WEST CLIFF MINE - 4.3.87

Section 89. Coal Mines Regulation Act, 1982.

Report of an investigation into the Notification of a Dangerous Occurrence.

A Fire Occurred on Longwall 7 Coalface at 12-45 a.m. on 13th December, 1986, when a block of polyurethane foam being used to fill a roof cavity self ignited.

AVOIDABLE

PANEL DESCRIPTION

The development of main roadways in West Cliff Mine for the formation of the longwall blocks of coal is in a North direction. Main roadways formed in this direction consisted of a six heading layout in 3 Area and a seven heading layout in 4 Area of the mine. Three roadways were then driven in an East-West direction to connect 3 Area and 4 Area thus forming blocks of coal for extraction by the longwall system. Due to inseam geological faulting there was a variation in the planning and formation of the longwall blocks.

During the first workings drivage for the development of Longwall 7, a one metre wide dyke was intersected in 477 Panel and projection of its direction showed the dyke would pass through the longwall block at an angle from the tail gate to intersect the start line of the longwall face at a distance of approximately 30 metres from the tail gate end.

During the formation of 477 Panel the dyke was penetrated with a continuous miner on about fourteen occasions. The dyke stone was relatively soft and whilst roof conditions in the immediate vicinity were poor they were not uncontrollable. On a few occasions the roof in the area of the dyke had fallen upto a height of 0.8 metres above the coal seam, this was considered to be due to insufficient roof support during cutting operations.

When 477 and 478 Panel roadway drivages were completed the connecting longwall 7 face line was formed with the dyke being intersected at a point 30 metres from the tail gate end of the 150 metre wide face line.

Longwall coal cutting and roof support equipment was then transferred and assembled on the face and cutting operations commenced on 25th November, 1986.

EVENTS PRIOR TO THE OCCURRENCE

There were no major problems during initial coal cutting operations and the longwall had retreated approximately 40 metres. A roof fall then occurred on the face within the vicinity of the dyke. The fall extended from the hade of the dyke for about 5 metres toward the tail gate end and the height of the cavity caused by the roof fall being unknown at that time. The fallen roof material buried the armoured face conveyor to the extent that drive motors stalled and the conveyor was no longer operable. An Eimco L.H.D. vehicle was then used to remove the broken roof material off the conveyor and dump it in the tail gate return roadways.

The roof fall material was cleaned up and the conveyor was then run. The height of the cavity formed by the fallen roof was estimated as being approximately 18 to 20 metres from the seam floor level. Above the powered roof supports (chocks) the fallen stone was broken and laying on the chocks at a 45° angle of repose. Due to the friability of the roof strata and coal adjacent to the dyke, the material had 'fretted' away to the extent that the distance between the coal face and the front extension roof support bar of the chock was 3.5 metres (See figure 1). Attempts were made to

LONGWALL 7 COAL FACE

VIEW LOOKING TOWARDS MAIN GATE SHOWING DYKE INTRUSION INTO COAL SEAM AND ROOF STRUCTURE

LONGWALL 7 COAL FACE

VIEW LOOKING TOWARDS TAIL GATE SHOWING FRIABLE ROOF STRATA AND STRUCTURE

LONGWALL 7 FACE

VIEW LOOKING INTO CAVITY SHOWING EXTENT OF ROOF FALL.

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push the conveyor to the face and pull the roof support chocks closer to the face. This failed due to slippage of the broken roof material from above chocks 85 - 89. When chocks were released the broken stone plus additional stone from the cavity walls crashed down onto the face side of the face conveyor.

With the knowledge of the longwall having to retreat through the dyke area in the Tail Gate, advice was sought from Chemfix Pty.Ltd., regarding the use of Polyurethane as a strata binder. It was thought the drilling of holes into the broken roof across the dyke from the tail gate rib side and injection of the Polyurethane as a strata binder, there would be a consolidation and improvement in the roof conditions. An underground inspection was made of Longwall 7 Tailgate by Mr. J. Schott, Chemfix Engineer and West Cliff personnel on 4th December 1986, whereon it was agreed to inject the roof strata from the Tail Gate rib side using the Polyurethane Foam. On Friday 5th December 1986, Mr . R. McKenzie a Service Engineer with Arnall - Wickman attended West Cliff Mine and injected polyurethane resin as a strata binder at a 5 : 1 expansion ratio into the broken roof strata from Longwall 7 Tail Gate. It was then decided to drill holes into the broken roof strata on the coal face and further polyurethane injection was carried out on Monday 8th December, 1986.

Approximately 600 litres of strata binder at a 5 : 1 ratio was injected into the roof above the coal face and reached a distance of 16 - 18 metres from the Tail Gate rib side. At that point the roof cavity above the coal face commenced and extended for about 7 metres towards the panel main gate and the dyke. Due to danger to employees from the possibility of falling stone over-riding the chocks, drilling operations for injection of the polyurethane strata binder ceased.

On Tuesday 9th December, 1986, a meeting was convened by West Cliff Mine management to discuss alternative ways of mining through the dyke area. It was recognised that both the seam and strata above the seam would have to be consolidated prior to coal cutting recommencing. Three alternatives were considered, they were:-

(a) To establish an artificial roof by erecting a timber canopy between the extension bars of the chocks and the face. This idea was abandoned because it was considered dangerous to commit employees to work in the face area and further to this the canopy would have to be of sufficient strength to withstand the impact of falling stone. (See Figure 2).

(b) Consideration was given to shorten the cutting length of the longwall by driving a heading from the Tail Gate to intersect the face on the Main GAte side of the dyke. (Figure 3). This alternative revealed the drivage could be achieved and the face conveyor could be shortened but

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the chocks in the goaf area could not be removed with safety and therefore would have to be abandoned.

(c) The third alternative was to establish an artificial roof from an area of safety at either end of the fall or from within the cover of the chock canopies. The artificial roof had to be substantial enough to withstand a fall from the top of the cavity and at the same time light enough to enable erection from a point of safety.

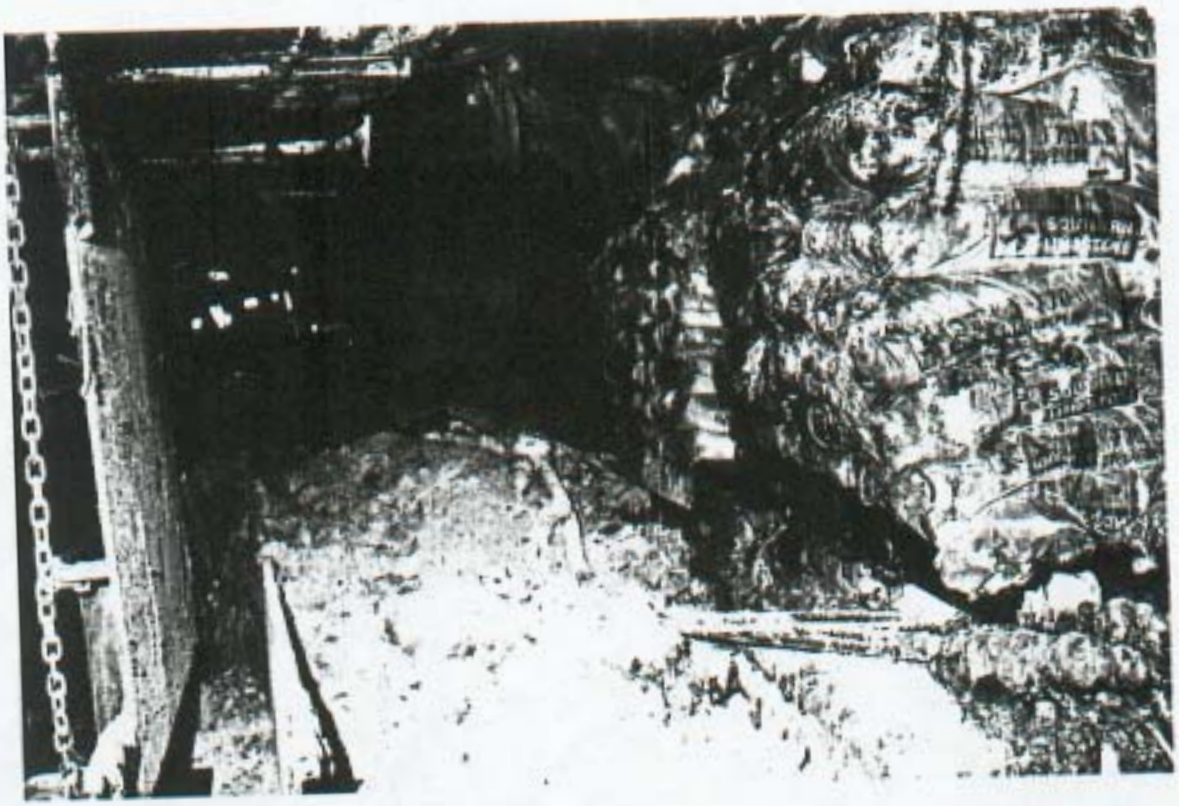
Prior to this management meeting the Mine Undermanager in Charge Mr. P. Harrington and Project Engineer Mr. Michael Weekes conversed with Mr. J. Schott of Chemfix Pty.Ltd., who recommended that wire cables be installed at roof level across the cavity and running parallel to the face. These cables were to be used to contain further fallen roof material where upon polyurethane foam could then be pumped over the fallen stone.

This advice was discussed at the management meeting and it was decided on advice received to form a plug of polyurethane material to make an artificial roof. To contain the polyurethane which was primarily in a fluid state and had to be pumped into the cavity, pallets containing bags of stonedust were placed to form a wall on three sides and underneath the chock beam on the coal face. These also formed a barrier between the face and the chocks. Brattice cloth was then draped down the inside wall of the stonedust bags thus sealing each end of the fall from floor level to the underside of the chock roof support beams (See Figure 4 and Photograph).

On Wednesday 10th December 1986, Mr. McKenzie and Mr. S. Ostle of Arnall - Wickman visited the mine and went underground with Project Engineer M. Weekes to inspect the roof fall area and determine the pumping procedure to form the plug within the wall of stonedust after which further pumping into the roof cavity would be carried out to form the artificial roof.

On Thursday 11th December 1986, at 1-00 a.m. Mr. McKenzie of Arnall - Wickman went underground to commence pumping operations of the polyurethane into the stone dust formed cavity. After initial preparation and setting up of equipment pumping operations commenced at approximately 3-00 a.m. with resin being pumped at a 20:1 ratio into the stone dust walled plug. Pumping ceased at approximately 10-15 a.m. with a total of 1300 litres of polyurethane being pumped in approximately 7¼ hours. At the completion of pumping it was estimated that the height of the foam in the void was to the position as shown in Figure 5. The Arnall - Wickman Service Engineer Mr. R. McKenzie observing the operation very closely did not see any signs of heating.

PHOTOGRAPH 4



SHOWING METHOD USED TO ERECT STONEDUST WALL BY USE OF BAGS OF STONEDUST ON WOOD PALLETS

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At about 10-30 a.m. on Thursday 11th December 1986, Chemfix Pty. Ltd., notified the Mine Management by telex that pumping should cease for a period of 16 hours to allow the material to cool. The Undermanager in Charge, Mr. P. Harrington at about 11-00 a.m. contacted R. McKenzie advising him there was to be a 16 hour wait time between each pumping cycle and that future pumping cycles should be 1000 litres of polyurethane or the layer of urethane should be not more than 1 metre in thickness. Mr. R. McKenzie returned to the surface of the mine at 1-00 p.m. and had further discussion with the Undermanager in Charge regarding future programming of the work. It was planned to commence the next pumping cycle at 2-00 a.m. on Friday 12th December, 1986. Further to this A.C.I.R.L. had been contacted to provide heat sensor thermistors for installation in the plug prior to pumping the next batch of polyurethane.

The pumping operation planned for 2-00 a.m. Friday 12th December, 1986, did not take place at that time due to installation of injection tubes and pump problems. It was 4-05 a.m when pumping commenced and by 7-10 a.m some 1100 to 1300 litres had been pumped into the cavity in 3 hours 5 minutes. It was estimated by Service Engineer R. McKenzie that foam pumped during this second stage was between 800mm and 1000mm in thickness (See Figure 6) and observations showed falls of roof had occurred from within the cavity. The job being completed, the two Arnall Service Engineers went out of the mine with the night shift crews at approximately 8-00 a.m. with Mr. McKenzie reporting to Undermanager in Charge Harrington there were no problems other than trouble with the pump at the start of the shift. Due to the non-availability of the heat sensor thermistors monitoring of the second polyurethane application was not carried out as intended.

THE OCCURRENCE

At approximately 10-30 a.m. on Friday 12th December 1986, Mr. Warwick Anderson a Shift Undermanager who was inspecting Longwall 7 telephoned Undermanager in Charge Harrington and advised that yellowish brown fumes were coming off the polyurethane. He further stated that when looking into the observation hole which was sited near the face at the top left hand side of the main gate side stonedust will he saw fumes rising off what appeared to be a boiling mass of material. The 'boiling' material was about halfway across the cavity and close to the coal face. Mr. Anderson was told to stand by the telephone until advice was obtained from John Schott of Chemfix. Before Mr. Schott was contacted Mr. Anderson rang back expressing concern about the situation and seeking advice. Undermanager in Charge Harrington then instructed Mr. Anderson to disconnect the stonedust hose that was feeding the tailgate stonedusting machine from the face conveyor spill trays and to push stonedust over the material in question.

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AVOIDABLE

Mr. Schott of Chemfix was then contacted and notified of the situation by Undermanager in Charge Harrington. Mr. Schott agreed to the covering of the material with stonedust and was requested by Harrington to obtain data sheets on the Chemfoam Part 1 and Part 2 in order to determine the products of combustion and the effects on men working in the contaminated area. Mr. Schott advised that personnel should stay on the fresh air side of the fumes and further advised he was leaving Chemfix at Nowra to deliver the data sheets to West Cliff Mine.

At about 2-00 p.m. an inspection party consisting of the Undermanager in Charge Harrington, Mr. Schott, District Check Inspector Mr. Loy and local Check Inspector Mr. Carr went underground to longwall 7. Check Inspectors Loy and Carr had previously been underground to carry out inspections and had been directed to longwall 7 by Undermanager in Charge Harrington at about 10-30 a.m. when the problem was first identified.

The inspecting party arrived at Longwall 7 and Mr. Loy noted there was a definite change in colour from brownu yellow to white of the fumes being issued from the polyurethane and that they were less dense than on the previous inspection he had undertaken on dayshift. The Chemfix representative Mr. Schott advised the problem of the issuing fumes had been caused by the second usage 1300 litre pour being pumped too fast. Further to this the change in colour and density of fumes was an indication that the material was cooling. Tests for methane showed 0.2% in the general body of air on the face and 0.1% - 0.2% in the tail gate airway.

Mr. Schott took temperature readings by using a thermometer attached to a fibre glass rod. Readings on top of the foam and along the front wall showed temperatures of 35° - 40°c. At some time later temperature recordings were taken using A.C.I.R.L's thermister operated by an A.C.I.R.L. employee. Temperatures above the foam were recorded as 27°c whilst along the front wall up to 35°c was recorded. An area was selected approximately one metre near the tail gate end of the stonedust wall. There was a space between two pallets of stone dust in which could be seen the brattice containing the foam. The temperature at this point was found to be between 40° -70°c. The inspecting party being satisfied that the heating process taking place in the polyurethane was slowing down then returned to the pit bottom. During this journey, return airways were checked at intermittent points and found to be contaminated by fumes and as a consequence the 4 Area of the mine was isolated because of the inability to provide a second means of egress.

On leaving the Longwall 7 site a Mines Rescue trained Deputy and assistant who commenced work at 7-00 p.m. were instructed by the Undermanager in Charge Harrington to stay on the fresh air side of the problem area with Siebba Gorman breathing apparatus at the ready and continually monitor the level of fumes given off. Should any increase be detected they were to contact the Shift Undermanager.

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The Undermanager in Charge Harrington on his arrival at the mine surface attempted to contact District Inspector Mr. R. Smith. Contact could not be made and contact was then made with District Inspector Mr. H. Clarke. District Inspector Clarke visited the mine with discussions taking place with the Undermanager in Charge. After a discussion concerning the decrease in temperature and decrease in fume being given off by the polyurethane plug it appeared the situation was under control. The Undermanager in Charge left the mine at 11-05 p.m. and District Inspector Clarke contacted District Inspector Smith and advised him of the situation.

The Deputy and assistant who arrived at Longwall 7 at about 8-10 p.m. carried out inspections of the area. At about 9-30 p.m. the site of the polyurethane plug was visited by the shift Undermanager along with Mr. J. Schott the Chemfix representative and the A.C.I.R.L. engineer. Temperature readings were taken and temperature over the top of the plug was 27°c. Later, a second reading taken in the same area gave a reading of 24°c. The probe was moved to the area of 86 - 87 chocks where the temperature reading was 70°c, the area was monitored for approximately 1½ hours with no increase in temperature. This party then returned to the mine surface at about midnight.

The Deputy and assistant continued their observations on site and between 10-30 p.m. and 11-30 p.m. they returned to the Longwall crib room for their meal break. At 11-45 p.m. they returned to the polyurethane site and observed very little change in conditions. They stayed in the area for a period of time then returned to the Longwall main gate where the assistant commenced servicing the P.E.T. tractor.

At about 12-45 a.m. on Saturday 13th December, the Deputy returned to the site alone and saw flames coming from the front of the stone dust wall opposite Nos. 87 and 88 chock. A fire extinguisher near at hand was discharged onto the flames which were being emitted from the stonedust bag wall and were about 600mm in length. A second fire extinguisher was then obtained from nearby and the Deputy saw a glow in the roof cavity over the top of the polyurethane plug. He discharged the second extinguisher into the cavity through the observation hole on the main gate side of the stonedust wall. A third extinguisher was obtained and this was discharged onto the flames issueing from the front wall. After discharging the three extinguishers, flames were still being emitted and the Deputy ran to the Longwall main gate, advised the assistant there was a fire, whereon fire hoses and nozzle were obtained from the fire depot. The two men returned to the site and in passing No. 54 chock connected the fire fighting hose into a fire hydrant. Water was then directed onto the flames coming out of the stonedust wall opposite No. 87 - 88 chocks. These flames were extinguished and water was then directed into the cavity onto the top of the polyurethane plug. There was then a re-ignition on the front

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wall which was again extinguished by water. More water was hosed onto the front wall until there was no further signs of re-ignition wheron water was then directed into the cavity. At about 1-25 a.m. the flames and glow from the polyurethane had been extinguished and the Deputy notified the Shift Undermanager who organised an on-shift Mines Rescue trained team to go to Longwall 7 and then instituted the Mine Emergency Procedure.

