35 firefighters entered the tailor's shop and used a thermal imaging camera to locate smouldering piles of material which they turned over and extinguished.

Firefighting Operations from Sector C:

Attempts to control the building fire from Sector A were being hampered by the burning tanker, which was preventing firefighting streams from reaching the building. The next area to attack the fire from was Sector C, however a number of issues complicated this plan:

1. The three level Sector C brick wall was considered unstable and in danger of possible collapse. A collapse zone was established that prevented firefighters from operating in the open area to the east of the building.

2. Beyond the collapse zone the railway line (including overhead 1500 Volt DC power supply) was present, also preventing firefighting operations from taking place.

The only place available to firefighters to attack the rear of the building fire from was the railway overpass bridge.

Pumper 28, under the command of S.O. Mark McFarlane was directed to commence operations to attack the building fire from The Seven Ways railway bridge. This area of the fireground was designated Sector D and S.O. McFarlane was appointed the Sector D Commander. The objective of S.O. McFarlane was to try and protect the building as best as possible from the heat and fire being produced by the tanker.

Pumper 28 was positioned on the railway overbridge. Firefighters obtained water supplies from hydrants located on the side of The Seven Ways on the eastern side of the railway line. Flames were venting through the roof of the building and from the side of the building. In an attempt to get the largest volumes of water possible onto the fire, firefighters initially deployed a monitor supplied with two 70 mm lines. The monitor stream was directed over the top of the building in an effort to establish a protective cooling deluge.

Foam Attack Increased:

Pumper 56, under the command of S.O. Steve Welch, was the second foam pumper to arrive at the fireground. The I.C. directed S.O. Welch to utilise Pumper 56 to commence a foam attack on the tanker fire. Pumper 56 positioned on Railway Street to the north of the involved tanker. Pumper 29 provided a 70 mm supply line to Pumper 56, enabling firefighters to commence a B Class foam attack with a 70 mm attack line from Pumper 56. The foam was proportioned at 3% and the branch operated *without* a foam aeration tube fitted.

S.O. Miller noted the following advantages of *not* using the foam aeration tube:

1. The projected foam stream was much longer, allowing firefighters to stand at a greater distance from the tanker, lessening the impact from radiant heat.

2. A large quantity of finished foam solution was reaching the surface of the burning fuel, rather than being drawn into the fire up-draft.

N.B., The above will be discussed in much greater detail in separate section at the end of this report titled “*Foam Firefighting Operations at Tanker Fires Involving Flammable Liquids*”.

Aerial Pumper 45 attacks the fire from the railway overbridge (upper).
Hydraulic Platform 21 and Aerial Pumper 45 attack the fire (lower).

Firefighters use 70 mm handlines to attack the building fire from the railway overbridge (top). These lines were shut down and water supplied to Aerial Pumper 45 (lower).

Firefighters attack the building fire from Sector C (top left). Fire attack crews in Sector A operate a 70 mm line (top right). Following extinguishment of the tanker fire a secondary search gets underway from the awning of the units above the involved shops (lower).

Aerial Appliance Placed in Operation:

Despite the best efforts of hose crews, firefighting streams were experiencing difficulty reaching all areas of fire burning within the building at 102-120 Railway Street, largely due to access issues. The building fire was continuing to burn with significant intensity. The Incident Controller directed Hydraulic Platform 21 to position on The Seven Ways at the southern end of the building and attempt to attack the fire through shop and apartment windows on the eastern side of the building (Sector C). Pumper 20 relay pumped to Hydraulic Platform 21, however initially water pressure was poor. Water service operators from Sydney Water were able to identify a large main on the Princes Highway that could be used to supply the aerial appliance. A water relay was established from the Princes Highway main, with Pumper 26 positioned as the base pumper. Hydraulic Platform 21 operators Firefighters Tony Roache and Max Wilson reported fire was burning through the roof of the building and directed the aerial stream onto the fire through the breached roof. Once Hydraulic Platform 21 commenced operations, the ground monitor located on the overbridge was shut down and replaced with two 70 mm handlines. Firefighters were directing the 70 mm streams through windows at the rear of the building into the burning shops and apartments.

Incident Command Point:

Incident Control Vehicle 1, under the command of S.O. Eddie Mendis and operated by SFF Andrew McCready responded to the incident and was positioned in Frederick Street, approximately 50 metres to the west of the tanker fire. The ICV became a focal point for the multi-agency response to the incident. Representatives of numerous agencies and services attended the ICV. The central point of contact for all agencies ensured a coordinated response to the incident was able to be established and maintained. The ICV was also a key coordination point for the two incidents that were running concurrently resulting from the one event; fire and rescue operations at Rockdale and the consequential hazmat operation at Muddy Creek, Kyeemagh due to the escaped fuel. The ICV was able to coordinate communications for Hazmat crews who were operating on a separate GRN talk-group (1102) to avoid congesting radio traffic at the Rockdale fireground.

Radio communications were conducted on Fireground Channel 505. No command channel was used. A significant amount of radio congestion occurred at the incident due to the heavy use of the radios.

Further Transfer of Command:

At 0240 hours Zone Commander South 2 Superintendent Michael Guymer arrived at the fireground. Following a handover briefing with Inspector Keelty, Incident Control was transferred to Superintendent Guymer and Inspector Keelty appointed Operations Officer. Following change of command and further size-up, Superintendent Guymer was satisfied to continue to operate with the firefighting strategies already in place, which he described as "*extremely sound*". Chief Superintendent Roger Bucholtz attended the scene, however elected not to take command. Manager State Operations Superintendent Glenn Sheedy attended the incident and in his capacity as State Duty Officer, provided updates to the Commissioner and Minister's office.

Establishment of Divisions:

Due to the geographical size of the incident, the IC made the decision to establish two Divisions:

1. Division 1 consisting of operations occurring in proximity to Frederick Street (the tanker fire).

2. Division 2, consisting of operations largely being undertaken by Hazmat within the drainage system and watercourses remote from the tanker near Bestic Street, Rockdale.

Major Firefighting Operations:

At this time there were three 70 mm foam lines from Pumpers 35 and 56 being directed by firefighters onto the burning tanker. Two 70 mm and two 38 mm attack line streams (water) were being directed onto the fire burning involving four shops and four apartments above adjacent to the involved tanker. From the railway overbridge firefighters were attacking the fire with two 70 mm handlines. Hydraulic Platform 21 was also attacking the fire from the C/D corner of the building. This was an extremely disciplined and precise attack; firefighters operating attack lines (with water only) ensured these streams were not directed onto the tanker where the foam attack was taking place.