THE INVESTIGATION

At about 1-35 a.m. on Saturday 13th December, 1986, I was contacted at home via telephone communication by Shift Undermanager Mr. B. Hadley who advised a fire had occurred in the polyurethane on Longwall 7. He further advised the flames had been extinguished but there was still a heating within the polyurethane on the face. The Mines Rescue Station had been notified and the Mine Manager and Undermanager in Charge were on their way to the Mine. I notified Senior Inspector Mr. R.J. Kininmonth and then proceeded to the Mine arriving there at 2-30 a.m. Mines Rescue Superintendent Mr. J. Strang and Mine Manager Mr. R. Ruston were at the Mine.

I was advised the flames had been extinguished, there appeared to be still 'hot spots' in the stone dust wall opposite No. 87 - 88 chocks and these were being dug out by the rescue trained colliery personnel who had been first sent to fight the fire. The West Cliff No. 1 Rescue team had gone underground at 2-20 a.m. and other rescue teams had been called out and were on standby.

Advice received from West Cliff No. 1 team Captain P. Harrington was that bags of stonedust had been removed from the top half of the middle two wood pallets in front of 87 - 88 chocks. (See Figure 7). There was evidence that flames had been issuing from between these pallets. The fire was under control, the situation at the site was not critical but more rescue teams were required to continue digging out the 'hot spots'. Ventilation on the face was good with 0.2% of methane (CH4) detected hard against the underside of the chock canopies. Tests for Carbon Monoxide (CO) had been carried out and at a point 5 metres on the return air side of the polyurethane zero reading was shown. At roof level at the goaf edge in the Tail Gate behind No. 100 chock the result was 10 p.p.m. which is the normal background level for the area. In the Tail Gate 5 metres outbye the face the resultant general body sampling was zero reading.

Replacement Mines Rescue teams were deployed at the site digging out until it was determined all 'hot spots' had been extinguished.

At 8-00 a.m. on Saturday 13th December 1986, I made an underground inspection of the site in the Company of Senior Inspector Mr. R.J. Kininmonth, Mines Rescue Superintendent Mr. J. Strang, Mine Manager Mr. R. Ruston and District Check Inspector Mr. M. Loy.

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We proceeded to the Main Gate entrance to Longwall 7 face where it was determined the air entering the hazardous zone to be carrying 0.1% methane. It was noted that the Anderson-Strathchyde was stationed at No. 56 Chock along the face. The 37mm diameter fire hoses were still connected to the fire fighting hydrant at No. 54 Chock. Tests for methane whilst travelling along the coal face showed 0.2% at the goaf edge within the underside of the chock canopies.

On arrival at the site it was observed the stone dust bag wall built on the coal face side of the conveyor from the floor to the underside of the chock beams (Photograph 1). At the upper left hand corner of the wall was a hole which had afforded observation into the cavity and the inside of the stonedust wall. Due to fallen roof stone very little could be seen except the roof of the cavity (Photograph 2).

Laying across the face conveyor were three wood pallets which had been dug out from the stone dust wall opposite 87-88 chocks. There was evidence of all three pallets having been on fire. (Photographs 3, 4, 5, 6).

Opposite Chocks 86-87-88 the stonedust bag wall had been demolished and the burnt polyurethane was exposed (Photographs 7-10). At the extremeties of the cavity exposed was evidence of the brattice cloth lining having been subject to intense heat which melted the brattice adhering it to the stonedust bag wall. A closer inspection of the polyurethane showed cavities of varying sizes in which there was evidence of burning whilst parts of the urethane were in a cindered or ash condition (Photograph 11-12). Also penetrating through the polyurethane were large pieces of roof stone which appeared to have fallen after the placement of the polyurethane and had punctured the shell of the urethane block. (Photograph 13).

Photograph 14 illustrates the position of the wood pallets in the wall built to contain the polyurethane plug. Photographs 15 and 16 show the system used to inject the polyurethane, note top right hand corner of 16 shows injection tubes into the coal face and roof.

On completion of the initial investigation the wall around the polyurethane was dismantled and Photographs 17 and 18 were taken looking from the tailgate towards the maingate. These show the extent of the polyurethane wall which had been affected by the self ignition caused by the exothermic reaction within the polyurethane. Despite this incident it did appear that the intent of the trial to form a false roof for the protection of workmen was successful.

SURFACE TRIALS

A surface trial was carried out to determine the consistency of the polyurethane when formed at the expansion ratio of 20:1 and pumped at the same rate as the second underground emplacement.

LONGWALL 7 GOAF FACE

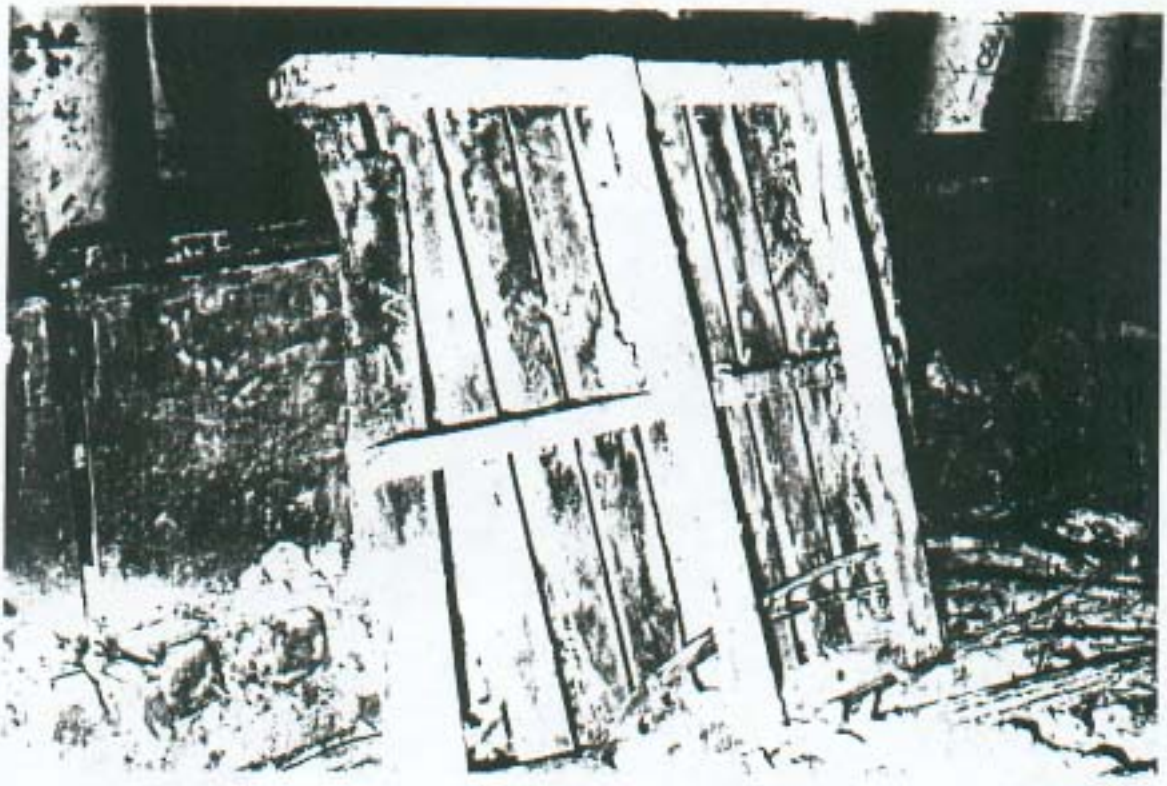
(1)

VIEW OF STONEDUST BAG WALL
WHEN APPROACHING FROM MAIN GATE

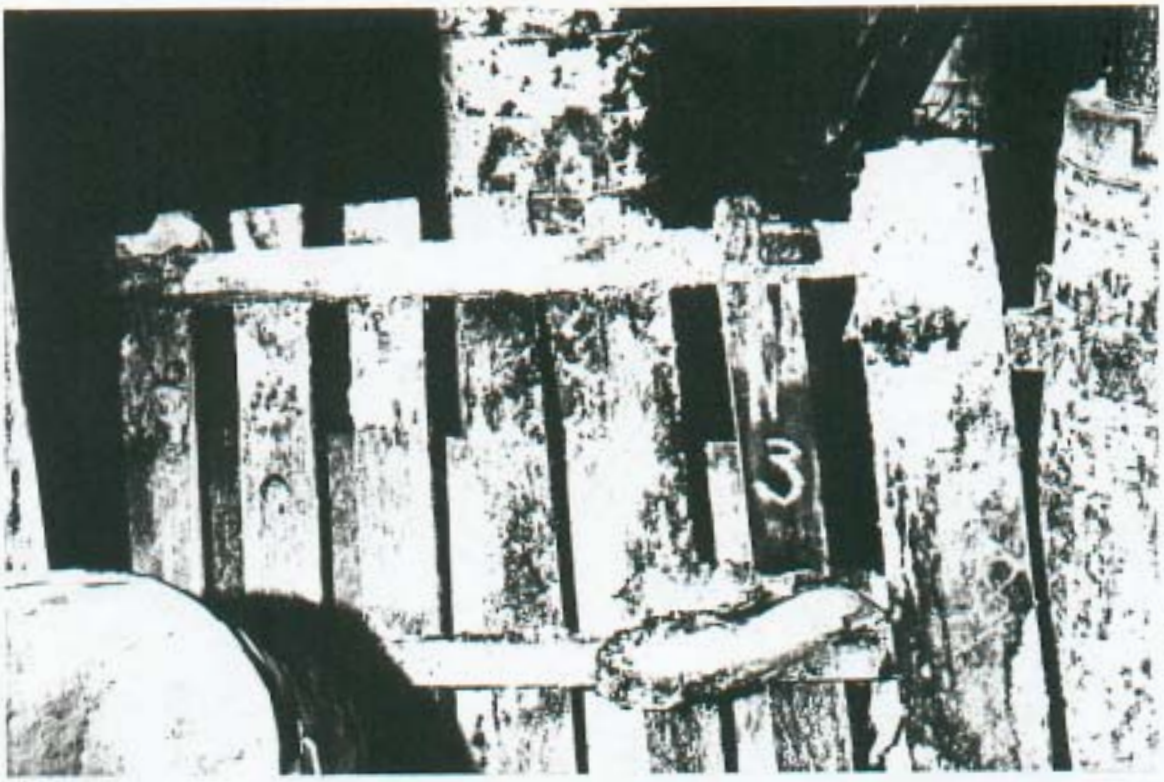
VIEW OF OBSERVATION (PEEP) HOLE INTO
CAVITY - FALLEN ROOF STONE OBSCURED
CLEAR VIEW OF POLYURETHANE BLOCK

(3)

SHOWS EXTENT OF BURNING OF WOOD PALLETS



(4)



(5)

SHOWS BURNT WOOD PALLET AND STONEDUST BAG PAPER

(6)

(7)

VIEW LOOKING TOWARDS MAIN GATE END OF STONEDUST WALL

SHOWING EXTENT OF BURNT POLYURETHANE AND CAVITIES - NOTE FALLEN ROOF STONE

(10)

VIEW LOOKING TOWARDS TAIL GATE END OF STONE DUST WALL

11

SHOWS CAVITIES IN URETHANE CAUSED BY OUTBURNING OF FIRE — NOTE STONEDUST IN MIDDLE OF CINDERED POLYURETHANE

12

SHOWS BURNT AND CINDERED POLYURETHANE ON RIGHT OF PHOTO CENTRE WHILST CENTRE PICTURE SHOWS URETHANE AND ROUT STONE

13

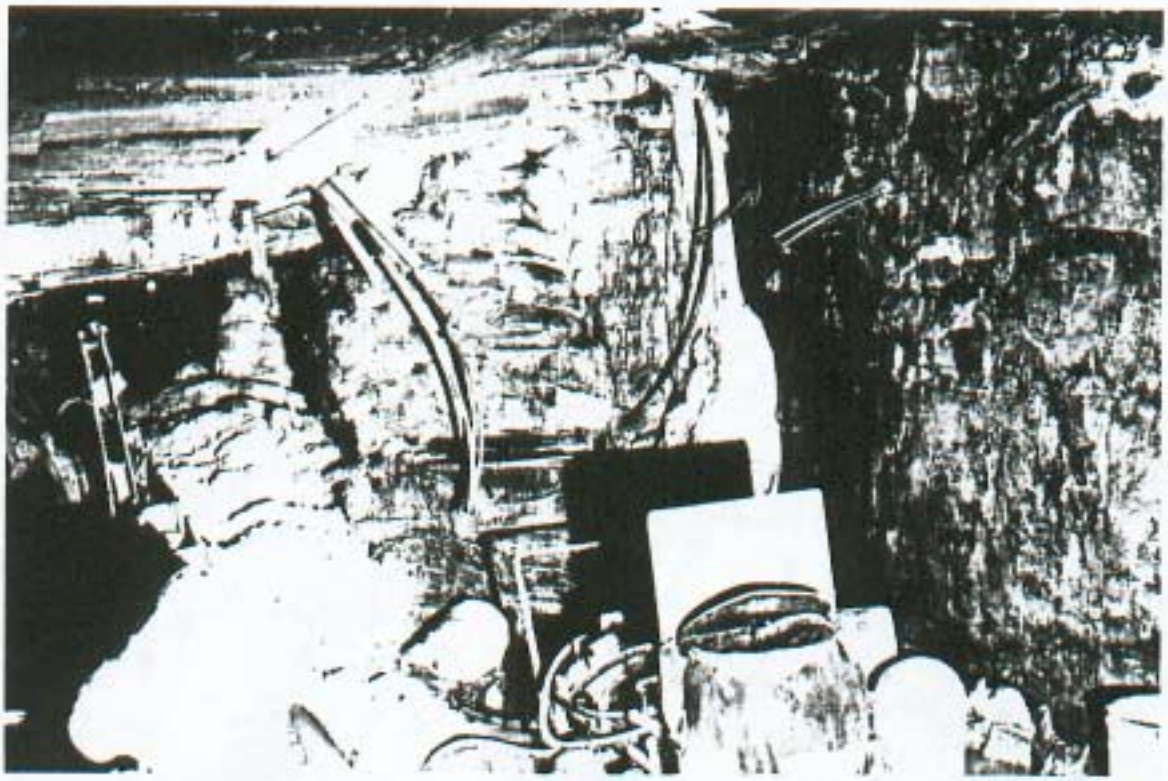
FALLEN ROOF STONE PROTRUDING THROUGH POLYURETHANE BLOCK

14

SINGLE POSITION OF WOOD PALLETS WITHIN STONE DUST WALL

15

SHOWS SYSTEM USED TO INJECT POLYURETHANE



16

R.H. TOP CORNER SHOWS INJECTION TUBES INTO COAL FACE AND ROOF TO BIND STRATA IN ADVANCE OF ROOF CAVITY.

(17)

SHOWS EXTENT OF POLYURETHANE WALL AFFECTED BY FIRE - VIEW FROM TAIL GATE

(18)

SHOWS TAIL GATE END OF POLYURETHANE WALL WITH CAVITIES FORMED WHEN BURNING OCCURRED

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A bagged stonedust compound was erected in order to form a 1.2 metre cube of the polyurethane. On the inside of the compound was draped brattice cloth to contain the polyurethane and across the cube to be formed was placed two temperature probes.

The polyurethane was pumped into the void at the same pumping rate and then allowed to set and cool. A 300mm wide strip was cut to a depth of 25mm from the surface of the formed polyurethane block. It was observed that cavitation within the block was fairly excessive whilst the matrix of the material appeared to be very porus.

A request was made by Chemfix and Arnall-Wickman for a standard Departmental test to be carried out on a prepared polyurethane block, the test result satisfied approval standards.

A second standard test was carried out on a piece of urethane taken from the trial 1.2 metre cube. When the test flame was applied to a flat surface of the block with the material matrix being fairly consistent, there was compliance of approval standards. However, when the flame was applied to an area of the block where the matrix was inconsistent and contained cavities, on ignition the flames then self generated.

LABORATORY TESTS

Samples of emitted fume gases obtained during the pre-ignition period have been analysed. Results show between 0.08% and 0.14% of methane was present with 0.035% Carbon Dioxide and less than 0.0001% of Carbon Monoxide.

A sample of burnt stone dust paper bag saturated by liquid or fume condensate was analysed. The liquid or fume condensate was extracted from the paper then analysed using a GC/Mass Spectrometer. The GC chromatograms showed a mass of peaks of which the major peak was identified as Amiline.

A Draeger tube determination of the fume concentrate showed a very slight indication of cyanide of less than 1 part per million (p.p.m.). The maximum for exposure to cyanide in an 8 hour day is 5 mgm per cubic metre which roughly equates to about 5 p.p.m.

FINDINGS AND COMMENTS

Polyurethane foam has been used in New South Wales coal mines for a number of years as a surface coating to prevent air ventilation leakage through stoppings, and overcasts. They have also proven very effective in the binding of fractured strata thus consolidating poor roof and coal rib sides and have been successful in the sealing of water bearing strata.

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The investigation of this incident at West Cliff Mine shows that due to abnormal roof conditions caused by the geological anomaly of a dyke intruding into the coal seam, dangerous roof conditions were being experienced by workmen. Alternative methods of roof control were considered and due to the success in the use of polyurethane as a strata binder at other coal mines, it was decided to adopt the method to prevent an extension of the existing roof cavity along the face line towards the tail gate end of the face.

On completion and apparent success on the injection into the broken strata of some 600 litres of polyurethane Mr. M. Weekes, Project Engineer, West Cliff sought advice from Chemfix when the point of the roof fall was reached. Mr. J. Schott the Chemfix representative in his statement said "he was called in for a discussion" and "he recommended cables be installed to the roof either side of the fall area to catch the falling stones" and then "pump this area with polyurethane foam". On receiving this advice further discussion took place between the Mine Manager, Undermanager in Charge and Project Engineers in which a joint decision was made to construct the false roof across the fall cavity by using polyurethane contained within a wall of bagged stone dust with brattice cloth draped over the inside of the wall.

It was decided to fill the void using a 20:1 expansion ratio foam and Mr. Schott advises in his statement that "an order had been placed by West Cliff for a large amount of high expansion foam". Chemfix then decided to "carry out a trial in a large mass of polyurethane to check for any problems". On Wednesday 10th December 1986, two trials were commenced by Chemfix at their Nowra factory. A cube of polyurethane measuring 1.2 x 1.1 metres x 900 mm thick was formed in 1-2 minutes with the material not very well mixed. Monitoring of heat generation was carried out by use of a thermo couple and a temperature of 147°c was reached. Approximately 3 hours after pouring a 75mm diameter hole was drilled into the foam block and a vapour slightly brown in colour was emitted from the hole. After a period of 20 minutes the hole was covered and the emission was contained within the foam. With the foam plug still at approximately 140°c the block was cut open and it was found to have cracks but no burning of the foam. A second trial was then carried out forming the cube in about one minute with a better mixed foam. The foam block was cut open the next day (Thursday 11th December) and it was observed there was no signs of foam degradation although some cracks had occurred.

A telex was received at West Cliff Mine from Chemfix (Nowra) at about 11-00 a.m. on Thursday 11th December 1986, advising that pumping of Chemfoam H.F. should cease for 16 hours after each 1000 litres is pumped or alternatively each 1 metre depth of foam is achieved. This advice received by Undermanager in Charge Harrington was relayed to Arnall-Wickman's on site engineer Mr. R. McKenzie who was underground at the Longwall 7 site.

WEST CLIFF MINE -

Section 89. Coal Mines Regulation Act, 1982.
Report of an Investigation into the Notification of a Dangerous Occurrence.
A fire occurred on Longwall 7 Coalface at 12-45 a.m. on 13th December, 1986, when a block of polyurethane foam being used to fill a roof cavity self ignited.

AVOIDABLE

The Arnall-Wickman site engineer Mr. R. McKenzie had made an underground inspection on Wednesday 10th December to determine their pumping procedure to place the polyurethane plug.

On Thursday 11th December at about 3-00 a.m. pumping commenced with the placing of the 20:1 ratio polyurethane into the cavity. Operations ceased at about 10-15 a.m. when 1300 litres had been pumped in approximately 7½ hours. On receiving information from the Undermanager in Charge concerning the quantities of polyurethane to be pumped Mr. McKenzie then returned to the surface of the mine.

Pumping ceased for about 17½ hours and recommenced at 4-00 a.m. on Friday 12th December, when Mr. McKenzie then pumped 1100-1300 litres into the cavity between 4-00 a.m. and 7-10 a.m.

The Mine Manager in his report of the incident advises that the Chemfix supervisor had indicated that "in order to reduce the application time, the pump rate could be doubled", so the second application of 1300 litres of polyurethane was consequently placed in approximately 3½ hours.

It would appear that this increased pumping rate was not conducive to good mixing of the two parts of polyurethane in that an exothermic reaction took place and the polyurethane block self ignited.

A further inspection of the burnt area of the polyurethane plug showed that large pieces of roof stone had fallen and penetrated the polyurethane plug. The rock extended into the first pumped block and was adjacent to the brattice and the position of the wood pallets.

The rocks then extended into the second pumped block and there appeared to be a channel to the cavity surface of the polyurethane, this channel had allowed stonedust and water to pass during fire fighting operations. There was no polyurethane adhered to these large pieces of rock which was indicative that the rock must have fallen after the emplacement of the polyurethane thereby puncturing the urethane and creating an air path. I would be of the opinion that when the exothermic reaction took place this was further accelerated by the inefficient mixing of the polyurethane, and the heat generated was assisted by a flow of air through the plug to ignite the wood pallets within the wall of the stonedust. Once this had occurred the fire within the urethane plug was self generating.

Further to this the building of the 1170mm (47 ins.) wide stonedust wall with brattice on the inside prevented the conduction of heat generated by exothermic reaction from being cooled by the passing mine ventilating. A further point was the fact that when the white smoke was seen coming from the upper surface of the polyurethane into the cavity, a layer of stonedust was injected into the cavity onto the polyurethane. Although this may have had an initial effect in cooling the plug it then acted as an insulator preventing heat dissapation and thereby further increasing the heat within the polyurethane plug and accelerated ignition.

WEST CLIFF MINE -

Section 89. Coal Mines Regulation Act, 1982.
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AVOIDABLE

Enquiries have been made with respect to the ignition temperature of polyurethane. Advice received from an I.C.I. representative indicates that ignition temperature is in the order of 350°c and polyurethane when correctly mixed should be light yellow in colour. If the colour is brown to black then non-mixing has occurred.

Samples of mixed polyurethane taken from the underground plug and from the simulated surface trial at West Cliff showed the colour as being grey to black which was indicative there was non-mixing of the polyurethane.

Reference is now made to a publication by the United States Bureau of Mines on 'Fire Hazard of Urethane Foam in Mines'. The report states that research has shown that spontaneous ignition can develop in a thick mass of urethane foam made from inadequately mixed chemicals. Foam less than 6 inches thick or those of any thickness that are made from adequately mixed chemicals have not ignited spontaneously in practice or in research. Spontaneous ignition has been demonstrated by spraying foam into a box and while spraying, the isocyanate and resin hoses are alternatively and partially closed for short periods. Immediately after spraying a 1 inch diameter hole is punched through the foam mass. When natural ventilation is allowed to pass through the hole, smoking and flaming generally occurs with 2 to 3 hours.

CONCLUSION

Evidence shows that the fire which occurred in a block of polyurethane placed in the cavity of a roof fall on Longwall 7 on 13th December, 1986, at West Cliff Mine was caused by the inadequate mixing of Chemfoam H-F Part 1 and Part 2 polyurethane high expansion foam.

It would appear that the first mix of 1300 litres of foam which had been placed during a period of 7 hours had cured satisfactorily. When the second 1100 litres were placed in 3 hours an exothermic reaction took place which was accelerated when a fall of roof occurred which punctured the polyurethane block causing a passage of air to flow. The resultant heat generated self ignited the polyurethane block and because wood pallets and stone dust bags were in close contact with the polyurethane, heat was transmitted to ignite the wood pallets.

The occurrence of a fire in a block of polyurethane placed with the intent of filling a void in the roof on a coal face should be classified as avoidable in that the polyurethane was not approved for that purpose and should not have been used. The conditions of Approval No. MDA Non-Ex 1469 specifically states "This approval only applies to the polyurethane strata binder system described in the application dated 17th December 1985, and any variation in its composition or method of use without prior approval, shall revoke the approval.

WEST CLIFF MINE -

Section 89. Coal Mines Regulation Act, 1982.
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AVOIDABLE

I now refer to the contravention of the Coal Mines Regulation Act and advise that inmy opinion certain Sections of the Act were contravened and therefore legal proceedings should be initiated.

COAL MINES REGULATION ACT 1982 - SECTION 160(b)
A person who negligently does at a mine anything likely to endanger the safety of the mine or the safety or health of persons at the mine shall be guilty of an offence against this Act.

1) *The Mine Manager was negligent in that he failed to recognise the conditions of the Approval No. MDA Non-Ex 1469 and did in using the polyurethane contrary to approval conditions endanger the safety of the mine and persons therein.*

2) *COAL MINES REGULATION ACT 1982 - SECTION 160(b) (1) (n) (o)*
SECTION 160(b)
Arnall-Wickman Pty., Limited was negligent in that they failed to comply with the conditions imposed in the Approval No. MDA Non-Ex 1469 and in so doing did endanger the safety of the mine and persons therein.

SECTION 160(1)
Arnall-Wickman failed to comply with provisions of the Act in that they contravened "Coal Mines Regulation (Approval of Items) Regulation 1984 Clause 6(4)(c).

SECTION 160(n)(o)
Arnall-Wickman failed to comply with a direction given to them by the Chief Inspector in that they did not comply with a condition imposed on them in accordance with a provision of the Act.

In concluding this investigation I would like to pass comments on the role of Chemfix Pty.Ltd., in the incident. The Chemfix Engineer Mr. J. Schott in his statement recommended the use of polyurethane foam albeit the intention may have been to try and form a canopy of fallen roof material on top of cables and then pump polyurethane above the loose material. The management of the mine was led to believe the polyurethane foam could be used as a void filler. Further to this the labels attached to the containers of polyurethane high expansion foam advise in the case of Chemfoam H-F Part 1 its application is 'FOR VOID FILLING' whilst Part 2 application is 'FOR CONSOLIDATION OF FRIABLE STRATA' (Copy Attached). A second point of note was the fact that Chemfix on receiving an order from West Cliff Mine for a large amount of high expansion foam then decided to carry out trials in a large mass of polyurethane to check for any problems.

From these trials recommendations were then made to West Cliff Mine, this would indicate Chemfix were not too sure on the reaction of bulk mixing polyurethane.

WEST CLIFF MINE -

Section 89. Coal Mines Regulation Act, 1982.
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A fire occurred on Longwall 7 Coalface at 12-45 a.m. on 13th December, 1986, when a block of polyurethane foam being used to fill a roof cavity self ignited.

AVOIDABLE

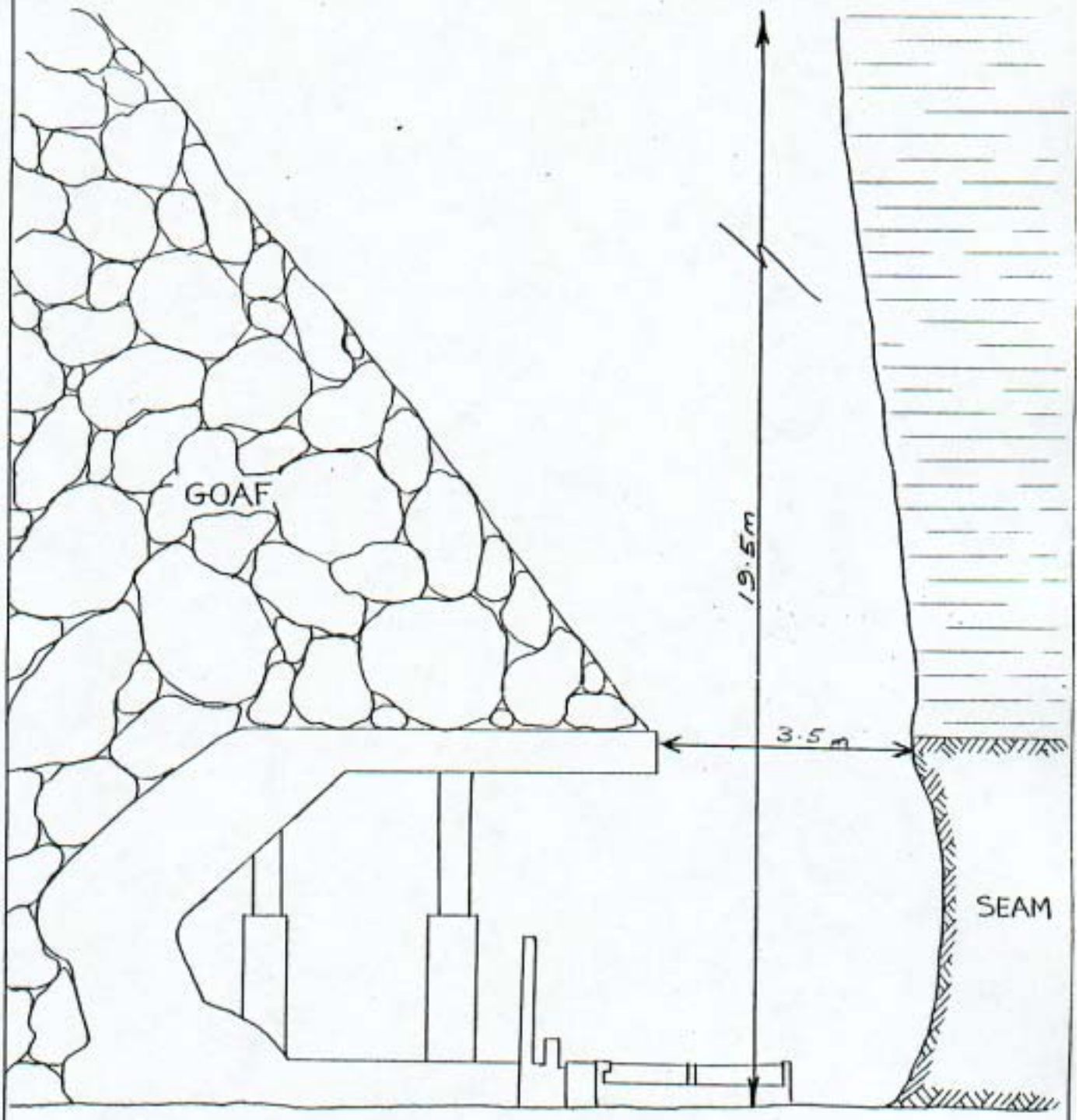
ATTACHMENTS:

1) Manager's Notification.
2) Site Plans.
3) Witness Statements (8).
4) Mine Manager's Report.
5) Statement R. McKenzie of Arnall-Wickman Pty.Ltd.
6) Statement J. Schott - Chemfix Pty.Ltd.
7) Report on Examination of L.W.7 Area - A.R. Aiken, Technical Manager - Chemfix.
8) Report on Samples - L.W.7 Face - G. Fawcett, Mine Safety Unit, Lidcombe.

Ron Smith,
Inspector of Coal Mines
13.3.87

Senior Inspector of Coal Mines

FIGURE 1



SKETCH SHOWING FALL IN L.W.7 FACE.

LONGWALL 7 COAL FACE

VIEW LOOKING TOWARDS MAIN GATE SHOWING ...SKE INTRUSION INTO COAL SEAM AND ROOF STRUCTURE

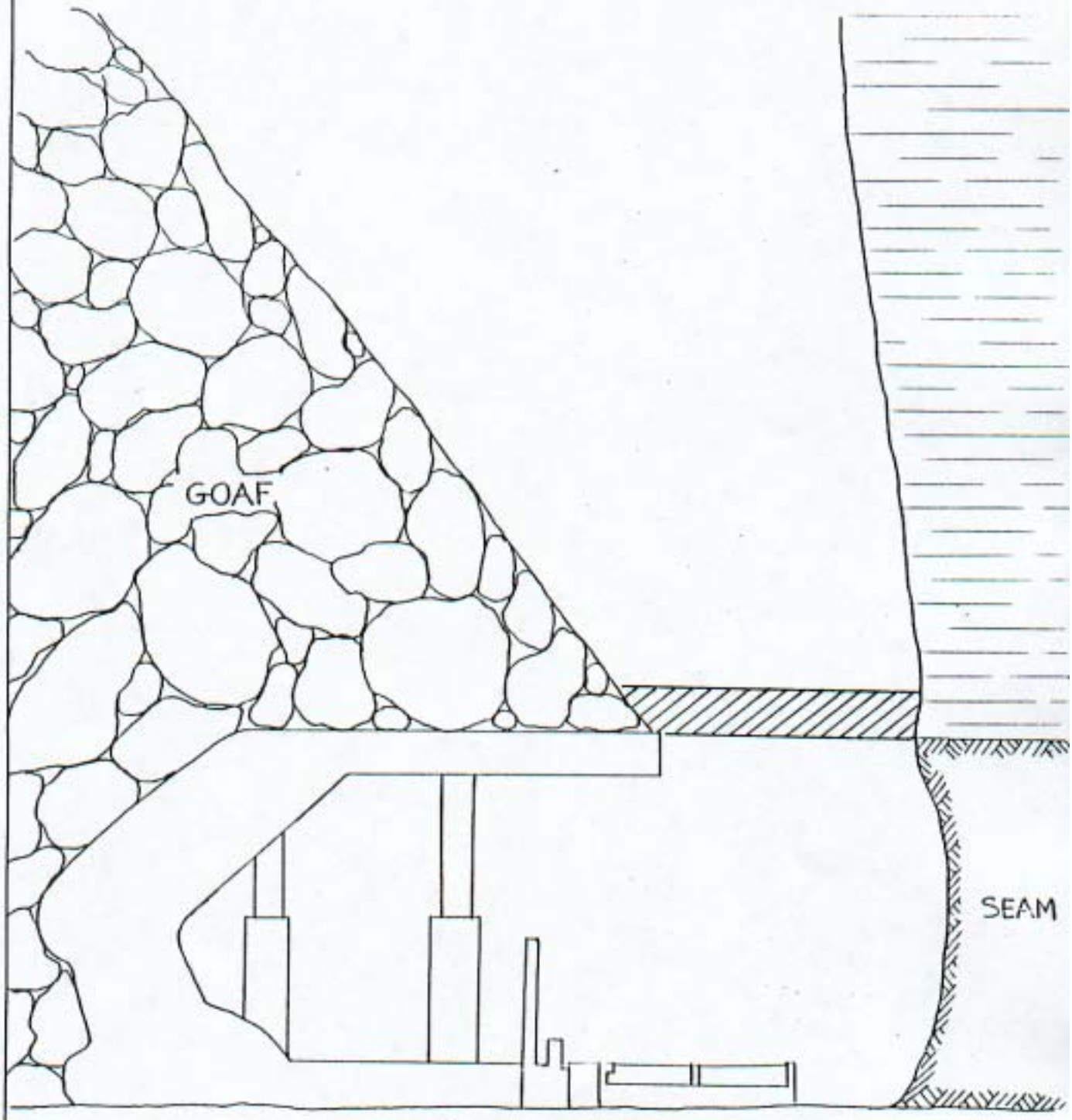
LONGWALL 7 COAL FACE

VIEW LOOKING TOWARDS TAIL GATE SHOWING FRIABLE ROOF STRATA AND STRUCTURE

LONGWALL 7 FACE

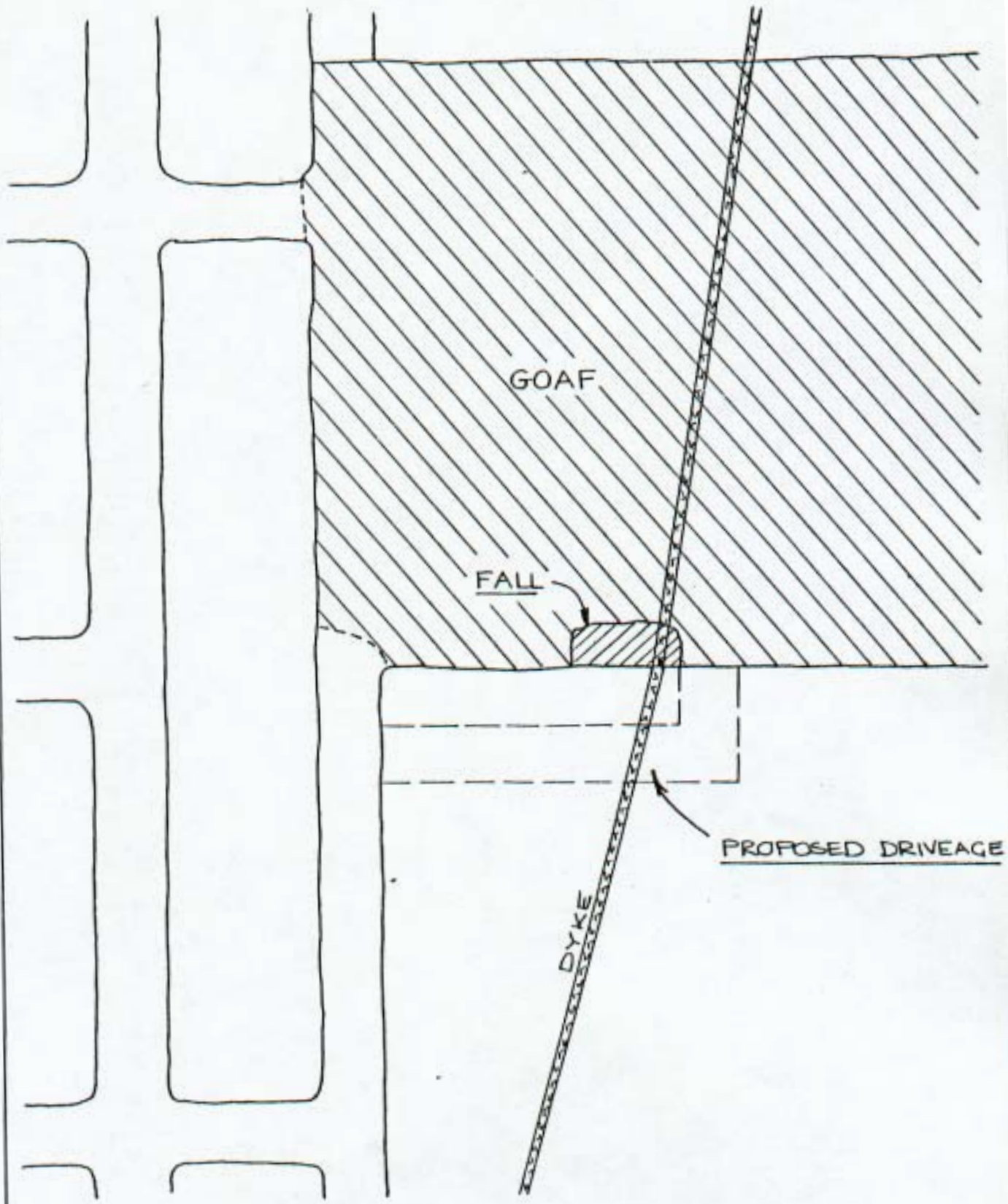
VIEW LOOKING INTO CAVITY SHOWING EXTENT OF ROOF FALL

FIGURE 2.