Tanker Fire Extinguished:

The three massed 70 mm foam streams resulted in a foam blanket beginning to form over the surface of the burning fuel within the tanker, slowly reducing fire intensity. As foam continued to be applied, the foam cover increased in size and thickness, until the surface area of all the burning fuel was completely covered. The success of the foam attack was due to the foam streams being concentrated at a single point of application on the surface of the burning fuel, increasing the strength and effectiveness of the foam application. After the surface of the burning fuel had been completed covered by foam, only small pockets of fire continued to breakout, mainly due to intense heat from hot metal components of the tanker causing areas of the foam cover to breakdown, allowing surface fuel to re-ignite at limited places. Firefighters continuously reapplied foam to the surface of the fuel, ensuring the foam blanket remained intact and any reignitions quickly extinguished.

Operations to Increase the Safety of the Scene:

Technical Support Vehicle 1 (TSV-1), Operated by S.O. Tim Fox and SFF Greg Watson responded to the incident. A large component of the TSV-1 inventory was designed for situations of structural collapse. This equipment greatly increased the safety of operations at the Rockdale fireground. Firefighters used the shadowless helium filled balloon lights to provide scene lighting, greatly improving scene visibility, particularly after extinguishment of the tanker fire had been achieved.

Structural Stability of Building:

The impact of intense heat and fire involvement of the building at 102-120 Railway Street alerted the IC to be concerned about the structural stability of the three level Sector C brick wall. TSV-1 carried equipment that could assist identification of structural instability of a building, including a laser surveying instrument to detect structural movement. Following confirmation from the Rail authority that it was safe to enter the rail corridor, rescue crews worked on the railway tracks to deploy this equipment. The survey instruments deemed the integrity of the structure was intact. This was later confirmed by structural engineers.

Further Search and Rescue of Apartments:

The I.C. appointed S.O. Paul Bailey Search and Rescue Commander for the building at 102-120 Railway Street. The I.C. instructed S.O. Bailey that as soon as fire intensity had reduced sufficiently, search and rescue crews needed to enter the building and conduct a search of the apartments above the shops adjacent to the tanker.

Following extinguishment of the tanker fire, a number of search and rescue crews entered the building to commence search operations. SCBA crews from 20, 26, 28, 33, 52 and 64 Stations placed ladders to the awnings which were used to gain entry into the level two apartments. Pumper 52 S.O. Greg Robertson advised firefighters working from the awning experienced difficulty due to extreme heat damaged caused by the fire. The section of awning near the tanker had twisted and started to melt, preventing access.

Occupant Rescued:

The Pumper 29 fire attack crew, consisting of Firefighters Neil Everitt and Brendan Mooney, assisted by Firefighter Jeff McPherson were continuing to direct the 70 mm stream into the involved building. Shortly after search and rescue operations had commenced, SFF Everitt looked up and saw the blinds move within a level two apartment and hand movement near the blinds. He then saw the face of a female appear at the window. Firefighter Jeff McPherson went to notify the search commander that a person had been seen inside the building. Firefighters began to remove a ladder from Pumper 56 to place against the awning. With no time to spare, the search commander S.O. Paul Bailey reacted out of instinct and noticed ground level stairs leading to the apartment the occupant had been sighted in. He made entry through the ground level doorway and went to the second level where he found Mrs Le Vano. S.O. Bailey then escorted her from the building and to the Ambulance treatment area approximately 100 metres to the north of the fire. She was transported to hospital having sustained minor smoke inhalation. Following release from hospital she made a full recovery.

The rescue of Mrs Le vano from te aprtment above the tanker fire (top left). Rear view of fire building. Arrows (A) indiacte sheets tied together by Mrs Le Vano in an attempt to escape (top right). Rom the front of the building, Mrs Le Vano's apartment (B) was above several fully involved shops. This apartment ws protected by 70 mm streams, saving Mrs Le vano's life (bottom right).

Heavy Rescue pod provided significant incident support that greatly improved incident and firefighter safety (top left). The Incident Control Vehicle was a vital platform that provided critical incident support, including planning, logistics and coordination of the multi-agency response to the incident (top right). Safety Officers confers with sector commanders (lower left) and Hazmat crews examine maps to identify the likely run-off path of thousands of litres of fuel that has entered the drains (lower right).

Ambulance Operations:

Ambulance Service NSW provided a significant response to the incident, under the control of Superintendent Jeff Woods (Operations Manager South East) and assisted by Inspector Wayne Casey (Deputy Operations Manager South East). Six ambulances including three intensive care units and one Ambulance (23-seater Toyota Coaster) bus attended the scene. Five persons were transported to hospital by Ambulance for a number of injuries including smoke inhalation and lacerations. As always, Ambulance provided an enormously invaluable contribution to the safety of community members and firefighters at this very dangerous incident.

Fire Brought Under Control:

Although the tanker fire had been extinguished, fire was burning in four shops on level one, three apartments on level two (numbers 155, 118 and 119) and one apartment within the basement level. From Sector A firefighters were attacking the fire with two 70 mm and two 38 mm hose lines. From Sector D, firefighters were attacking the fire with two 70 mm hose lines and Hydraulic Platform 21.

Although Hydraulic Platform 21 was providing an effective attack on fire burning through the roof of the second level of the building, the hydraulic platform operators were experiencing difficulty directing the elevated aerial stream into the middle and lower levels of the involved building. At the direction of the Incident Controller, Aerial Pumper 45 was positioned on the overbridge and the boom lowered to enable the aerial stream to attack fire burning inside the building within the lower levels that could not be reached by the hydraulic platform. Within a very short time following commencement of the operation of Aerial Pumper 45 these fires were extinguished. By 0400 hours, all significant fire had been extinguished, with only areas of smouldering fire remaining in the building.

Following control being established of significant fire activity within the building, SCBA crews using 38 mm lines entered the structure to complete final extinguishment. These operations were assisted by thermal imaging cameras, enabling hot spots and areas of hidden fire to be identified.