SKETCH SHOWING PROPOSED FALSE ROOF.

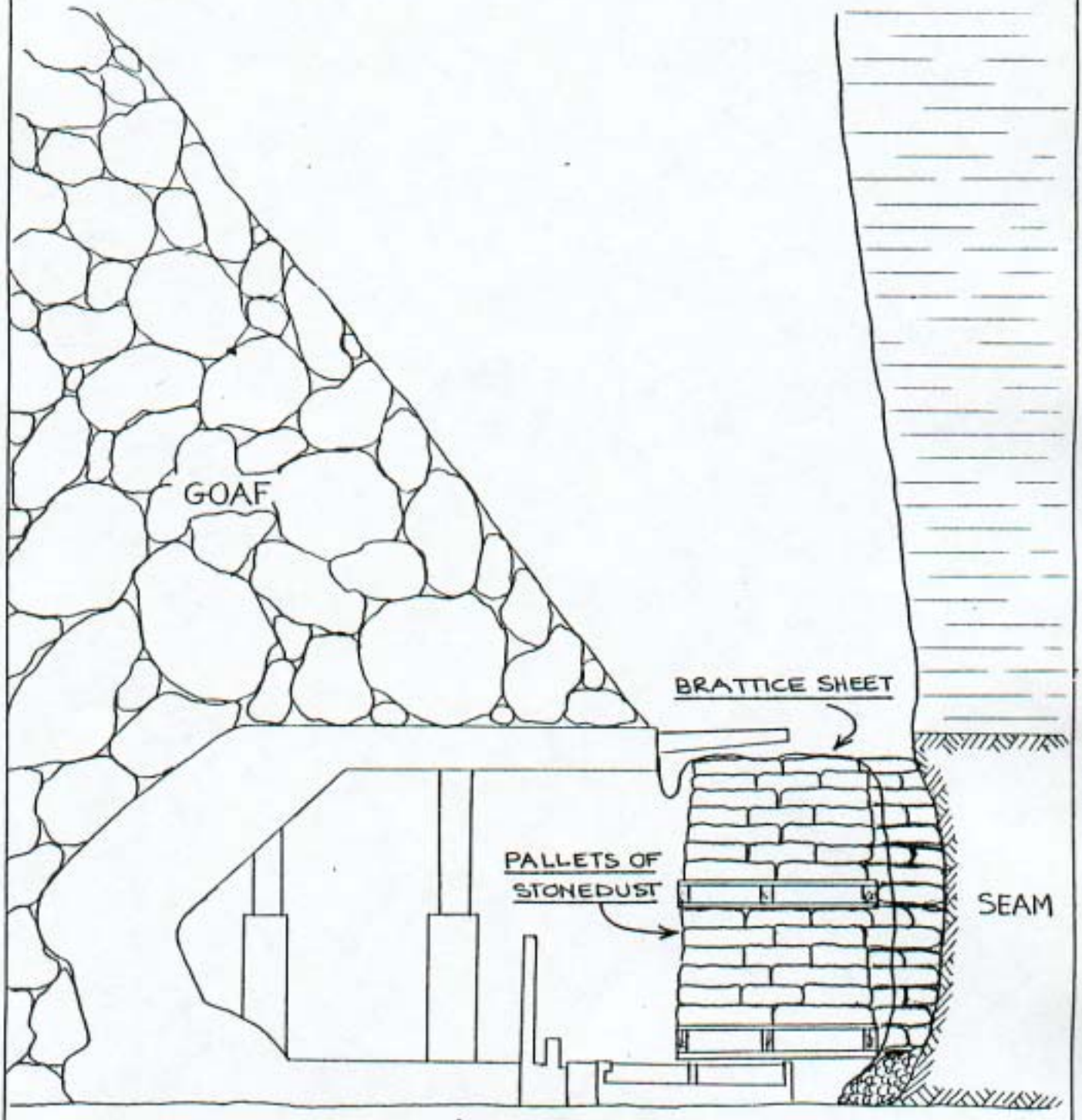
FIGURE 3.



PROPOSED DRIVEAGE TO SHORTEN THE LONGWALL.

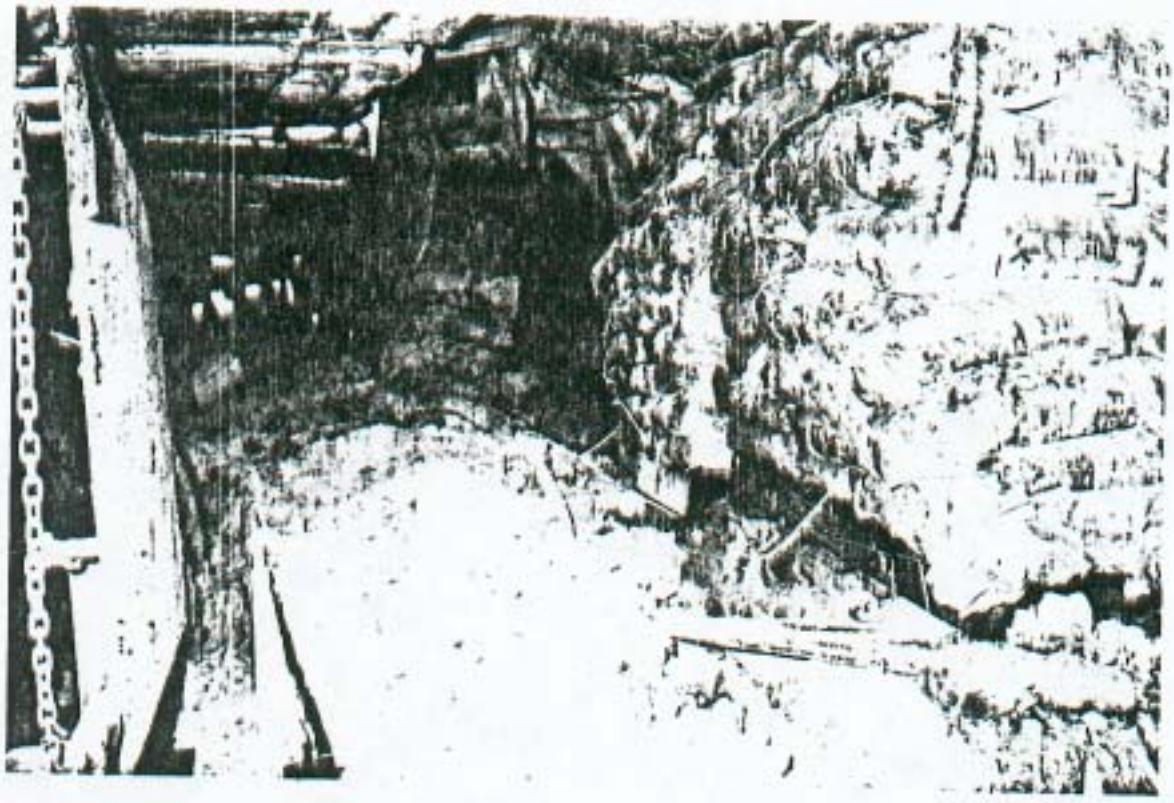
PLAN VIEW.

FIGURE 4



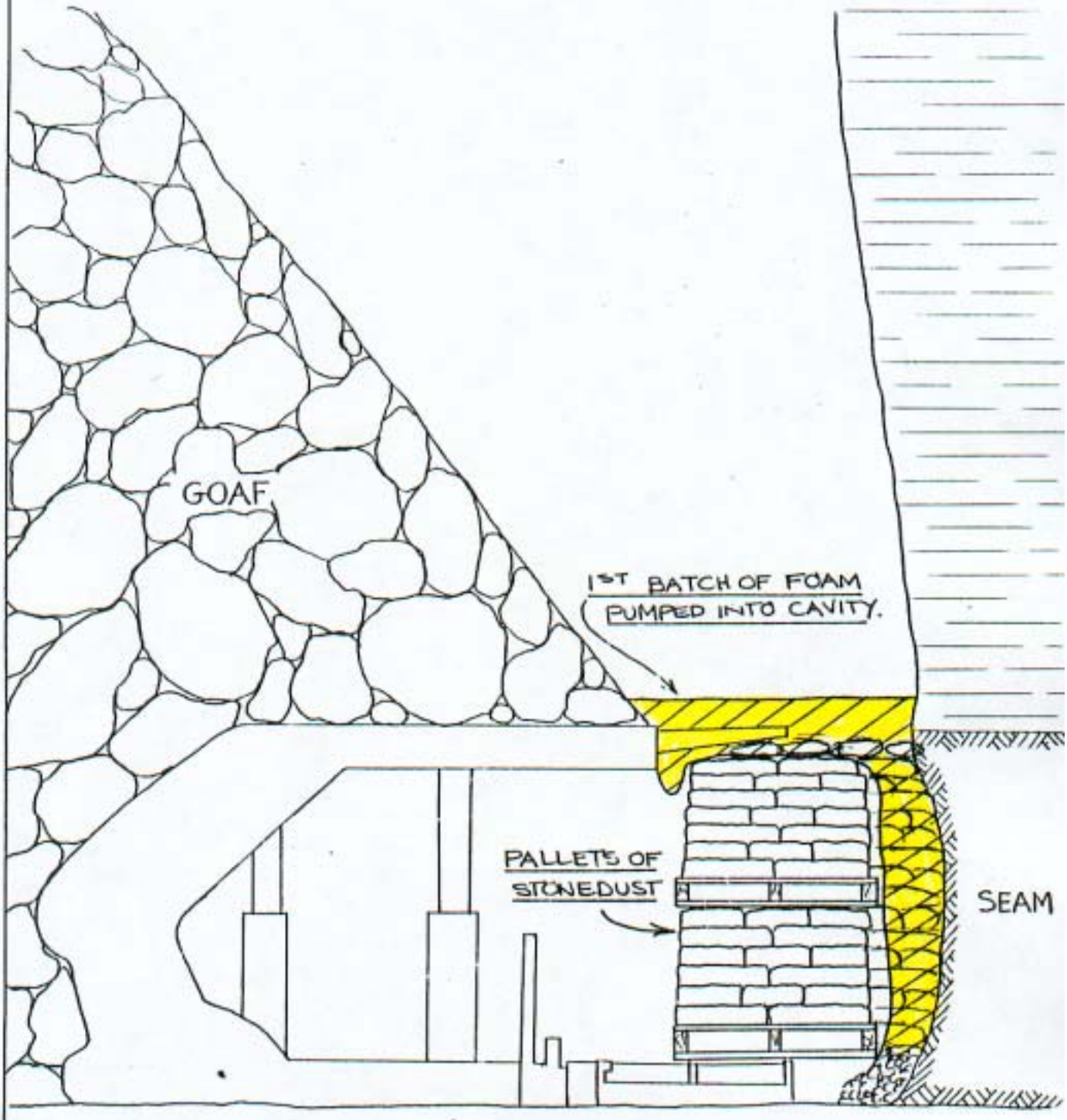
SKETCH SHOWING POSITION OF STONEDUST BAGS AND BRATTICE SHEET PRIOR TO INSTALLATION OF POLYURETHANE.

PHOTOGRAPH 4



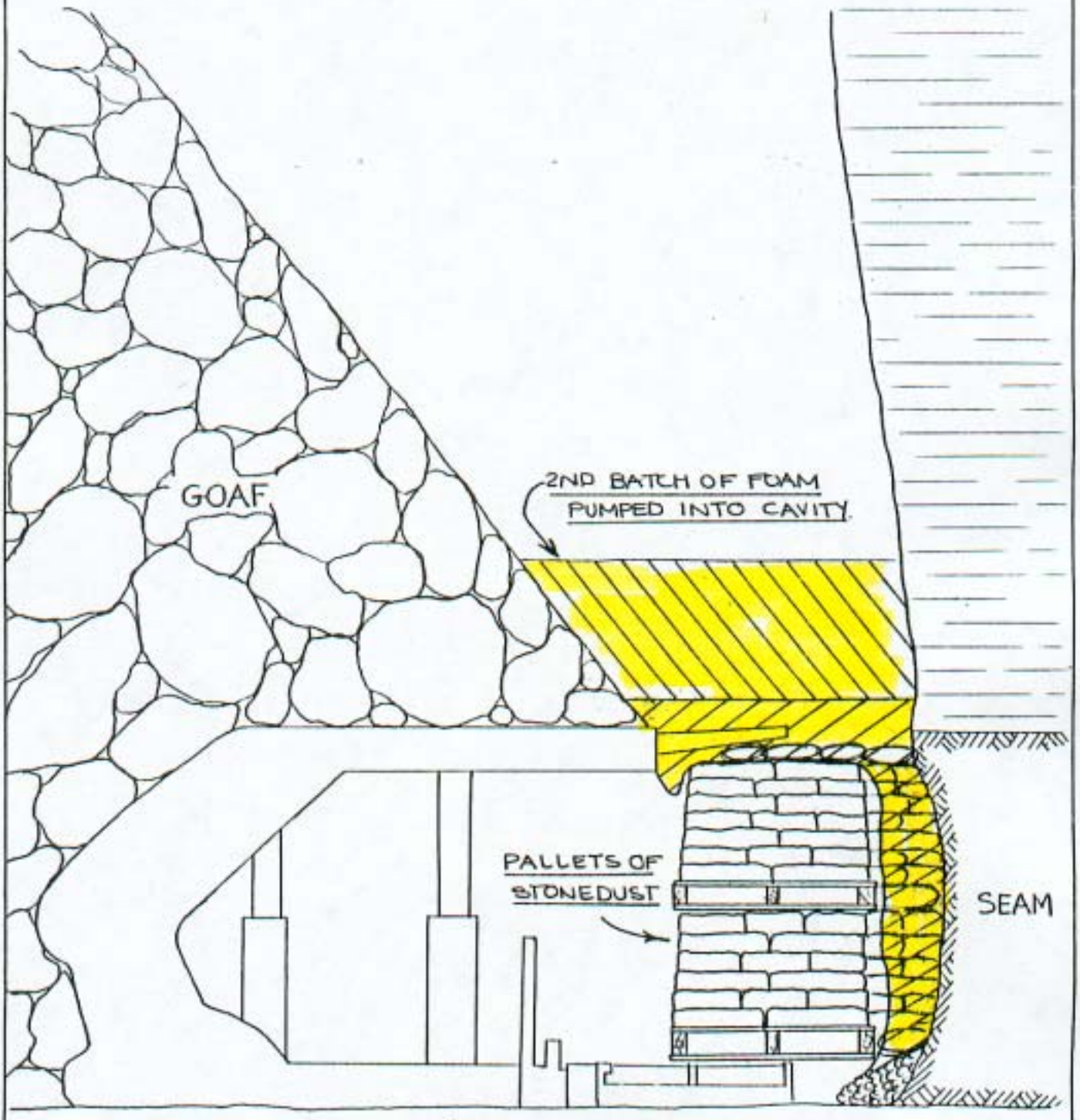
SHOWING METHOD USED TO ERECT STONE DUST WALL BY USE OF BAGS OF STONEDUST OR WOOD PALLETS

FIGURE 5.



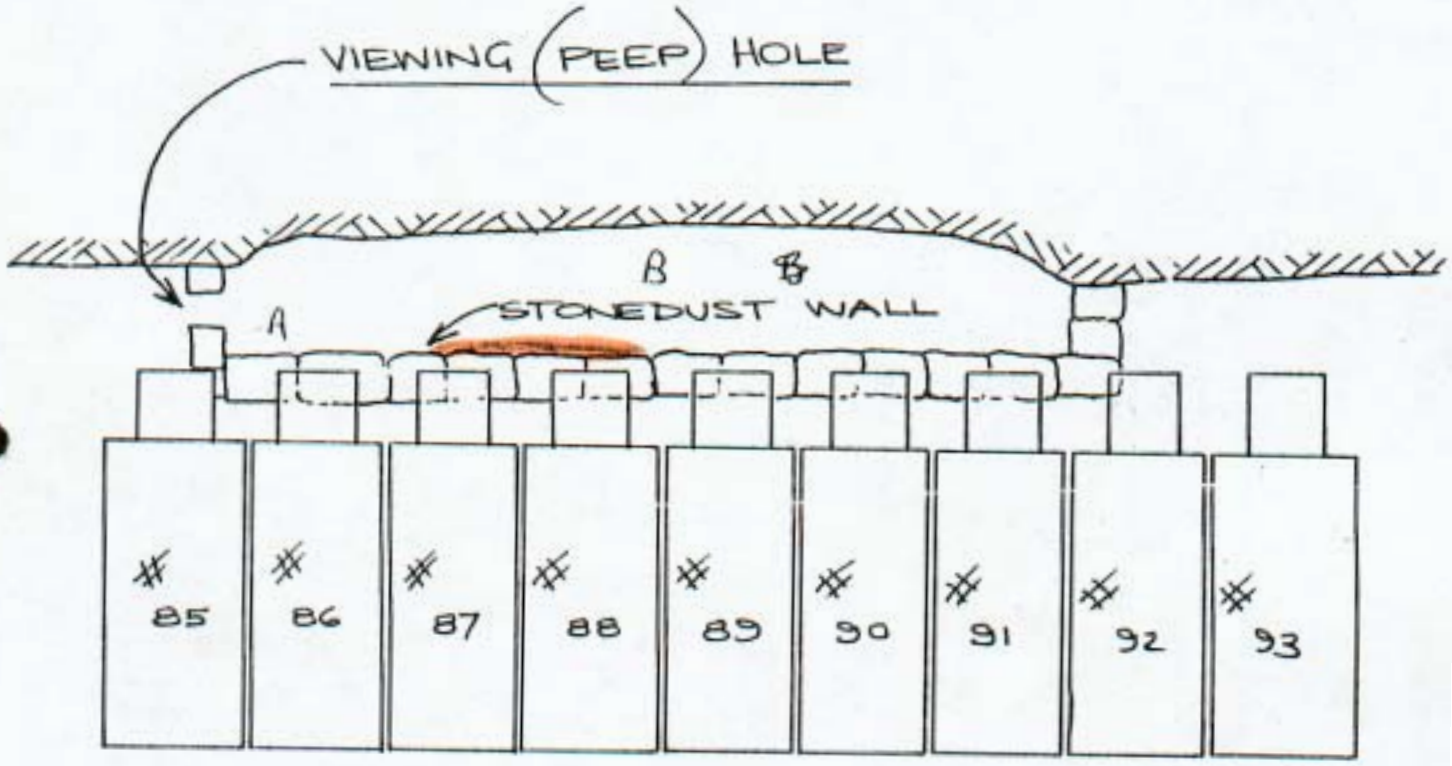
SKETCH SHOWING FIRST BATCH OF FOAM PUMPED INTO CAVITY.

FIGURE 6.



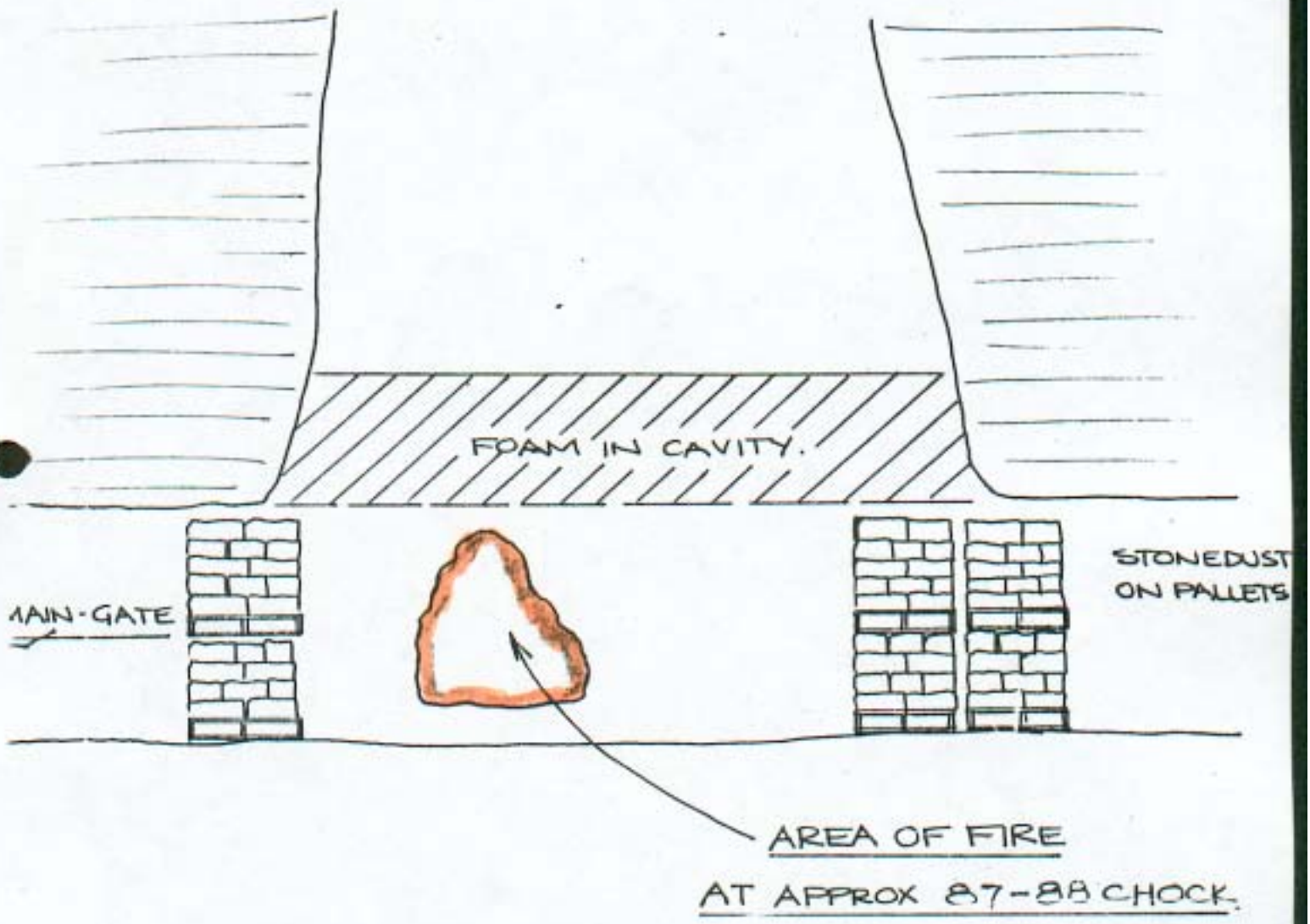
SKETCH SHOWING SECOND BATCH OF FOAM PUMPED INTO CAVITY.

FIGURE 7



SKETCH SHOWING LOCALITY OF VIEWING (PEEP) HOLE.

FIGURE 7



SKETCH SHOWING LOCALITY OF FIRE.

N.T.S

COAL MINES REGULATION ACT, 1982

SECTION 89.

Notification of Dangerous Occurrence or Buried Continuous Miner

Name of mine WEST CLIFF

Where situated APPIN N.S.W.

Name of manager R RUSTON

I hereby send you notice of a *Dangerous Occurrence/~~Buried Continuous~~ Miner which took place at this mine at 12.45 a.m./~~p.m.~~ on 17th DECEMBER 1986.

Place of occurrence:

20cm from the Tail gate Long wall 7 face.

Nature of occurrence:

A fire in a block of polyurethane foam used to secure and form a roof in a fall area on the face of the Long wall

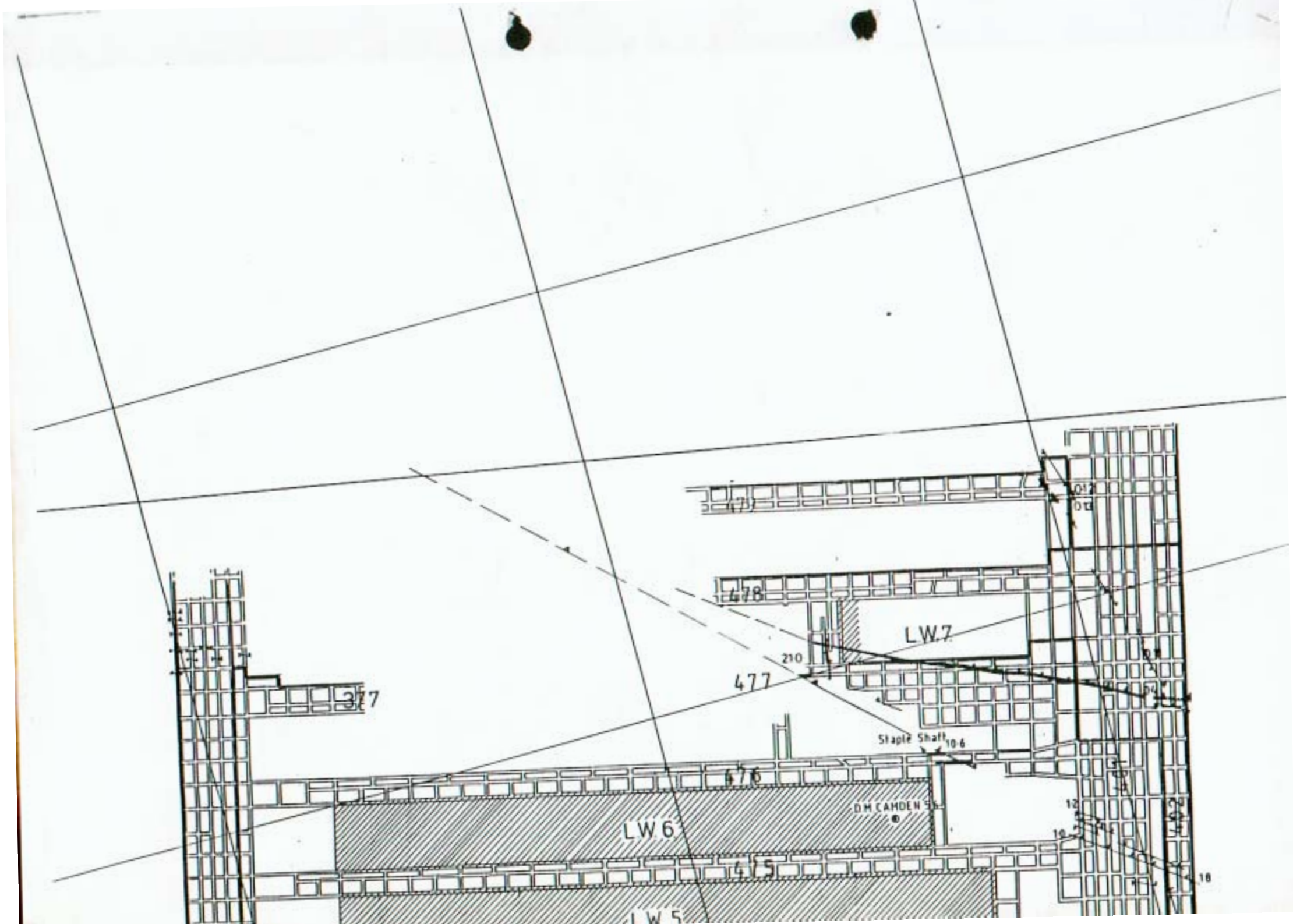
Signed R. R. (Manager)

Date 14-12-86

* Delete as applicable

NOTE: Oral notice to be given forthwith to District Inspector and District Check Inspector. This report to be submitted within twenty-four hours next after the occurrence.

S15B46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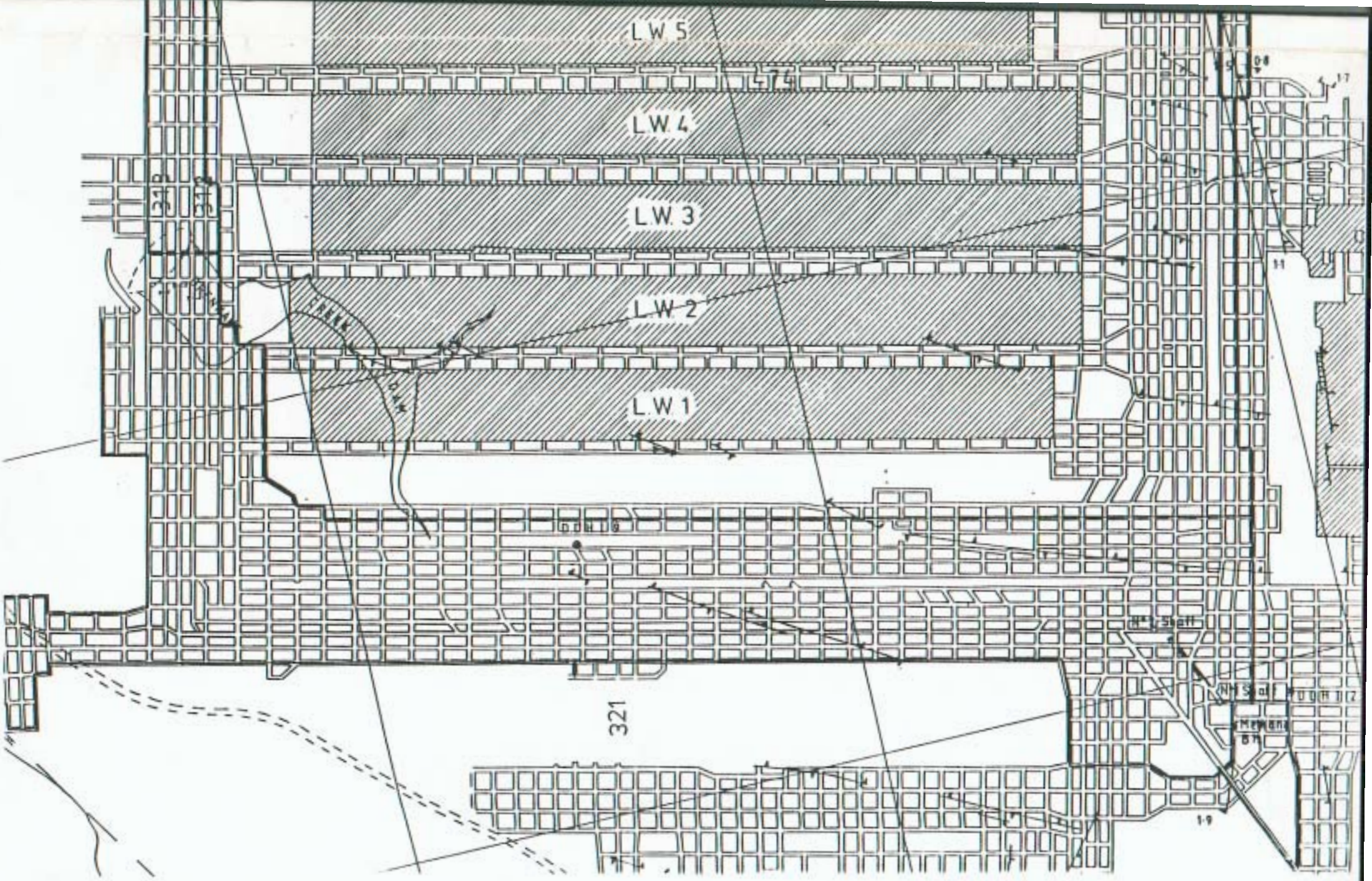
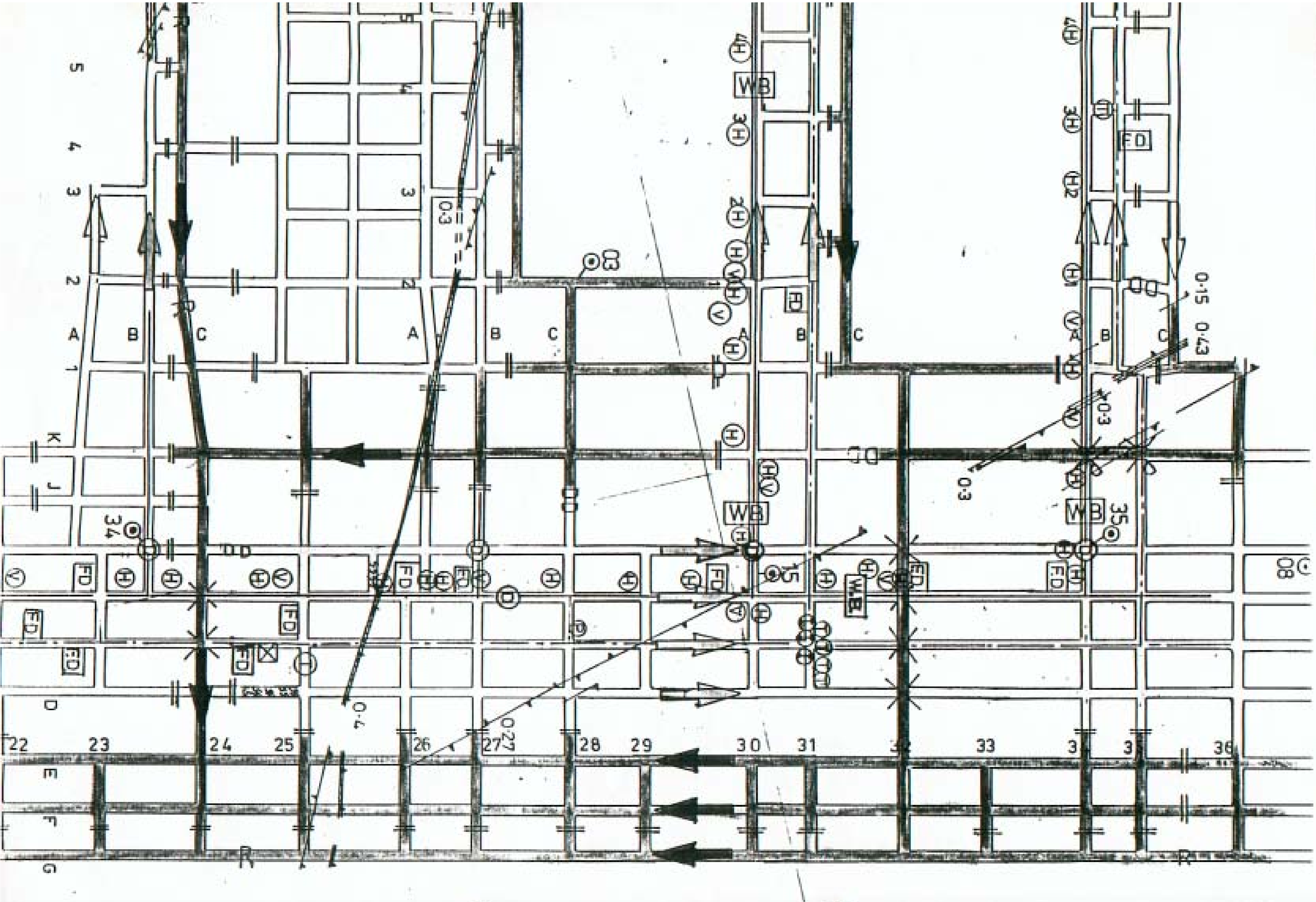
LW.7
210
477
377
Staple Shaft 10·6
476
D.M.CAMDEN
LW.6
475
LW.5