Major Hazmat Operation:

Concurrent with the firefighting operation was a major hazardous material operation. A large quantity of the 36,019 litres of unleaded petrol being transported on board the tanker had spilled onto the roadway and into the drains. The drainage system in the area was connected to local water courses and ultimately flowed into Botany Bay. During the initial phase of the incident, 9 Hazmat 1 and 9 Hazmat 3 had been assigned to the call.

S.O. Trevor Bosher was the Officer-in-Charge of initial responding hazmat unit 9 Hazmat 1. Upon arriving at the incident, the I.C. appointed S.O. Bosher the role of Hazmat Commander. The I.C. informed S.O. Bosher a large amount of fuel had spilled from the

tanker and entered the drains. The initial priority of S.O. Bosher was to identify where the spilled fuel had gone. Initially hazmat crews began searching the drainage system to locate the drain in which the escaping fuel had entered. After examining a number of drains, firefighters located a drain containing fuel and foam flowing through it. The next objective of hazmat crews was to work out where the fuel was going. By using a street directory, Hazmat crews were then able to determine the likely travel direction of the drain. Maps indicated the drain containing the petrol was probably heading towards a canal that then entered Muddy Creek, before entering Cooks River and a short distance later Botany Bay.

Hazmat crews identified a cut-off point the fuel had not reached and set up a containment perimeter. Hazmat crews placed booms in the canal before the entrance to the creek, with the intention of establishing containment and stopping fuel entering the creek. After placing booms, firefighters observed the fuel exiting the drain-pipe and enter the canal, before being caught at the booms. Importantly, the booms were in the canal *before* the fuel arrived, ensuring all of the spilled fuel was captured. S.O. Bosher advised there were a number of challenges for hazmat crews establishing a containment point:

"*The fuel was initially flowing under the streets. It entered a canal and was flowing over rocks in cages before entering deeper water.*"

Hazmat 1, Inspector John Bedford (now Division 2 Commander) attended the location of operations to contain the spill at Muddy Creek. S.O. Bosher was appointed Operations Officer. The fuel recovery became a significant multi-agency operation, involving representatives from EPA, local council, EPA, Sydney Ports, National Parks and Wildlife Services, fuel owner and recovery contractors. Inspector Bedford liaised with representatives of all agencies and services present and reported the level of cooperation amongst all services was extremely high.

Beyond the initial line of booms, further booms were placed along the creek within deeper water near the intersection of Cooks River strengthening containment. Hazmat firefighters then placed inflatable booms and hydrocarbon absorbent booms across the creek. Approximately 100 metres downstream of the hazmat booms, Sydney Ports laid a larger floating boom across the creek. Approximately 40 metres of NSWFB hazmat booms were laid, resulting in unleaded fuel, oil and firefighting foam being captured before it could enter the watercourse. S.O. Bosher advised that the ability of hazmat to have the booms in place *before* the escaped fuel reached the containment point was critical.

Hazmat crews liaised EPA who organised hazardous waste removal contractors to attend the scene with pumping and recovery equipment to remove the fuel. The owner of the fuel also provided a fuel spill recovery team to assist operations. An important factor during recovery operations was the effect of the tide, which caused water levels to rise and fuel, necessitating hazmat crews continuously monitoring and moving the booms as necessary. At one point a rain storm occurred upstream, causing a surge in water in the spill recovery area.

Contractors used a skimmer to remove fuel and contaminated water from the creek and pump it to a road tanker. Throughout this process 20,000 litres of liquid was recovered from the creek containing 8 – 10,000 litres of unleaded fuel.

Changeover of Firefighting Crews:

The first wave of relief crews arrived on scene at Frederick Street Rockdale at approximately 0500 hours, releasing stations that had been in attendance since the commencement of the incident. By 0600 hours all firefighters that had been part of the initial response to the incident had been released from the fireground.

Tanker Recovery:

As the morning progressed contractors using cranes and heavy vehicle salvage equipment arrived at the scene and conducted operations to remove the tanker. During these operations firefighters provided fire protection with charged foam lines. Salvage and recovery crews also removed the two burnt cars and light truck from the scene.

Completion of NSWFB Operations:

Throughout the course of the day firefighters continued to inspect the building for any areas of hidden fire. By 1427 hours the I.C. was satisfied all fire had been completely extinguished and the site was handed over to NSW Police. A short time later, the final NSWFB resource (Pumper 29) departed the scene.

Fire Damage Summary:

Fire damage as a result of the subject fire included the following;

1. Fuel tanker and load totally destroyed by fire.

2. Two parked stationary cars and one parked light delivery truck totally destroyed by fire.

3. Four ground level shops severely damaged by fire.

4. Three level two apartments and one basement level apartment severely damaged by fire.

5. Heat, smoke and water damage to several level one shops and four apartments.

6. Partial fire damage to two shops (clothes tailor and antique furniture shop).

These views show how close the tanker came to the building at 102-120 Railway Street. The initial firefighting strategy was to try and protect the building until a foam attack could be commenced. This strategy saved the building and protected a trapped person inside the building.

The entrance doors to units above the shops were completely impassable due to the fire, indicated by arrows. Heavy firefighting streams by initial arriving crews increased the survivability of the apartments above the entrance doors.

Severe fire damage occurred to four shops adjacent to the tanker (top and middle). Firefighters halted lateral fire progression at the antique furniture shop. A delivery truck at the front of the shop was destroyed (lower right) however firefighters saved all contents within the shop (lower left).

Severe fire damage to the tanker. The aluminium tanker shell “melted down” as the fire burnt lower. The remnants of the tanker shell (shown by arrows) are indicative of the levels of flammable liquid at the time of extinguishment. When attacking a flammable liquid fire, the objective of firefighters is to get foam onto the surface of the flammable liquid.

Incident Outcomes

The following incident outcomes were achieved:

1. All lives were protected. Trapped persons were rescued and no lives were lost.

2. Fire was contained – Fire did not spread after firefighters arrived on scene.

3. The fire was fully extinguished.

4. Despite the ferocious impact from the tanker inferno, the fire building was able to be saved and eventually rebuilt.

5. Numerous exposures directly under threat were protected and saved.

6. Numerous critical infrastructure and services were protected.

7. Hazardous run off was contained and removed and the local ecosystem protected.

Fire Behaviour Considerations

The following fire behaviour considerations are of note:

1. Immediately following the collision a large quantity of flammable liquid began to spill from the overturned tanker and pool on the ground (it is most likely this spill came from equipment located on the top of the tanker). Flammable vapours were released from the spilled fuel, resulting in the formation of a flammable gas cloud (the expansion rate of unleaded petroleum to vapour is approximately 800). At the time, low wind speeds of 13 km/h were recorded, allowing the cloud to build up (as opposed to being dispersed by winds of higher strength). **Petroleum will commence to release flammable vapours at temperatures as low as - 43 °C**.