L.W.5
L.W.4
L.W.3
L.W.2
L.W.1
321



WB
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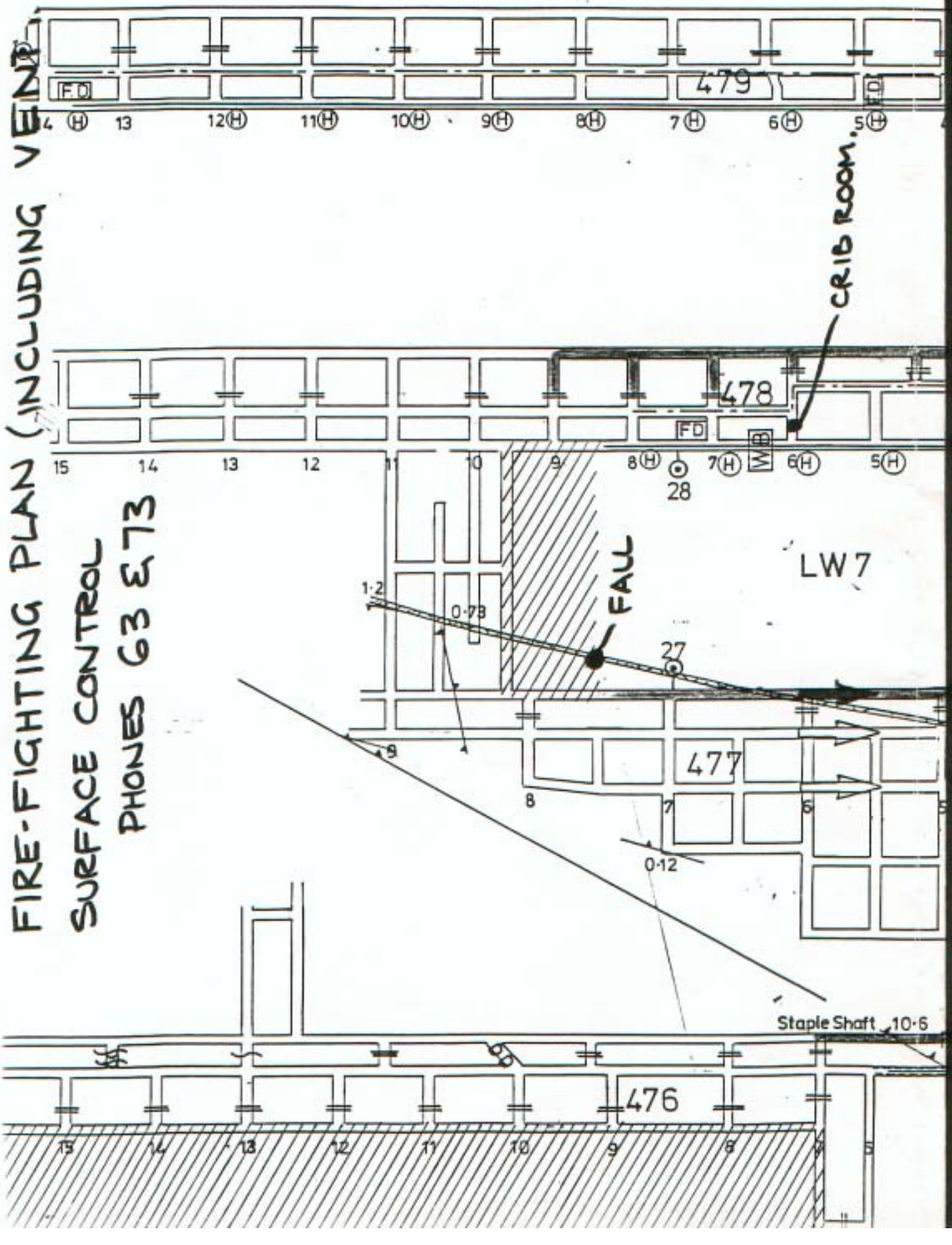
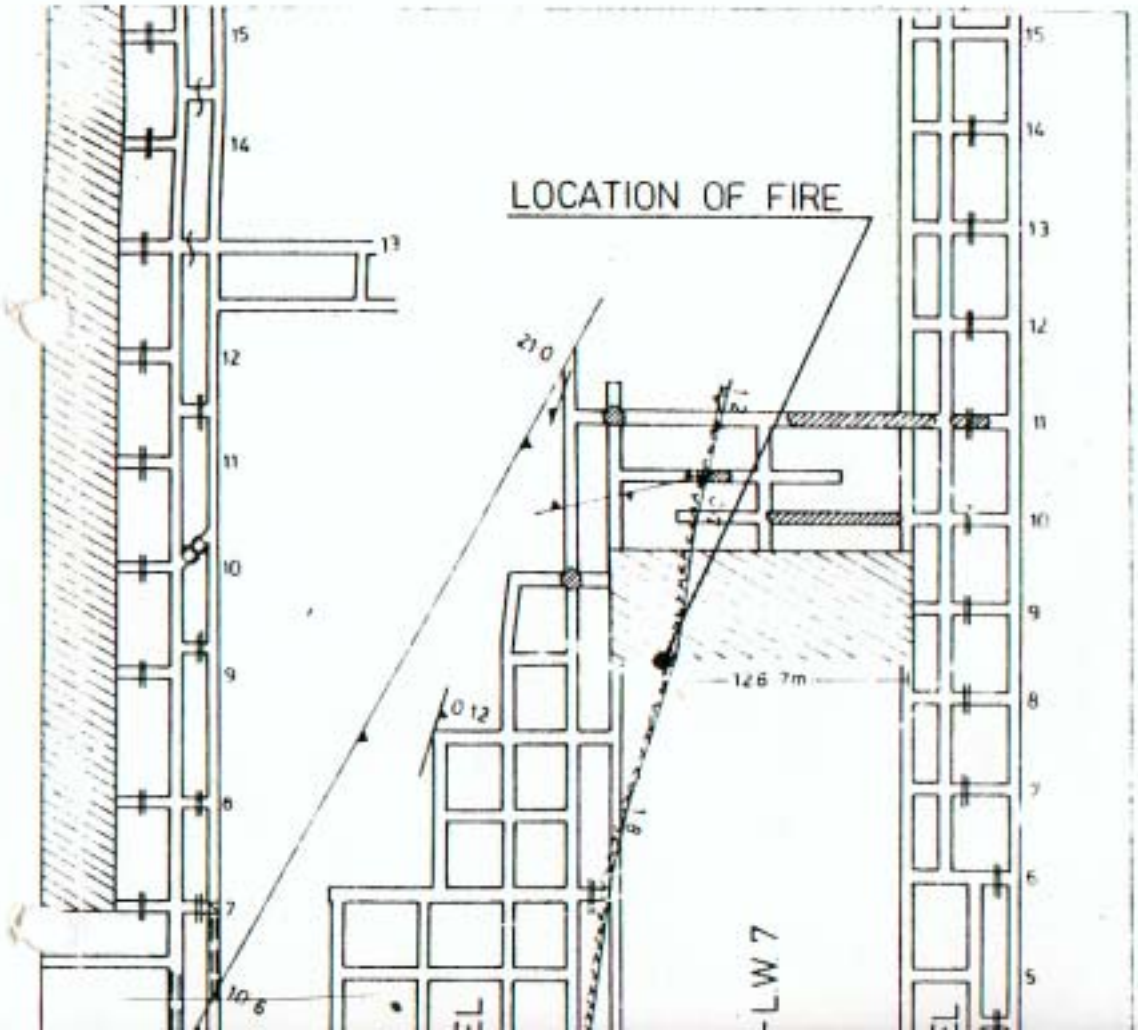
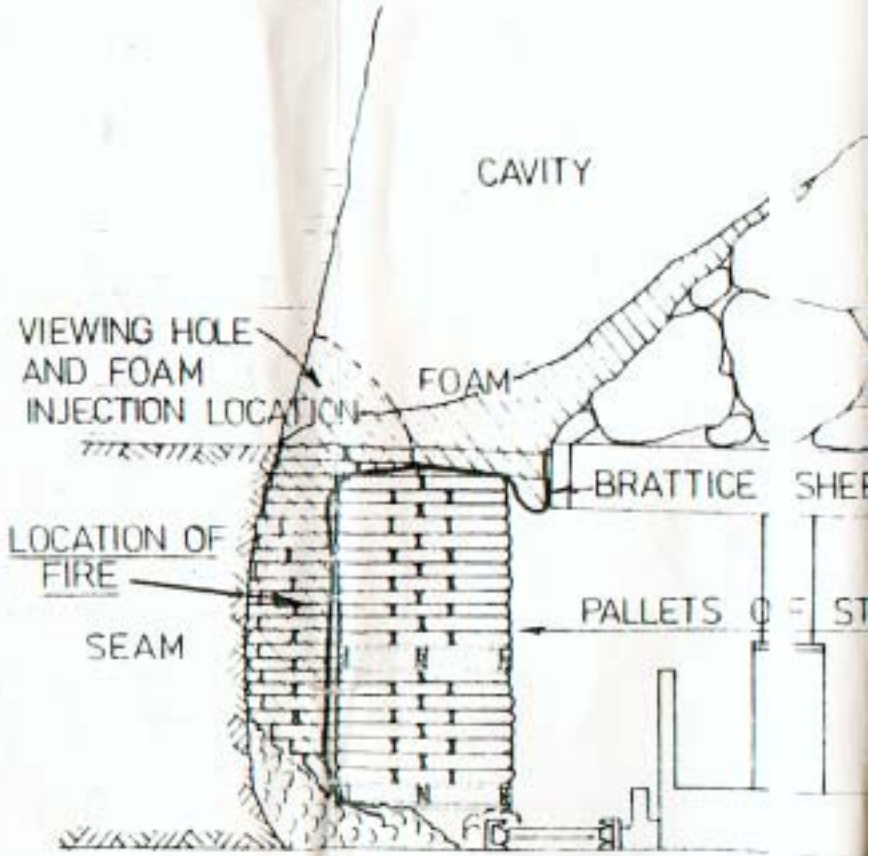

FIRE-FIGHTING PLAN (INCLUDING VENT
SURFACE CONTROL PHONES 63 & 73
479
478
477
476
CRIB ROOM.
FAULT
LW7
F.D
28
27
1·2
0·73
0·12
Staple Shaft 10·6

PLAN SHOWING L OC

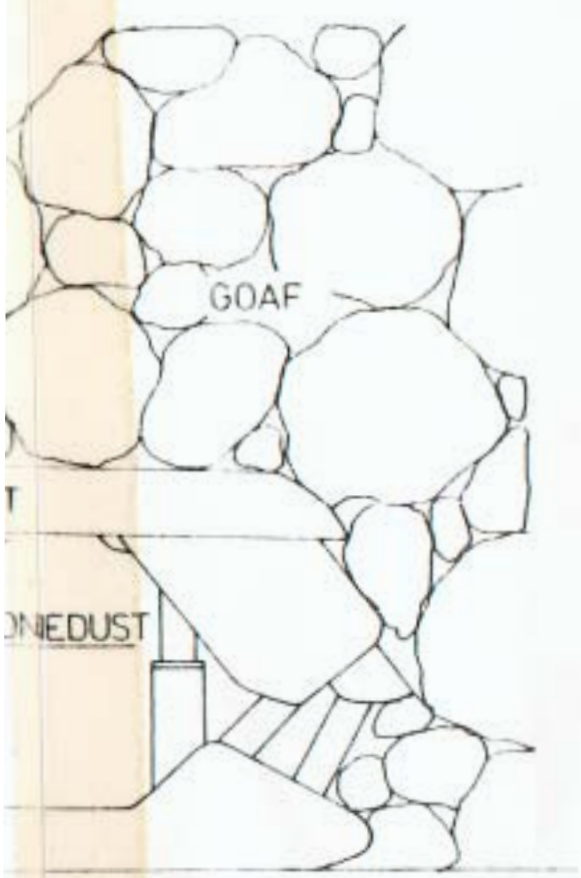
LONGWALL 7 — 1



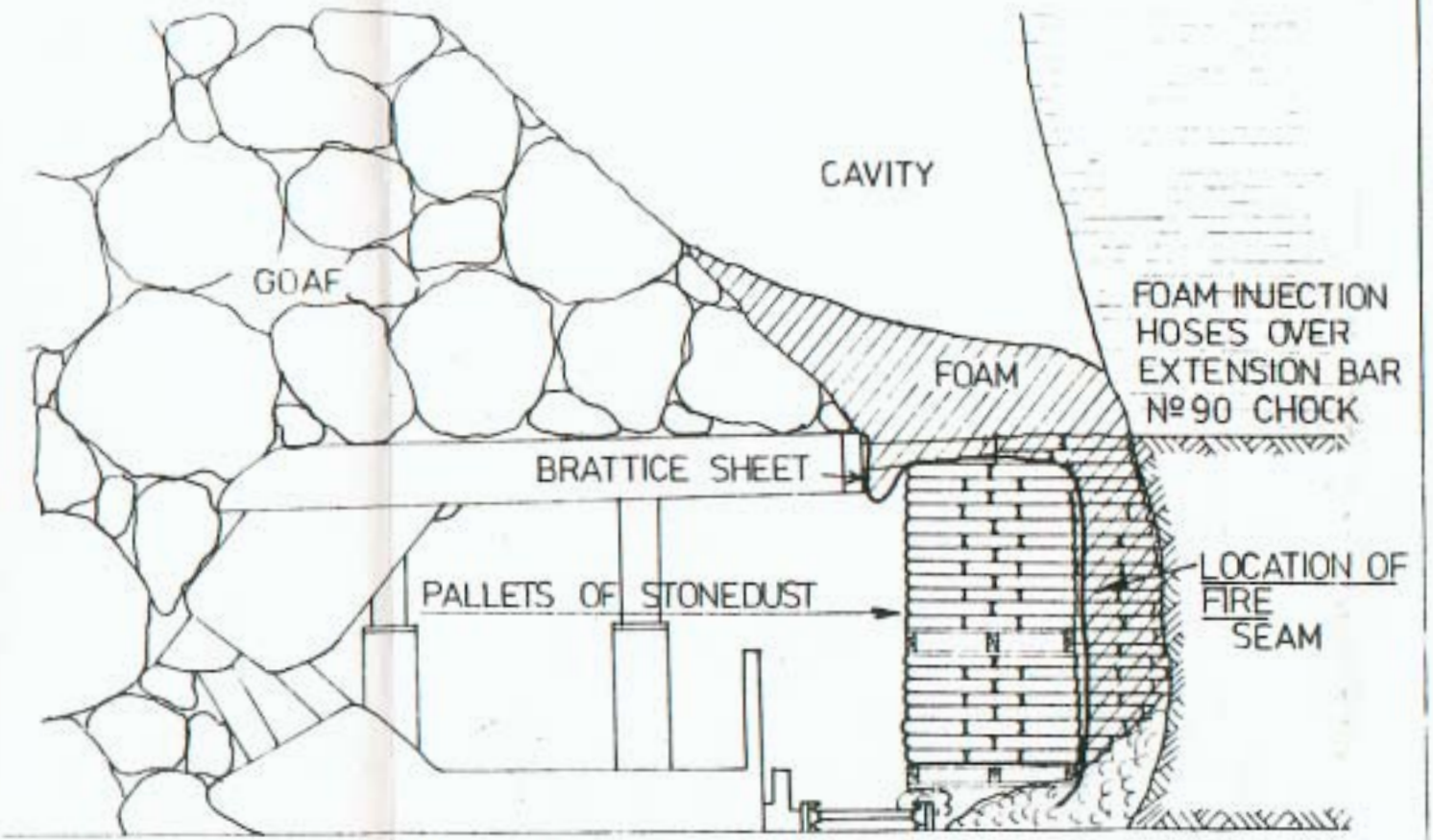


ATION OF FIRE ON

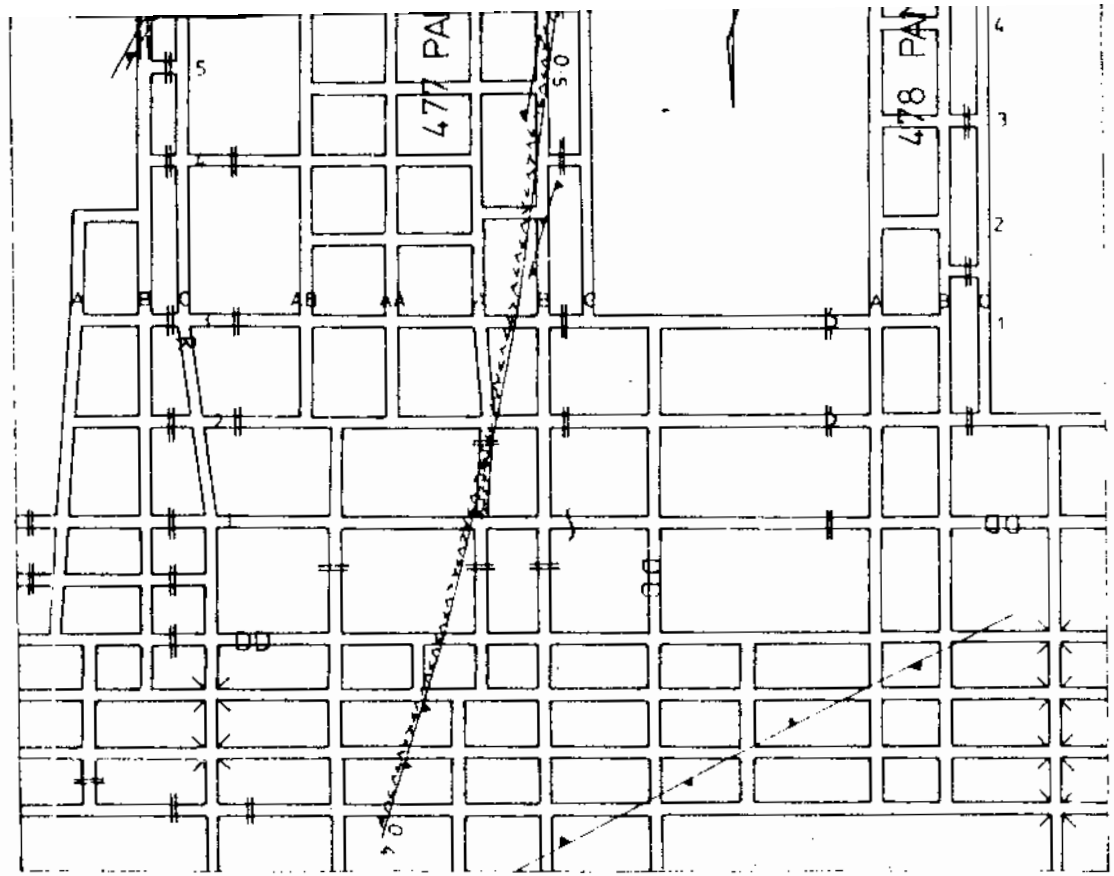
-12-86.