N.B., There were six manhole covers located on the top of the tanker (each 320 mm in diameter) above each fuel compartment. Attached to the manhole covers were inspection hatches/emergency vents, dip adaptors, fill adaptors and vapour transfer vents. It is possible fuel may have leaked from this equipment if it was damaged or dislodged in the crash.

2. Fuel continued to flow from the tanker and spread, causing the fuel spill area to increase in size, resulting in the formation of a larger flammable gas cloud. Two parked cars, a light delivery truck, the overture tanker and the western side of the building at the southern end were within the flammable vapour cloud.

3. As the vapour cloud expanded, it began to mix with air, causing an increased volume of the cloud to be within the flammable range for petroleum (**the flammability range for petroleum is of 1.3% – 7.1%**).

4. As the result of the crash, pole mounted electrical equipment was arcing violently above the overturned tanker and spilling fuel. It is highly likely this was the ignition source of the continually expanding petrol vapour cloud.

5. Immediately following ignition of the vapour cloud, flammable vapour associated with the spilled surface fuel ignited, producing intense fire conditions.

6. Two motor vehicles, a light delivery truck and the tanker were located above the spilled fuel when it ignited and were immediately subject to the above fire conditions, resulting in these vehicles rapidly becoming involved in fire. Within a short time these vehicles became totally involved in fire.

7. Intense radiant heat from the surface fuel fire attacked the single skin (5 mm thick) aluminium shell of the tanker barrel (the tanker barrel was divided into six 7,000 litre compartments). The weakest part of the tanker was the ullage space near the top of the tank (on this occasion the off-side of the tank due to the tanker being overturned and laying on its side) where the aluminium was not being cooled by the liquid contents of the tanker (the unprotected aluminium tank shell will begin to melt at around 660°C). Within a short time the section of tank shell above the liquid line began to melt down to the level of the burning liquid. The tanker barrel became exposed above all six compartments, releasing flammable vapours from the petroleum contents, which then ignited, resulting in a fire involving the 36,000 litre fuel load of the tanker.

8. Following ignition of the tanker contents, **only the surface of the fuel was involved in fire. The fire burnt downwards at a rate of approximately 30 cm per hour.**

N.B., As the surface of the flammable liquid continues to burn downwards and the sides of tanker shell progressively melt, the width of the surface area of the burning area will continue to broaden, resulting in an increased area of fire.

9. Properties of the fire associated with the burning petroleum within the tanker included:

a. **The flame temperature of petroleum is approximately 1,026°C**.
b. **The radiant heat produced from the burning petroleum was approximately 44 MJ/kg.**
c. **The average heat flux density for burning petroleum is approximately 3.5 kW/m^2.**
d. **The average heat release rate for burning petroleum is approximately1670 kWm^2.**

10. The burning fuel produced large volumes of thick and black hydrocarbon-rich smoke. The smoke column contained significant thermal energy, creating buoyancy that caused the column to extend to at least 1,000 metres. As the hydrocarbon enriched smoke was drafted into the superheated convective column and mixed with air it ignited, creating the

appearance of “fire balls”. Large flames vented from the burning fuel. A combination of flames and unburnt hydrocarbon ignition within the convective plume resulted in flame heights of 60 metres.

11. Within a very short time following ignition of the tanker contents, the fire began to create its own atmosphere, drawing air into the base of the fire (creating the fire’s own wind) and producing a strong thermal updraft and convective plume.

12. Fuel continued to pour from the tanker and flow along the road and into the drains. Escaping fuel ignited almost as soon as it reached the road surface, resulting in a running fuel fire, that entered the drain system and continued to burn for almost 1,000 metres. The drains contained large quantities of flammable vapour that continuously ignited when the air mixture came within the flammable range. The confined space of the underground drains resulted in significant explosions occurring that were powerful enough to violently displace heavy iron drain covers secured with steel bolts from the road surface.

13. Radiant heat from the tanker fuel fire resulted in place glass shop frontages and “ordinary” glazed windows failing within the fire burning, allowing fire to enter and ignite building contents on levels one and two of the fire building. Extreme heat due to the close proximity of the tanker to the building increased the level of fire within the building.

14. It is important to note the risk of a BLEVE (Boiling Liquid Expanding Vapour Explosion) or explosion of a petrol tanker is unlikely. The tanker shell is formed of very lightweight aluminium and has very low resistance to heat. In the event of a fire impacting the tanker, the shell is designed to fail (causing pressure to be released), to prevent an “overpressure” situation occurring.

N.B., **LPG tankers** on the other hand are formed of solid steel, product is stored at high pressure and these tankers can (and do) BLEVE. However this is another topic for another report.

Operational Safety Considerations

Some of the Operational Safety Considerations identified at this incident include the following:

1. The first principle of firefighting operations at petrol tanker fires is to site appliances up-hill and up-wind of the tanker. This is exactly what first arriving Pumper 29 did.

2. Radiant heat is a critical factor at tanker fires. The following precautions can enhance safety:

a. It is important to position appliances at adequate distances to prevent damage due to radiant heat.

b. Where possible, firefighters should attack the fire from the furthest distance possible. The larger the attack stream, the greater the projection and the further crews are from the fire.

N.B., Radiant heat is directly proportional to the square of the distance to the fire. In basic terms, if a firefighter moves a short distance towards a radiant heat source, they will experience a large increase in radiant heat. Similarly, if a firefighter moves a short distance away from a radiant heat source, they will experience a large decrease in radiant heat.

3. Heat stress is a highly critical factor at tanker fires. Crews should be rotated regularly due to the high exposure to intense heat and hydration levels should be monitored and maintained. This will require a very disciplined control and application of the three deep deployment model.

4. Firefighters should wear the maximum level of structural PPC (Level 4) possible, including SCBA due to hazards associated with high heat, escaping product from the tanker, smoke and operation of foam.