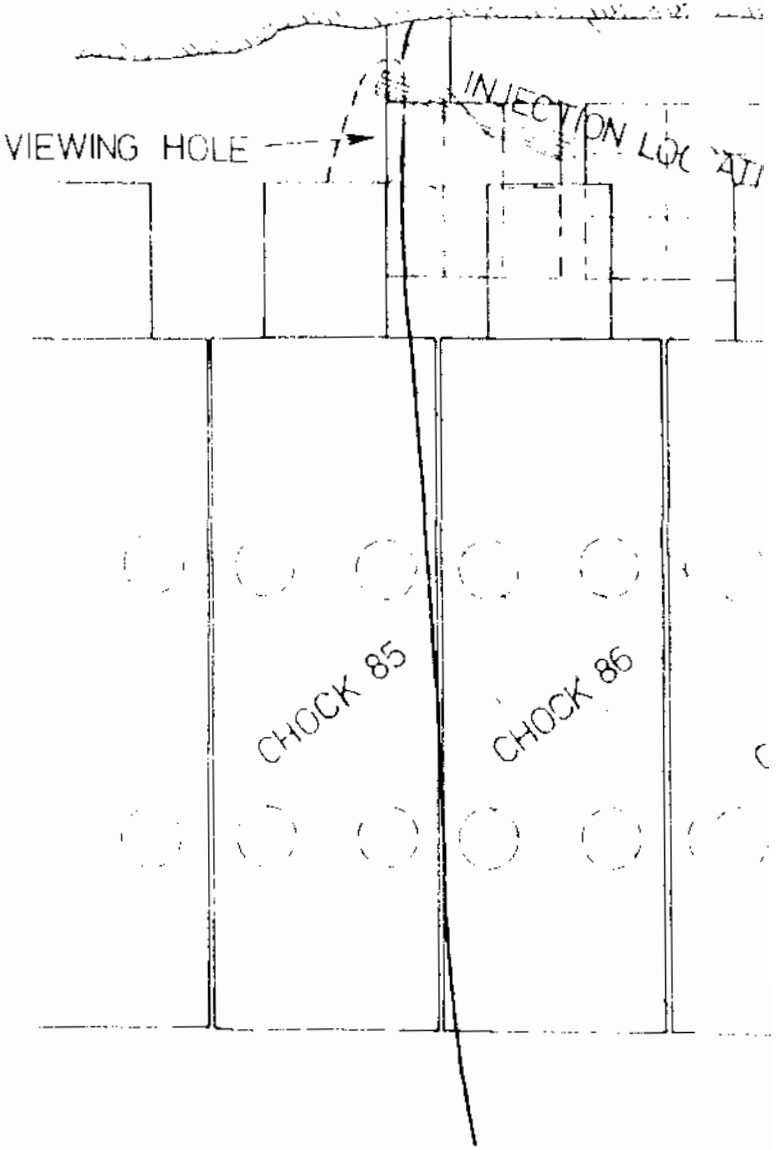
IGATE END



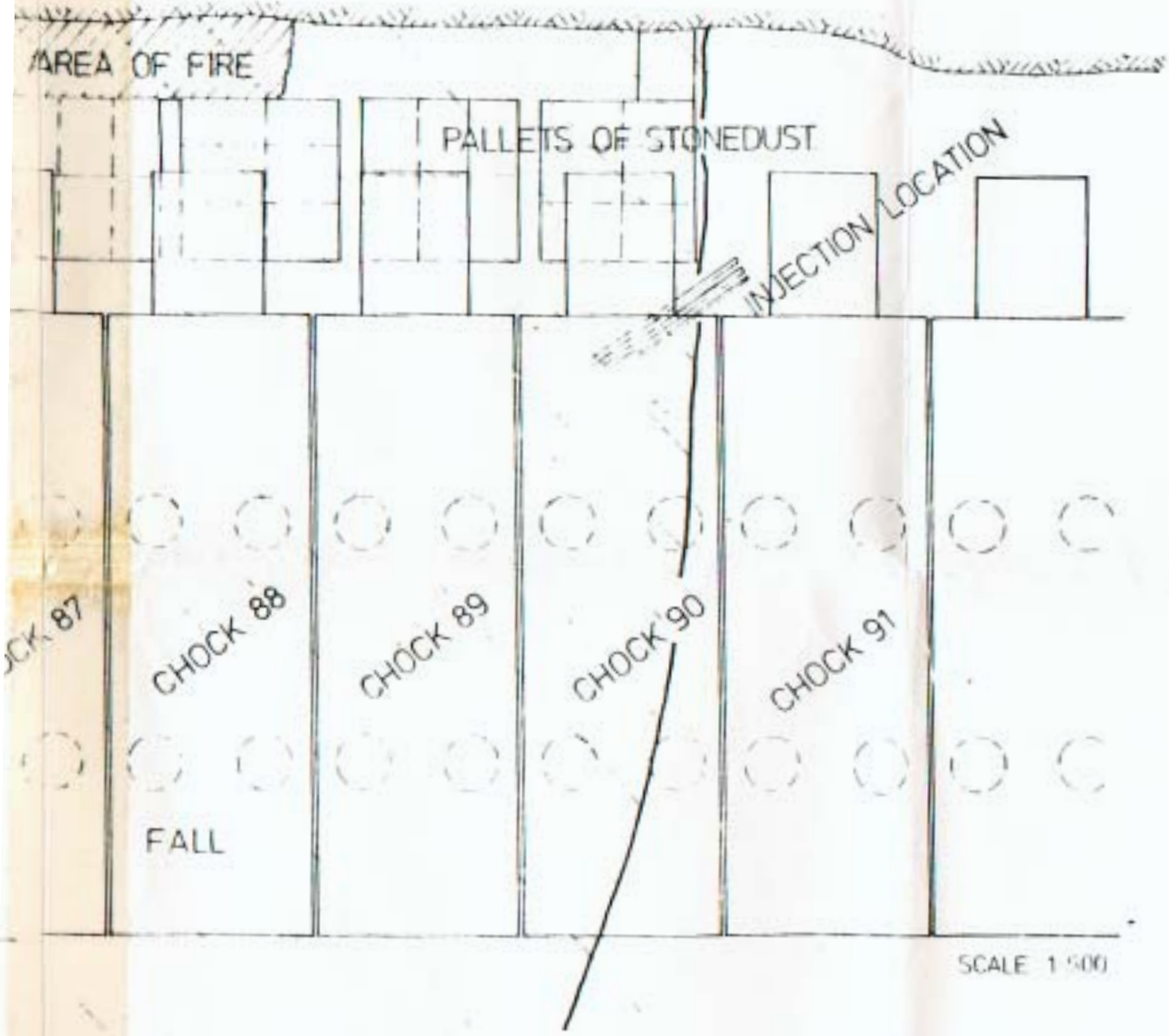
VIEW FROM TAILGATE END



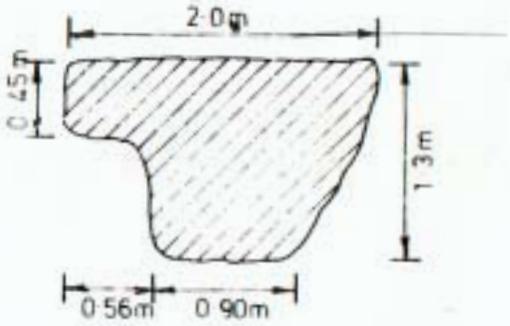
LOCALITY PLAN



PLAN VIE



SHOWING POSITION OF FIRE



DIMENSIONS OF SECTION DUG OUT DURING INITIAL FIRE.

POLYURETHANE PROGRAMME - LONGWALL 7

Statement by Paul Harrington

During the initial driveage for the development of Longwall 7, the line of a dyke was established in 477 Panel and development showed the dyke would pass through the tail gate side of the longwall block.

During development of 4 Area and of Longwall 7, the dyke was penetrated with a continuous miner on approximately fourteen occasions. The dyke was known to be soft and while roof conditions in the immediate vicinity were poor, they were definitely not unmanageable.

During the development, the roof in the area of the dyke has fallen on two occasions. Both of these however, were considered to be due to insufficient initial support and were therefore not of major concern.

When longwall 7 commenced operations, the location of the dyke was about 30 metres from the tail gate end of the 150 metre wide face. Initially no problems were experienced in cutting, however after the wall had advanced approximately 40 metres a fall occurred at the face. The fall extended for approximately 5 metres along the face with the dyke on the main gate end. The material from the fall buried the face conveyor to the point where it could no longer be operated and consequently a loader was used to remove the fall material into the tail gate.

A large volume of broken goaf material was then held above chocks Nos. 84 to 89 and any attempt to advance any of these chocks caused an immediate slippage of the broken material onto the face conveyor. Concurrently, both the seam and the overlying strata in front of these chocks fretted to the point where the face was approximately $3^{1}/2$ metres from the extension bar of the chock.

Diagram 1 shows a cross section of the locations of the chocks in relation to the fall. No support could be undertaken of the face area due to the danger to employees brought about by the possibility of falling material overriding the chocks.

It was recognised that in order to allow the face to be advanced, firstly an artificial roof would have to be constructed between the chocks and the face, and secondly, both the seam and the strata above the seam in the immediate vicinity of the face would have to be consolidated prior to cutting commencing.

The original thoughts were to establish a roof as shown in Diagram 2. This would be erected by constructing a beam between the extension bars of the chocks and the face. The artificial roof formed in this fashion would have to be strong enough to withstand the impact of stone falling from the top of the fall area which, by this time, exceeded 20 metres high. This method of constructing an artificial roof was abandoned because it was impossible to carry out the construction without committing employees to working close to the face in an extremely dangerous location.

Consideration was also given to shortening the longwall face by driving a heading using a continuous miner on the main gate side of the dyke, as shown in Figure 3. An analysis of this alternative revealed that the face conveyor could be shortened and the drivage could be achieved, however the chocks could not be removed with safety and it would be likely that one or more chocks would need to be abandoned.

It was necessary to obtain an artificial roof which could be established from an area of safety at either end of the fall or from within the cover of the chock canopies. For this to be achieved the artificial roof had to be substantial enough to withstand a fall from the top of the goaf but at the same time, light enough to enable erection from a point of safety.

A polyurethane material had been used for strata binding by in-seam injection. This material is very light, however once set, becomes very strong. It was therefore proposed to form a plug of polyurethane material as the artificial roof. The material is pumped as a liquid and consequently had to be constrained to some extent so stonedust bags on pallets were loaded onto the face to form a solid barrier between the face and the chocks. Brattice was then draped over the stonedust bags and sealed at each end of the fall.

Figure 4 shows the position of the stonedust bags and brattice on the face prior to the application of the polyurethane bonding material. Initially pumping of polyurethane commenced and 1300 litres was pumped into the cavity on L/W 7 face in front of 85 - 91 chocks. Pumping started at approx. 3.30 a.m. on Thursday 11th December 1986 and was completed at 10.00 a.m. The material filled the void in between the stonedust and the face and there was a thin layer across the extension bars of the chocks.

I received a telex from Ron Aiken, Technical Manager, Chemfix, at approx. 11.00 a.m. on Thursday 11/12/86 (see copy attached). The main point of the telex was that pumping should cease after 1000 litres of material was pumped or alternatively each one metre of depth of foam was reached. The telex stated pumping should cease for 16 hours to allow for cooling. On receiving this telex, a phone call was made by Chemfix and Mr. John Schott was told we had in fact pumped 1300 litres before stopping. After consulting Mr. Aiken, Mr. Schott informed us there would be no problem, provided we waited the full 16 hour cooling down period.

Pumping on the second stage was due to start at 2.00 a.m. Friday 12/12/86. Due to problems with the pump, the second stage didn't in fact start until 4.00 a.m. The same volume, i.e. 1300 litres, was pumped in approx. 3 - $3\frac{1}{2}$ hours. The job was completed and the pump cleaned up for 7.30 a.m 12/12/86. The Arnall's people (Mr. Ron McKenzie being in charge), came out with night shift people. Mr. McKenzie reported no problems other than trouble with the pump at the start of the shift.

At approx. 10.30 a.m. on Friday 12/12/86, Warwick Anderson rang and was noticeably distressed. He reported yellowish/brownish fumes to be coming off the polyurethane. He stated he had looked up through the man-hole at the maingate end of the cavity and saw fumes rising off what appeared to be a boiling mass of the material. This "boiling" material was about half way across the cavity and closer to the face. Warwick was told to stand by the phone whilst a phone call was made to John Schott of Chemfix. Before getting on to Mr. Schott, Warwick had rung back again and was anxious about the situation. He was instructed to break the stonedusting hose along the back of the spill trays and to push stonedust up over the material in question.

John Schott was then contacted and informed of the situation. He agreed that covering the material with stonedust was the correct way to go. He was, at this stage, asked for a data sheet on the fumes being released and about what effects they would have on men working in the contaminated area. Mr. Schott advised us to stay on the fresh air side of the fumes. He then left Chemfix, Nowra to bring the data with him and to go down to observe what was happening.

Prior to the second pump, John Schott had asked if we minded him using A.C.I.R.L. to monitor temperatures in the material. This was agreed to, as there was no other way of monitoring the temperatures and we would also get an idea of the depth of cover. The person from A.C.I.R.L. didn't arrive until late afternoon on Friday 12/12/86. A.C.I.R.L. had had a lot of difficulty procuring the materials required for the heat sensing probe.

On arrival at the pit, just after afternoon shift had gone down, Mr. Schott went underground with myself to the trouble area on L/W 7. Also in our company was Mr. M. Loy (District Check Inspector) who, in the company of Mr. T. Carr (Local Check Inspector), had made an earlier inspection of the site on day shift. M. Loy and T. Carr had been advised by myself to inspect the site after the problem had been reported to me earlier on day shift.

On arriving at the site, M. Loy reported to us there had been a definite colour change in the issuing fumes and that the fumes were less dense than on his previous inspection on day shift. Mr. John Schott told us the problem of the issuing fumes had been caused by the fact that the second 1300 litre pour of that morning, was pumped too fast. The pumping cycle should have been spread across a time period of 6 - 8 hours. He went on to say that the change in colour and density of the issuing fumes was a clear indicator that the material was cooling down. Mr. Schott took several temperature readings (see attached) at various points to ensure this was in fact the case. With that, both M.Loy and myself were satisfied that the process taking place in the ploy urethane was slowing down and, given time, would in due course cease. We left the scene, leaving afternoon shift people to observe the site.

Whilst travelling outbye to pit bottom a couple of stops were made to check district and main return airways. It was found that the fumes had contaminated all these roadways back as far as the No.1 upcast shaft. On arriving at pit bottom it was decided to isolate the 4 Area of the pit due to the contamination of the atmosphere in the second egress. Evening shift only worked 3 Area of the mine with the exception of two men in 4 Area based at L/W 7. These two men were experienced, one a deputy and one a rescue trained miner (i.e. P. Forbes and W. Morris respectively). These two men were told to stay on the fresh air side of the problem area, with Siebe Gorman gear at the ready, continually monitoring the situation.

After lengthy discussions with M. Loy (see copy of District Check Inspector's Report dated 12/12/86) and both being satisfied the situation was under control and that everything that could be done was being done, I left the mine at approx. 11.05 p.m. on the night of 12/12/86.

Finally, without going into the details of the fire in this report, I was rung at home by Mr. B. Hadley, the Evening Shift Undermanager, to tell me there had been a fire at the site of the injected polyurethane, the fire was now out, but there were still hot areas. This phone call would have been around 1.00 - 1.30 a.m. Saturday 13/12/86. I instructed Mr. Hadley to invoke the Emergency Procedure and immediately proceeded to the mine.

P. HARRINGTON

T

86-12-11 1035 ST ⊕
KEMCOL AA29172
CMFX AA26758
ATTN PAUL HARRINGTON
FROM RON AIKEN TECHNICAL MANAGER CHEMFIX

THIS TELEX IS TO CONFIRM OUR JOHN SCHOTT'S ADVICE THAT YOU SHOULD CEASE PUMPING CHEMFOAM H-F FOR 16 HOURS AFTER EACH 1000 LITRES IS PUMPED OR ALTERNATIVELY EACH 1 MTRE DEPTH OF FOAM IS ACHIEVED. THIS IS ESSENTIAL TO ALLOW TIME FOR FOAMED MATERIAL TO COOL SO AS TO AVOID ANY OVERHEATING WHICH MAY LEAD TO DEGRADATION OF THE FOAM. IT IS IMPORTANT NO SAMPLING, DRILLING ETC OF THE FOAM TAKE PLACE TILL IT HAS COOLED.
JOHN HAS DISCUSSED WITH ME THE POSSIBILITY OF USING THERMOMETER PROBES. THIS IS NOT A GOER- UNGROUNDED METAL PROBES OF ANY SORT MUST NOT BE USED IN THE FOAM.
JOHN IS CURRENTLY TALKING WITH MIKE FABJANCZYK OF ACIRL ABOUT A SUITABLE MONITORING SYSTEM AND WILL BE TALKING TO YOU AS SOON AS HE CAN MAKE CONTACT.

IT MAY WELL BE THAT THE METHOD OF INSTALLATION IS NOT REALLY CAUSING A HEATING PROBLEM BUT UNTIL WE FIND A SUITABLE METHOD OF MONITORING WE BELIVE IT IS ESSENTIAL TO ALLOW TIME FOR COOLING OF EACH LAYER

RGDS RON AIKEN

≈≈≈≈≈≈≈≈ THIS IS AN URGENT TLX AND SHOULD BE RELAYED TO PAUL AS SOON AS POSSIBLE≈≈≈≈≈≈≈≈ THANK YOU

SENT 10:42AM
⊕
KEMCOL AA29172

12/12/1986 15:28 63

'86 12 12 14:29 Z 61 44 221637 CHEMFIX 01

FACSIMILE FROM: RON AIKEN CHEMFIX - NOWRA
):
ATTENTION: CHEMFIX

RE: PAUL NARRINGTON
W'CLIFF

FAX. NO: COUNTRY

FROM: CHEMFIX PTY LTD
102 ALBATROSS ROAD
NOWRA N.S.W. 2541
(P.O. BOX 554)

OUR REF:
DATE: 12.12.86

TELEX NO: AA26758
TELEPHONE NO: (044) 214377
FACSIMILE NO: (044) 221637
TAL PAGES:
(including this header) 4

AUTHORISED SIGNATURE(S):

IF YOU DO NOT RECEIVE ALL PAGES, PLEASE TELEPHONE OR TELEX IMMEDIATELY.

CHEMFIX PTY. LTD. (INCORPORATED IN N.S.W.)

102 ALBATROSS RD., P.O. BOX 554, NOWRA, N.S.W. 2541. PHONE (044) 21 4377. TELEX AA26758

RA:cm

12th December 1986

Mr Paul Harrington
Westcliffe Colliery

The Chemfoam components are mainly high boiling and unlikely to give rise to fumes. The most likely components which may fume due to excessive heat build up are plasticiser traces and traces of amine catalyst.

If some degradation of the foam has occurred because of overheating, there may be low molecular weight polyol degradation products such as aldehydes and/or ketones, which may fume.

A R ATKEN
Technical Manager.

CHEMFIX PTY. LTD.

[redacted]

MATERIAL SAFETY DATA SHEET

CHEMFOAM PART 2

Chemical Composition Polymeric diphenyl methane diisocyanate composition.

Use Part 2 of a 2 component polyurethane foaming system.

Regulatory Labelling

CAS No.	N.A.
UN No.	2063
CLASS	III
HAZCHEM	2WE

General Hazards

Harmful by inhalation as vapour, aerosol or dust. Skin and eye irritant. A potential respiratory sensitiser. Avoid all personal contact. Reacts vigorously with water and other materials containing free hydroxyl groups. Smoking must not be allowed where risk of MDI vapour in the atmosphere exists.

Physical Properties

Appearance Dark brown liquid, slight musty odour.
Vapour pressure - less than 10^{-5} mm Hg @ 20°C.
Flash point 230°C.