5. Petrol tanker fires are very resource intensive, particularly if the three deep model of deployment is to be establsihed and maintained. The I.C. should consider an early higher alarm response to ensure adequate resources are in place to enable the proper rotation of crews, particularly in light of the very exhausting conditions firefighters will be confronted with.

6. Have sufficient hose run out to locate branch person at any point around the fire if the need arises due to wind shift.

7. Firefighters should be aware of their surrounding topography. Crews and equipment should not be placed either downwind or downslope to ensure that vapours or the spill does not trap them.

8. Always plan a path of unobstructed retreat when dealing with flammable liquid fires.

9. Always lay down a cover of foam between the fire and the branch crew.

10. Avoid walking or dragging hose through a foam blanket. Foam blankets are reluctant to self-seal if broken.

11. Where possible, the foam line crew should be protected by at least one backup team with a Turbojet nozzle.

12. Do not assume a foamed area is safe. Use a portable gas detector to determine the flammable vapour level present, after the fire has been extinguished and a foam blanket applied.

13. Hose in poor condition or percolating hose must not be used; high pumping pressures may result in hose bursts, placing crews at risk.

14. Have enough firefighters on the hose line to safely control the reaction force created by the water stream.

15. After extended exposure, smell sense becomes desensitized to the odour of petroleum products; another good reason to utilise portable gas detectors to test for the presence of vapours.

16. Firefighter personal decontamination should be established and operated.

17. Firefighters should be aware of open and closed drains and any covers on the road surface. If spilled fuel has entered the drain system it is possible drain explosions could occur, resulting in the violent displacement of drain hole covers and venting flames and smoke.

18. Petroleum vapour is heavier than air and it is possible hazardous flammable vapour clouds could form on the fireground. It is important that Hazmat are tasked with area atmospheric monitoring to detect the presence of any such clouds.

19. Once a foam cover has been applied to the surface of the burning fuel and all visible fire is extinguished, it is important to remain vigilant; Re-ignition could occur due to a breakdown of the foam cover from things such as warm fuel, hot metal components within the tanker or water streams accidentally being directed onto the foam blanket. Suitable precautions to take include:

a. Establishment of a restricted access zone around the tanker.
b. Continue to wear the maximum level of structural PPC possible (level 4), including SCBA when operating near the tanker.
c. Continuously conduct atmospheric monitoring near the tanker to ensure flammable vapours are not escaping from hidden breaches in the foam blanket.

d. Continuously inspect and maintain (through reapplication when needed) the foam blanket for at least one hour after the fire is seen to be “extinguished”.
e. Instruct fire attack crews operating on other parts of the fireground that no water streams are to be directed towards the tanker.

20. A tanker fire is an extremely significant fire event that will impact many utility services. Ensure appropriate reprsentatives are called to the scene so that the various services can be inspected and isolated if necessary to enable firefighters to operate safely. Sevices impacted at Rockdale included electricity (including high voltage), gas, sewers, railway, railway power supply (including 1500 Volt DC and a sub-ststaion) and telecommunications.

21. Scene lighting is an important issue. When the fire is burning the scene is extremely bright and well lit. However once the fire is extinguished, the scene will be plunged into darkness with many trip hazards on the fireground, including hoselines, foam drums and other firefighting equipment. As a proactive measure, scene lighting should be deployed prior to the fire being extinguished.

Firefighting Operations at Petrol Tanker Fires

N.B., It is recommended that this section of the report be read in conjunction with FRNSW document “*Firefighting foam and foam making equipment Recommended practice*”, Version 03, January 2018 File: D16/54959.

Petroleum tanker fires are extremely hazardous and firefighting operations are very complex. The following considerations are applicable when conducting firefighting operations at petrol tanker fires:

Initial Actions of First Arriving Stations:

An effective firefighting foam attack is the most appropriate way to extinguish a petrol tanker fire. However, a foam attack is complex and will take time to establish before it can be commenced. While the necessary equipment and resources are being put in place to commence a foam attack, there are a number of other critical operations that can be undertaken immediately by first arriving crews.

Rescue is the first priority of firefighters. If safe to do so, firefighters should check the cabin of the tanker prime mover, other vehicles involved and any property exposures for possible trapped persons. Hose crews may use fog streams to push burning fuel away from trapped persons and to make the rescue operation safer.

The Incident Commander should attempt to establish the contents of the load the tanker is carrying, as this will have a significant bearing on later firefighting operations. For the purposes of firefighting, there are two types of load a fuel tanker could be carrying:

a. **Hydrocarbon based fuel** (such as unleaded, premium unleaded or diesel), or
b. Product containing an ethanol blend which must be treated as an **alcohol based fuel**.

If the product type cannot be identified, the I.C. should err on the side of caution and treat the product as if it were alcohol based.

Where practically possible, firefighting should be made on the upwind side of the tanker, for the following reasons:

a. This will give firefighters some protection against the smoke plume.
b. Dangerous flammable vapours will not be blown towards firefighters.
c. This will assist the foam stream to reach the surface of the burning fuel.

Water should **never** be directed onto the surface of the burning flammable liquid. However, the application of hose streams onto the burning tanker can be beneficial if used correctly, including:

a. Sweeping large streams along the upper section of the exposed external aluminium tanker shell will assist in cooling the shell and will assist to slow "*meltdown*" of the aluminium.

b. Cooling the external aluminium tanker shell will assist to cool the petroleum product inside the tanker. If the petroleum can be cooled below its boiling point (120°C) there will be a significant reduction in the release of flammable vapours and consequent release in fire intensity, assisting the foam application process.

c. Water streams will assist in cooling the hot metal outside the tank shell, to allow foam inside the shell to seal against it.

By keeping the tank shell intact, the size of the fire is reduced, as well as the amount of water and foam required for extinguishment. Flammable liquids can only burn at their surface; the smaller the surface area, the smaller the fire.

N.B., great care should be taken to ensure no water enters the tanker or mixes with the fuel.

d. Petrol will ignite at temperatures as low as -48°C. Therefore water will not cool burning petrol to a low enough temperature to remove sufficient heat to prevent continued combustion.

Fog streams can be used to push burning pools of fuel away from exposures.

Firefighting Strategy:

Prior to committing to a foam attack, the Incident Controller must decide what incident strategy to employ. There are two strategies that can be employed at a petrol tanker fire:

a. **Offensive Strategy** – An attempt is made to extinguish the tanker fire with foam, or

b. **Defensive Strategy** - Allow the tanker to burnout and concentrate on protecting surrounding exposures.

A major factor in deciding which strategy to engage in will be the availability of resources, in particular stocks of foam concentrate, water supplies, firefighting equipment (in particular eductors and pumping appliances) and firefighting personnel.

Principles of Foam Firefighting:

The principles of foam firefighting consist of:

a. **Suppression** - Preventing the release of flammable vapours.

b. **Exclusion** - Preventing oxygen from mixing with the flammable vapours.

These principles of extinguishment are achieved by foam bubbles being delivered onto the surface of the burning flammable liquid. The foam bubbles are produced when the foam solution is broken into droplets as it leaves the branch. The foam droplets then aerate whilst moving through the air, producing finished foam solution (bubbles).

The finished foam solution must be:

a. Heavy enough to overcome the fire thermal updraft to reach the surface of the liquid.
b. Light enough to have sufficient buoyancy to float on the surface of the flammable liquid.

Preparing For a Foam Attack:

Prior to commencing a foam attack, the I.C. must ensure there are sufficient resources at the fireground before the attack commences. Resource considerations include:

a. Adequacy of foam concentrate stocks.
b. Adequate water supply to ensure attack lines can operate at the required flow rate.

A significant consideration with flammable liquid fires is that there is no such thing as a fire being 99% extinguished. If extinguishment cannot be completed (for any reason), the fire will simply burn back to total involvement and all of the hard work previously undertaken will be lost.

Commencement of a foam attack should be delayed until the I.C. is satisfied there are sufficient stocks of foam concentrate on hand to complete extinguishment once the attack starts. Similarly, commencement of a foam attack should be delayed until the I.C. is satisfied there are sufficient resources at the fireground. As stated above, once the foam attack commences, it must continue until the fire is completely extinguished.

Commencement of the foam attack should be delayed until multiple foam lines can be placed in operation simultaneously enabling **streams to be "massed"**; i.e. all streams are projected onto the same point on the surface of the burning liquid.

There are a number of components involved in the establishment of effective firefighting foam at a tanker fire. These are tabled within the section below "*Foam Firefighting Technical Set-Up*" and include;

a. The correct pump pressure.
b. The correct foam proportion setting.
c. The correct flow rate (at the branch).
d. The correct foam concentrate type must be used (Solberg RF3x6 Class B foam concentrate).
e. The eductor must be in good working order and set up facing the correct direction.
f. A maximum of three lengths of hose should be used.
g. The angle of elevation of the branch should be as low as possible.
h. The vertical distance between the end of the pickup tube and the eductor should be no greater than 1.5 metres.

It must be emphasised that if the foam making system is not set-up exactly as per the foam manufacturers specifications, it will not be possible to produce *effective* firefighting foam. It is a trap to assume that a white substance that looks like foam will put out the fire. Unless the foam is produced exactly as specified, it will be incapable of extinguishing fire.

The type of product the tanker is carrying must be identified, to ensure foam concentrate is being proportioned correctly at the eductor. If the product type cannot be identified, firefighters should err on the side of caution and treat the fuel as an alcohol blended fuel, setting the **foam proportioning to 6%**.

Factors that Adversely Affect a Foam Attack:

During the process of projecting finished foam solution onto the surface of the burning flammable liquid a number of conditions will be present severely and adversely impacting the foam stream, including:

a. Powerful thermal updraft created by the fire.
b. Radiant heat.
c. Atmospheric winds created by the fire.
d. Turbulence.
e. Flame impact.

During foam firefighting operations **at least 75% of the finished foam solution will be lost** when firefighters attempt to attack a flammable liquid fire.

Foam Firefighting Operations -

The most effective method of foam extinguishment of a petrol tanker fire involves the "*massing*" of streams; i.e. all firefighting streams are directed to one single point on the surface of the flammable liquid. This will enable foam to build up and spread out. If the streams are applied separately, the application density will be insufficient; the foam application will have little or no impact and the fire will continue to burn. The operation of massed streams will require significant coordination of resources.

Experience has shown that the application of three 70 mm foam attack streams has resulted in the most effective foam application and fire attack at petrol tanker fires where streams have been massed.

Once the foam from massed streams has succeeded in extinguishing the fire in one spot on the surface of the burning fuel, the foam will start to move out and eventually spread over the entire surface of the burning liquid, completing extinguishment.

Due to the complexities associated with foam making operations, a pumping appliance tasked to supply foam should supply **one** foam attack line only. Further, this pumper should not supply any other lines, for any other purpose.

Once a pumper is tasked to supply foam, it is advantageous if the entire crew can assist the pump operator, due to the complexities and labour-intensive nature of making foam (drums are constantly being moved, opened, poured, replaced etc.). Every 90 seconds one 20 litre drum of concentrate will need to be replaced.

When using foam concentrate contained within 20 litre drums, a common mistake is to place the pickup tube directly into the drum. During the time taken to withdraw the pickup tube from an empty drum and place it a full drum, the concentrate pickup is lost, resulting in only water being delivered through the fire attack stream, which will be harmful to whatever foam has cover has been laid.

To avoid this problem, the pickup tube should be placed in an open container such as a bucket or small (60 litre) hazmat bin and foam concentrate poured into the container and continuously topped up. It is important to remember that once the foam attack starts, it should not stop until a foam cover has been successfully placed over the entire surface of the flammable liquid.

As mentioned above, a key objective of foam firefighting operations is to place finished foam solution (foam bubbles containing air) onto the surface of the burning flammable liquid. However projecting an attack stream containing foam bubbles can be problematic for firefighters. Almost as soon as the aerated foam leaves the branch, the bubbles will begin to slow down due to air resistance. This is known as the "*parachute effect*". A consequence of the parachute effect is that the distance the stream can be projected is significantly shortened.

Radiant heat produced by a petrol tanker fire is extremely fierce and firefighters may have difficulty getting close enough to the tanker area to direct a foam attack stream onto the surface of the burning fuel. This is also very dangerous for firefighters. Therefore, the greater the distance of stream projection, the more successful firefighters will be at being able to direct a foam attack stream onto the surface of the burning fuel.