Fire and Explosion Hazard Data

Combustible. Product will emit toxic fumes on burning. Fire fighters should wear full emergency equipment including self contained breathing apparatus. Extinguishing media - BCF, dry chemical, carbon dioxide, foam.

Health Hazard Data

MDI compositions may cause respiratory irritation and are potential respiratory sensitisers. Allergic responses characterised by chest tightness and asthmatic breathing may occur during exposure and as a delayed response well after cessation of exposure. Sensitised individuals may develop symptoms at atmospheric concentrations well below the recommended hygiene standard. Mild skin irritant. Contact can result in temporary skin discolouration and may cause sensitisation. Moderate eye irritant - can cause chemical conjunctivitis.

Threshold Limit Value 0.02 p.p.m. 'Ceiling Value'.

Emergency and First Aid Procedures

Eye Contact: Flush thoroughly with water for at least 15 minutes keeping eyelids held open. Seek immediate medical assistance.

Skin Contact: Wash contact areas thoroughly with water and then soap and water. Remove contaminated clothing and launder before re-use. If redness, blistering, swelling or irritation occurs, seek medical assistance.

Inhalation: Remove from further exposure to fresh air. Keep at rest. All but the most minor symptoms seek immediate medical assistance.

Ingestion: Seek immediate medical assistance.

Reactivity Data

Reacts vigorously with water and other materials containing free hydroxyl groups producing carbon dioxide. Isocyanates tend to harden rubber and some plastics and increase risk of splitting.

../2

PRODUCT NAME: CHEMFOAM PART 2 (continued)

Spill or Leak Procedure

Evacuate area of all unprotected personnel. Increase ventilation if possible. Contain spill using sand, earth or other suitable absorbent. Prevent run-off into drains or waterways. Collect contaminated materials and place in drums for disposal. Personnel involved in clean-up must wear full protective equipment including impervious footwear. Decontaminate area with Chemfoam Neutraliser. Empty drums must be decontaminated before disposal.

Storage and Handling Procedure

Maximum recommended storage temperature 25°C. Protect from contact with moisture. Inspect containers for damage in transit. Do not reseal containers if product is moisture contaminated because of the hazard of pressure build-up in container. Wear chemical goggles, P.V.C. gloves, overalls (heavy cotton preferred), safety shoes, breathing apparatus with a dedicated air supply if inhalation risk exists. Ensure air supply is free of water, dirt or oil. Protective equipment should be checked regularly and decontaminated immediately after use. Gloves should be replaced as soon as there is evidence of hardening. Ensure adequate ventilation. Wash hands before smoking, eating, drinking and going to the toilet.

**** We believe all the information given in this form is accurate and is offered in good faith but without guarantee.

CHEMFIX PTY. LTD.

MATERIAL SAFETY DATA SHEET

CHEMFOAM PART 1

Chemical Composition Mixed polyether polyols incorporating up to 20 parts of a fire-retardant chemical.

Use Part 1 of a 2 component polyurethane foaming system.

Regulatory Labelling None required.

General Hazards

A mild to moderate skin and eye irritant. Product will emit toxic and irritant fumes in a fire situation.

Caution: Slippery if spilt.

Physical Properties

Appearance

Fire and Explosion Hazard Data

Flash Point greater than 200°C. Product will emit toxic and irritant fumes in a fire situation, but will self extinguish once the ignition source is removed. Fire fighters must wear full protective equipment including self-contained breathing apparatus.

Extinguishing media - water spray, foam, carbon dioxide, dry chemical.

Health Hazard Data

Prolonged contact may defat skin causing irritation. Observe good industrial hygiene practices to avoid all personal contact.

Emergency and First Aid Procedures

Eyes: Flush thoroughly with water for at least 15 minutes keeping eyelid held open. Seek medical assistance.

Skin: Wash contact areas with soap and water. Remove contaminated clothing and launder before re-use.

Inhalation: Not expected to be a problem.

Ingestion: If victim conscious, give water to drink and induce vomiting. Use fingers in throat or Ipecac syrup (APF). Seek immediate medical assistance.

Spill or Leak Procedures

Contain spill using sand, earth or other suitable absorbent. Place contaminated absorbent in drums and seal for disposal. Slippery when spilt. Clean up immediately to avoid accidents. Wash spillage area thoroughly with detergent and excess water.

Storage and Handling Procedures

Store in cool dry place. Product will absorb moisture from the atmosphere. Keep containers closed at all times. Wear chemical goggles or full face shield, impervious gloves, overalls, safety footwear. Check regularly for spills and leaks. Use with adequate ventilation. Wash hands before smoking, eating, drinking and going to the toilet. Ensure protective equipment is decontaminated before re-use.

***** We believe all the information given in this form is accurate and is offered in good faith but without guarantee.

Report on Inspection carried 57
out at Westcliff Colliery on
12.12.86 Re Problems being
experienced with the Polyurethane
Tube being used in the
Tailgate of LW6.7 N. 14.12.86

In company with the U/Manager
in charge Mr. P. Harrington
Mr. J. Scott (Development Officer
of Chemfix) Mr. N. WALTKER (
Industrial Chemist with Chemfix)
& Mr. T. Carr (Local Mine Inspector)
I carried out the above inspection
& report as follows :-

I first arrived at the site
in question about 10.30 am this
morning. Browny - Yellow
fungal vapor was issuing
from inside the fall cavity &
from holes in the Headlast
bag barrier. The vapor was
very thick and unbreathable.
on the outby side of the site.

We went back to the site
about 2 pm. and there was
a noticeable change in the
environment. The vapor had
changed colour from browny

yellow to white and the volume was noticeably less. The whole area had been flooded with stonedust in an attempt to hasten the chemical action of the curing poly-urethane. Temperature probes were placed into the area. One was placed through the stonedust wall and this registered a temperature of 40° Celcius. A probe was then placed up into the cavity & this registered a temperature of 30° Celcius. I then ~~took~~ took some Dragir tubes tests for the presence of Carbon Monoxide.

My first test was through the stonedust wall and it could only detect a very faint trace of CO. I then donned breathing gear & went into the return and I could only detect 10 PPM of CO at the point where the smoke was issuing from one of the cracks.

Tests for CH_4 revealed only 0.2% CH_4 on the L/W Face 6:15 & 0.1 to 0.2% CH_4 in the return. No increase in CO & CH_4 was detected in the Computer based Mine Monitoring system. For the reasons outlined I am of the opinion that no conditional heating exists at this point in time.

The Returns & 2nd Mains of Egress from the 400 area are full of this vapor and therefore cannot be travelled and so the area mentioned has been stopped, men withdrawn and the area isolated electrically.

A check of the 300 area returns & Second means of egress show no such contamination, and therefore I am of the opinion that the following panels could be worked i.e. 313 Panel, 317 Panel, 316 Panel, 315 Panel & 321 Panel.

As before stated the

2nd Means of Egress from the 300 area is free of contamination with the exception of the last few Pillars of the 313 & 317 Panels. For this reason the 2nd means from these two panels will be slightly altered so that the men from these panels will deviate from their known 2nd Means through 7 Ct. 312 Return into 316 Panel 2nd means. The alteration will be clearly marked.

The cause of the present problem is simply that too much poly-urethane was pumped into the area too quickly. The people in question were given orders as to how the job was to be done.

I am of the opinion that before any further application of this product is carried out, the people concerned must show to all concerned that they are capable of doing

the J26 in a correct manner and I would recommend that they remain under constant supervision of a senior battery official.

Malcolm Loy
Asst. Track Inspector
12.12.86

STATEMENT BY BRUCE HADLEY

I, BRUCE HADLEY, am employed at West Cliff Mine as a Shift Undermanager on Evening Shift.

Events Prior to D/W 13/12/86:

In the company of representatives from Chemfix and A.C.I.R.L., the longwall was inspected at approximately 9.00 p.m. on 12th December 1986. With the use of temperature probes, readings were taken at :

1) the maingate end of the stonedust.
2) in the area of chock No.86/87.

Reading 1:
The last reading taken on A/S indicated a temperature of approx. 40°C. The two readings taken on E/S were 27°C and 24°C.

The probe was then moved to the area of 86-87 chock. In this area there was a continual stream f vapour coming from the stonedust bags (vapour approx. 1.2m from top of A.F.C.).

Reading 2:
This reading indicated a temaperature of 70°C. The area was monitored for approx. 1 1/2 hours with no increase in temperature, but I stated to the representative from Chemfix I was of the opinion that the haze was increasing from the area of 86/87 chock.

We left approx. 12.00 midnight to return to the surface.

Events for Night Shift - 13/12/86:
At approx. 1.20 a.m., P. Forbes, Longwall deputy, notified me of the longwall fire. He stated they were using fire hoses to fight the fire and he was of the opinion they would be able to bring it under control.

STATEMENT BY BRUCE HADLEY: (Cont'd.)

I notified pit bottom deputy, N. Campbell, and instructed him to take three people with him to assist P. Forbes on the longwall face.

I instructed pit bottom to cancel all overtime and arrange for all labour to be withdrawn from underground except the six men I had allocated to the longwall. The washery was also instructed to isolate No.1 shaft (upcast).

N. Campbell informed me at approx. 2.00 a.m. that as far as he could determine, the fire had been extinguished but there was still some hot spots in the fire area.

In the company of P. Harrington and four other men, we arrived on the longwall face at approx. 2.45 a.m. (approx. 30 minutes lost with dolly car). After inspecting the area, I commenced dismantling the stonedust bags in the area of Nos. 86 - 89 chocks - the site of the fire. On inspection of the stonedust bags during dismantling, there were a number of bags charred but not burnt. When any hot areas were discovered the area was hosed down to prevent any possible re-ignition.

When the first wooden pallet was removed I reported that the inside edge (maingate end) had been burnt, the condition of the timber being such it crumbled when handled.

The worst of the charred stonedust bags was shown to P. Harrington before they were removed to allow me to clear the area down to the A.F.C.

STATEMENT BY BRUCE HADLEY: (Cont'd.)

In general, the conditions found at the fire sight were :-

1) Charred stonedust bags.
2) Burnt brattice.
3) Some burnt pieces of foam.
4) Some charred pieces of coal.
5) Water drippers from No.88 chock quite warm - cooled down approx. 5.30 a.m.

I was not aware till 7.00 a.m. of P. Forbes reporting that he thought he had seen flames in the hole at the top of the stonedust bags in the maingate end.

This area had been inspected quite thoroughly on Evening Shift, and especially on Dogwatch and I am of the opinion that there was not a problem in this area.

On being relieved from clearing the stonedust from the face I instructed the oncoming team to work towards the tailgate, clearing the stonedust and checking for any hot spots.

This report is to complement the report given to the Surveyor, T.Hargrave, at 7.00 a.m. on 13/12/86.

STATEMENT BY BRUCE HADLEY: (Cont'd.)

Q: With respect to the deployment of men to Longwall 7, how many men were deployed to the place and why?

A: Instructions given to my by Paul Harrington, the Undermanager in Charge, were that 4 Area was isolated and that no labour was to work in 4 Area at all, with the exception of the longwall deputy and an offsider, mainly from the safety point of view of two men working together. They were to monitor the conditions on the longwall face during the shift.

Q: What time did you arrive at the site with Chemfix and A.C.I.R.L. representatives?

A: Approxinately 9 p.m.

Q: On arrival at the site, did you test for methane in the site area?

A: In the general body, as far as I can do with safety without going on the return side of the polyurethane plug. The general body readings were .2% and .4%.

Q: Did you take any readings in the chocks?

A: Yes - on the maingate side, in the chocks I examined, I found between .2% and .4% of methane.

Q: How many wood pallets were pulled out of the stonedust wall by your rescue team?

A: We pulled one pallet out from the mid wall level. All stonedust was removed from the pallet down to floor level and the pallet was ready to be brought out by the relieving team.

STATEMENT BY BRUCE HADLEY: (Cont'd.)

Q: What advice did you receive from Paul Harrington, the Undermanager in Charge, who had been on the site on Afternoon Shift, as to the condition of the polyurethane product and the area around it?

A: Paul told me the conditions on Afternoon Shift with the vapour given off during Afternoon Shift was quite heavy, and he was unable to clearly see the tailgate end of the longwall, but the vapour was slowing up which indicated that the area was cooling down, and we were to monitor the area until conditions were normal, then this would allow us, after a period of 24 hours, to recommence pumping.

Q: When Chemfix representatives had taken temperature results, did they offer advice when pumping could recommence?

A: In conversation with the Chemfix representatives, we came to the conclusion that we could start pumping after a 32 hour period, i.e. 8 hours cooling down and 24 hours for a further cooling down period, which then allow the pump cycle to start.

Q: Why were the Chemfix men of this opinion?

A: Because of the temperature which was dropping on the maingate end, (e.g. it had gone from 40^{O}C on Afternoon Shift down to 27^{O}C and 24^{O}C on Swing Shift), and the temperature in the area of 86/87 chock where the probe had been placed. He was of the opinion that this would continually drop, and the fact that the vapour was abating.

B Hadley

BRUCE HADLEY

15/12/86

5954B

STATEMENT BY PETER FORBES

I, PETER FORBES, am employed at West Cliff Colliery as a deputy on Evening Shift regular. On 12th December 1986 I was deployed to Longwall 7 for the purpose of monitoring the polyurethane plug that had been put in place during the preceding shifts.

I had received instructions from Paul Harrington, the Undermanager in Charge, who had told me that when he had last been in there, he could not see the tailgate for the fumes coming off. When he left, he said it was pretty clear and you could see the tailgate quite clearly. He said that if it got so that I could not see the tailgate, I was to notify him straight away.

I had also been given an assistant, Bill Morris, whose job was to stay with me throughout the shift.

On arrival at the maingate of Longwall 7 at the start of the shift, we went down to the site of the cavity and had a look around. We did not go on the return side. There was not any great sign of smoke at all. It was similar to water haze - very fine, white fumes.

On the way down to the site, we took one big and two small Siebe Gormans in case of an emergency.

We arrived at about 8.10 p.m. and remained at the site for about 20 minutes and I did my inspections outbye. After I had completed my inspections on the maingate side, Bruce Hadley, the Shift Undermanager, arrived with an A.C.I.R.L. representative and a Chemfix representative. We went back up to the site of the cavity. They had a temperature probe which is like a fishing rod, and they took temperatures of the plug over the top and on the side between 87 and 88 chock. I heard them say that the temperature over the top of the plug was 27^{O}C and after taking a second reading it had reduced to 24^{O}C. They left about 10.00 p.m..

STATEMENT BY PETER FORBES: (Cont'd.)

Just before Bruce left, a little more smoke seemed to appear. It was not a white haze - it was a whitish smoke.

We stayed at the site for a further period and then we went for our crib from some time between 10.30 p.m. and 11.30 p.m. After we had crib we returned to the site at around 11.30 p.m. to 11.45 p.m. We had a look around and it had not changed a great deal from the condition it was in after Bruce left. We stayed 5 - 10 minutes and went back to the maingate.

I was at the maingate for 3/4 hour and I instructed Billy to service his machine. This was 12.35 a.m.

I returned to the face at about 12.45 a.m. I walked up the face conveyor. I went around the shearer and then climbed back onto the face conveyor. At that time I saw flames showing out in front of 87/88 chock.

I grabbed a fire extinguisher and discharged it into the cavity where the flames were being emitted in front of 87/88 chock. The flames were approximately .6 metres long from the tip to the stonedust. The edges of the stonedust bags were burnt.

I went back towards the shearer and got a second extinguisher and, coming back to the site, I saw a glow in the cavity. I discharged the second extinguisher through the observation hole into the cavity.

I then obtained a third extinguisher and I discharged this one on the flame at 87/88 chock.

After discharging the three extinguishers, it did not seem to have much effect at all. So I returned with haste to the maingate. I sang out to Bill Morris that we had a fire. I waited for him to acknowledge that he had heard me.

STATEMENT BY PETER FORBES: (Cont'd.)

On the way past the fire depot at the maingate, I grabbed two hoses, a breach and a nozzle. By the time Bill arrived I gave him one hose and we went up and ran the hoses out. We turned the water on and directed the hose on the fire between 87/88 chock. The fire died down quite a bit, with virtually no flame at all, and then we returned and directed it into the cavity.

In the meantime, the area at 87/88 had reignited. Bill Morris returned with the hose from the cavity and directed it onto the flame at 87/88 again. We put the flame out and returned to put the hose in the cavity.

While Bill was hosing into the cavity, I put the Siebe Gorman on and went up to the tailgate to see if I could connect another hose into the hydrant liner at the other end. When I got there, I noticed I could not hook the fire hose onto the hydrant because of a Tee-piece on the hydrant which had been fitted for the tailgate bolters.

I returned to Bill and said I will go and get another hose and ring up Bruce and tell him what is going on.

At about 1[illegible].25 p.m. I rang Bruce Hadley, the Shift Undermanager, and told him we had a fire and that we seemed to have it under control. He said he would send another crew of men in.

I took another hose from the fire depot and ran it out in between the chocks from the breaching piece at 54 chock. Whilst I was doing this, Bill Morris was still discharging water into the cavity. I told Bill we would put two hoses into operation so that one could be directed into the cavity whilst the other one was on the hot spot at 87/88 chocks.

STATEMENT BY PETER FORBES: (Cont'd.)

The other men arrived by that time and they assisted and connected the second hose into the system. Water was applied in the top cavity and also in 87/88 chocks.

The fire was virtually out and we commenced to pull stonedust bags out away from the 87/88 area which appeared to be the base of the fire. We pulled quite a few bags out and found some charred material which we put in a bag and bought to the surface.

We continually hosed down. We put a lot more water into the top of the cavity to make sure there was no chance of the fire developing there, and pulled more bags away from the assumed fire site in front of 87/88 chocks, when Paul Harrington, the first rescue team captain arrived.

After discussion with Paul we left the site and travelled out of the pit. There was myself, Billy Morris, Barry Banks, Ray Brandner, Neil Campbell and Charlie Gibbs.

Q: Priot to going to Longwall 7, what instructions had been given to you by the Undermanager?

A: Virtually to be an observer and monitor the area where the polyurethane plug had been installed.

Q: Were you told what to look for?

A: If the fumes got worse, I was to notify the Undermanager.

Q: Did you request an assistant?

A: No. Billy Morris was allocated to my by the Undermanager.

STATEMENT BY PETER FORBES: (Cont'd.)

Q: During your inspections, what concentration of methane did you detect in the area?

A: Very low - in the order of 0.2% to 0.3%. I tested between the chocks and on the face side of the conveyor.

Q: When you took the bags of stonedust out of the wall at 87/88 chock, did you notice whether there was an air flow between the stonedust wall and the brattice cloth?

A: No - in my opinion I thought the air was going up through the observation hole into the cavity and appeared to be going down the back and coming out where the flame was at 87/88.

Peter Forbes

PETER FORBES

15/12/86

5954B