A further problem related to the parachute effect is the influence of the fire thermal updraft on the foam stream. Buoyant aerated foam bubbles are drawn into the thermal updraft and lifted above the fire, coming anywhere near the fire. During the application of foam, **at least 75% of the finished foam concentrate that leaves the branch will be lost** due the effects of radiant heat, flame impingement and thermal up-drafts caused by the fire.

To overcome the above issues, the foam solution must be light enough for the bubbles to float on the surface of the burning foam, however heavy enough to penetrate through the thermal updraft created by the fire. Use of an Akron branch *without* the foam aeration tube will produce foam that is light enough to float on the surface of the flammable liquid and heavy enough to penetrate the fire thermal updraft.

The nozzle of a FRNSW Akron Turbojet is designed to break the foam solution into tiny droplets as it leaves the nozzle; the foam droplets then aerate whilst moving through the air, producing a finished foam solution. This type of finished foam solution has sufficient weight to penetrate the fire thermal updraft and sufficient buoyancy to float on the surface of the flammable liquid. Advantages of undertaking foam attack *without* a foam aeration tube fitted include:

a. **Stream projection distance will be increased by at least 33%**.

b. Heavier bubbles are less vulnerable to the *parachute affect* and less likely to be drawn into the fire thermal up-draft.

c. Foam is more fluid and will flow more quickly over the surface of the liquid, achieving faster extinguishment.

At the commencement of foam production, the stream should be directed away from the area of intended application to avoid directing water onto the fire area. Only when the branch crew is satisfied that stream consists of correctly formed finished foam solution should it be directed onto the surface of the flammable liquid.

If during the application of foam the fire attack crew notice correctly formed finished foam is no longer coming from the branch, the stream should be immediately directed away from the area of the fire until correct foam returns, to avoid damaging the foam blanket already in place or being laid by other attack crews.

N.B., Do not shut off the branch (unless necessary for other reasons) because this will cause the eductor to lose pick-up.

When conducting foam attack, the foam should be applied gently (known as “feathering”) onto the surface of the burning liquid, to avoid “*plunging*” which will cause turbulence and agitation of the flammable liquid, resulting significantly increased fire activity and breakdown of any foam already in place. Feathering is achieved by holding the branch at a *slightly* elevated angle.

During the application of foam onto a burning petrol tanker, the most effective technique to achieve extinguishment is known as the “*snowstorm*” affect. This is created by slightly elevating the nozzle and allowing the massed streams to gently fall in a similar manner to a snowstorm onto the surface of the burning fuel.

It is important to remember during foam application that if the nozzle is elevated at too high an angle, backpressure will form causing the eductor to shut down.

Water must **never** be applied onto the surface of a burning flammable liquid at the same time a foam attack is being made. **Water will break up the foam blanket and agitate the surface of the flammable liquid, increasing fire intensity.**

Following Establishment of the Foam Blanket:

Once the flammable liquid surface has been covered by foam and all visible signs of fire are no longer present, firefighters can **switch to an attack *with* the foam aeration tube** fitted to the branch. The thermal updraft is no longer a problem and therefore foam bubbles containing increased levels of aeration will provided a more effective vapour suppression cover on the surface of the flammable liquid. Reapplication of the foam blanket to a depth of 100 mm should be continued for at least one hour after the surface fire has been extinguished, to ensure re-ignition does not occur.

Residual heat from the tanker will cause the foam blanket to break down. Following extinguishment, water can be used to cool the side of the tanker shell and hot metal components of the tanker. Care must be taken to ensure no water is directed onto the foam blanket.

Atmospheric monitoring should be conducted continuously to identify any flammable vapours escaping from breaches in the foam blanket.

Even though a foam blanket is in place and no visible signs of fire are present, firefighters should continue to remain vigilant for sudden and unexpected re-ignitions. Necessary precautions include:

a. Enforcement of the exclusion zone around the tanker.
b. Continue to wear full structural PPC (level 4) and SCBA when working near the tanker.
c. Continue to maintain atmospheric monitoring, in particular for flammable vapours.

Foam Firefighting Technical Set-Up

When conducting foam firefighting the following specifications must be used to ensure *effective* firefighting foam solution is produced:

1. Eductor proportioning setting (hydrocarbon fire): 3%
2. Eductor proportioning setting (polar solvent fire, e.g. ethanol fire): 6%
3. Pressure at pump delivery/eductor inlet: 1400 kPa
4. Pressure loss due to eductor operation: 400 kPa (resulting in an eductor outlet pressure 1000 kPa)
5. Branch flow rate (38 mm attack): 230 L/min
6. Branch flow rate (70 mm attack): 475 L/min
7. Friction Loss per length of hose (38 mm attack): 100 kPa
8. Friction Loss per length of hose (70 mm attack): 20 kPa
9. Maximum lengths of hose in line: three
10. Optimum operating pressure at the branch: 700 kPa

Learning Notes

Significant learning notes from this incident include the following:

1. The initial priority of the first arriving station was the safe positioning of the appliance. There were numerous hazardous conditions present when firefighters first arrived on scene. The correct positioning of the appliance provided a base that enabled firefighters to safely and effectively commence initial firefighting operations.

2. Although the most obvious temptation was to commence directing attack lines onto the fully involved tanker, officer-in-charge of the first arriving appliance Pumper 29 Station Officer Colin Taylor showed tremendous fireground insight, directing the first firefighting streams into the heavily threatened building metres from the burning tanker. S.O. Taylor's reasoning included:

a. There were insufficient resources on the scene to mount an attack on the tanker and therefore these efforts would have been simply wasted.

b. He was aware there was a probable life risk in the building behind the tanker.

c. It was far more beneficial to concentrate firefighting operations on protecting the building.

The above decisions were made within seconds of Pumper 29 arriving on scene. It transpired that these decisions saved the life of 68-year-old Mrs Le Vano, who was sheltering in a rear bathroom of a level two apartment. Following her rescue, Mrs Le Vano stated:

"*I began to put wet towels at the bottom of the bathroom door. I could see the orange glow of the fire and I thought I was going to die.* ***Then water started to come through the gap between the floor and the door. That was when I knew would survive.***"

The water that was coming through the door of Mrs Le Vano's bedroom door was the 70 mm attack line stream being directed into the second level apartment window above the fully involved tanker by Senior Firefighters Neil Everitt and Brendan Mooney. Their actions saved Mrs Le Vano's life.

3. Initial Incident Controller S.O. Colin Taylor recognised the enormous threat to life this fire posed. He was particularly concerned because he knew residents lived above the shops, however there were no persons on the street (it transpired that the 12 occupants within units 118 and 119 had made a desperate escape while Pumper 29 were responding to the fire). Firefighters made a determined, disciplined and courageous effort to ensure no persons remained trapped by placing a ladder to the awning and going from apartment to apartment to ensure all persons were out of the building. In the face of the out-of-control inferno, they were instructed to "*go as far as you can*" along the awning and were only stopped when flames from the tanker were roaring through the middle of the steel awning, making it impassable. These operations were undertaken in a systematic, professional and thorough manner and ensured that there were no persons remaining within the building to the north of the tanker.

4. Firefighters continued to direct 70 mm streams into the involved building while crews were preparing to conduct the foam attack. The attack with 70 mm lines stopped the fire's lateral spread and reduced the intensity of the fire burning in the building. This operation was so successful that despite the ferocious impact of heat from the burning tanker, the building remained structurally intact and following extinguishment was able to rebuilt rather than be demolished.

5. The fully involved tanker appeared to be the singular issue of concern. However fireground commanders were able to identify numerous other issues consequent to the tanker fire, through the process of on-going and continuous size-up that required intervention. Incident objectives were identified and prioritised and crews assigned specific taskings to ensure all incident objectives were achieved. These operations were conducted in a systematic and planned manner. The incident was divided into Sectors and Divisions, again greatly assisting the achievement of specific objectives.

6. Firefighting operations were conducted in accordance with a systematic strategy:

a. The largest possible attack streams (70 mm lines and aerial pumper and hydraulic platform aerial master streams were being directed onto the building fire) while the foam attack was being established.

b. The foam attack consisted of a coordinated operation involving three 70 mm foam streams, which were "massed" onto the surface of burning fuel within the tanker. The

discipline and coordination of the operation, undertaken by firefighters in the face of enormously hostile conditions, was successful in achieving extinguishment of the tanker.

c. One the tanker fire was extinguished, fire control within the building at 102 – 120 Railway Street was relatively straight forward.

7. Fortunately, petrol tanker fires are very rare events. When they do occur, it is an opportunity to validate firefighting theory. The operations at Rockdale prove that when foam firefighting operations are carried out in accordance with the laid down recommended practices, they do work.

8. The foam attack only commenced when there were sufficient foam stocks at the fireground.

9. When firefighters arrived on scene the incident was rapidly expanding and the situation quickly deteriorating. Through the application of sound firefighting strategies and tactics, underpinned by robust incident objectives that were defined through the process of continuous size-up, effective containment strategies were established from the arrival of the first appliance, that were continually strengthened and enhanced as the incident progressed. No expansion of the incident occurred after firefighters arrived on scene. All incident objectives were safely and effectively achieved.

10. Firefighting operations at flammable liquid fires and in particular petrol tanker fires are inherently complex and hazardous. The specialist issues and considerations associated with flammable liquid fires, petrol tanker fires and foam firefighting operations is contained within a separate section of this report "*Firefighting Operations at Petrol Tanker Fires*".

11. The incident was located *near* the rail corridor. Although it did not occur within the rail corridor, the incident did demonstrate some of the complexities that can occur whenever an incident impacts the rail corridor and the need for the expert advice from railway representatives (Rail Commanders).

12. The fireground was extremely complex, containing a number of geographical locations and very specialised taskings. The establishment of a robust command structure ensured all operations were carried out in accordance with the objectives defined by the Incident Controller. The command structure consisted of the establishment of sector and divisional commanders and a number of specialist functions such as Hazmat Group. Despite the complexity of the incident, all incident objectives were able to be safely achieved because of the establishment of an effective command structure.

13. Support provided by specialist resources such as technical rescue and the Incident Control Vehicle were invaluable, enabling operations at such a hazard and complex incident to be undertaken as safely and effectively as possible.

14. Hazmat operations were particularly complex. The professionalism and thoroughness of the work undertaken by hazmat crews prevented the incident from developing into an environmental emergency.

15. A petrol tanker crash and fire can occur at any time at almost any location. Many destinations for petrol tankers (service stations) are located within urbanised areas, increasing the threat to life and property. The best way to be prepared for this type of incident is by regularly checking and being familiar with all of the equipment used in the foam making process and have as thorough an understanding as possible of how this equipment will need to be used in a fire situation.

16. The report author strongly recommends that this report be read in conjunction with FRNSW document "***Firefighting foam and foam making equipment Recommended practice***", Version 03, January 2018 File: D16/54959.

Conclusion:

The Rockdale petrol tanker fire demonstrated the type of complex, destructive and potentially catastrophic situation firefighters could be called to respond to at any moment. It also demonstrated that no matter how seemingly formidable the challenge, firefighters can begin to establish control and containment of an incident and systematically achieve the best possible incident outcomes.

At Rockdale, firefighters displayed enormous courage and determination in the face of a fireground that was ferocious, complex and extremely dangerous. They also displayed discipline, a compelling awareness of fireground safety and a strong mastering of basic firefighting skills. Despite the complexities of operations and the numerous competing incident priorities, fireground commanders determined appropriate incident objectives, formed strategies and established a plan of tactical operations that was robust, safe and effective. All incident objectives were achieved and most importantly, lives were saved. This did not happen by accident; it happened because firefighters applied basic firefighting skills with very high levels of proficiency and skill.

Firefighting operations at flammable liquid fires can be extremely challenging, hazardous and complex. Part of this report examines foam firefighting operations at flammable liquid tanker fires. These fires are not straight forward and the more prepared we can be for them, the better the outcome will be when they do occur. The Rockdale tanker fire is a tremendous example of how excellent outcomes can be achieved in the face of great adversity, through the simple application of correct firefighting techniques.

There are some important lessons to be shared based on the incredible work of firefighters at Rockdale. The types of operational proficiency demonstrated at Rockdale are achieved through a mindset of always being prepared. Constantly checking equipment, undertaking drills, continuous self-improvement, always learning and being the best we can be as firefighters. Then one day, if another Rockdale comes, we too will be ready.