

High And Dry By The Mangroves? South Australia's Dry Creek Explosives Magazines

[Originally presented at the Fifth Australian Urban History Planning History Conference, University of South Australia, 13–15 April 2000, and published in the *Conference Proceedings*, edited by Christine Garnaut and Stephen Hamnett, University of South Australia, Adelaide 2000, pp.222–232].

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Introduction

The South Australian government's supervision of explosives imports was integral to the state's civil construction, quarrying, and mining. The management even of fireworks and toy paper caps was as important as that of dynamite and gunpowder, those essentials 'necessary for the development and progress of the community' (Treasury Office, 796/00). Two of the government explosives stores served mainly British, South African, and German explosives merchants and their Australian agents.¹ These were the North Arm Magazine in Magazine Creek, built 2.4 kilometres from the Port Adelaide inner harbour in 1858 (demolished in 1916), and its replacement 6.4 kilometres to the east at Dry Creek, which operated from 1903 to October 1995 (Figure 1).

The original eleven buildings at Dry Creek (1903-1907) survive and in 1994 were placed on the Register of State Heritage Items (no. 14521). Their condition is generally sound. But deteriorating hollow concrete block piles, which in the 1960s replaced the jarrah piles, are so corroded by saline soil that instability threatens several magazines. The following gives a broad historical account of the Dry Creek Magazines.

Landwards to the east

When, in the later 19th century, the frequency and quantity of explosives imports (mainly for Broken Hill) increased, their storage received fierce public criticism. Even in December 1858, during final construction of the North Arm Magazine, local disapproval was voiced that such a 'hazardous commodity' as explosives was situated so close to Port Adelaide's population, wharves and warehouses, Port River channel shipping, and the costly, recently-built North Arm bridge and embankment. The magazine, of four adjoined, gabled halls, was 18 metres from the end of the bridge, but its distance from Port Adelaide, although approved, was nonetheless very disquieting (SA Parl. Debates, 1858: 786-787). It replaced (or supplemented) an older powder magazine to its west on Le Fevre Peninsula which probably had supported incipient colonial defence of the seaboard. The Dry Creek Magazines took explosives storage even further inland, and on to an undeveloped intertidal estuarine plain.

In response to demand that the North Arm menace be abolished, the two dynamite hulks – auxiliary stores normally moored 360 metres from the magazine – were banished northwards some 16 kilometres to the Port Gawler Magazine Reserve. But by 1889 the seven main South Australian importer-agents complained of the cost of lightering explosives from Port Gawler to the North Arm (and thence to ketch or rail transport), a difficulty compounded by the time lost in waiting for favourable tides.

In 1891 the Port Adelaide Corporation sponsored public indignation meetings against the North Arm store; and a citizens' protest deputation petitioned the government to over-ride the powers of the Marine Board, which administered the magazines under the Explosives Act 1881.

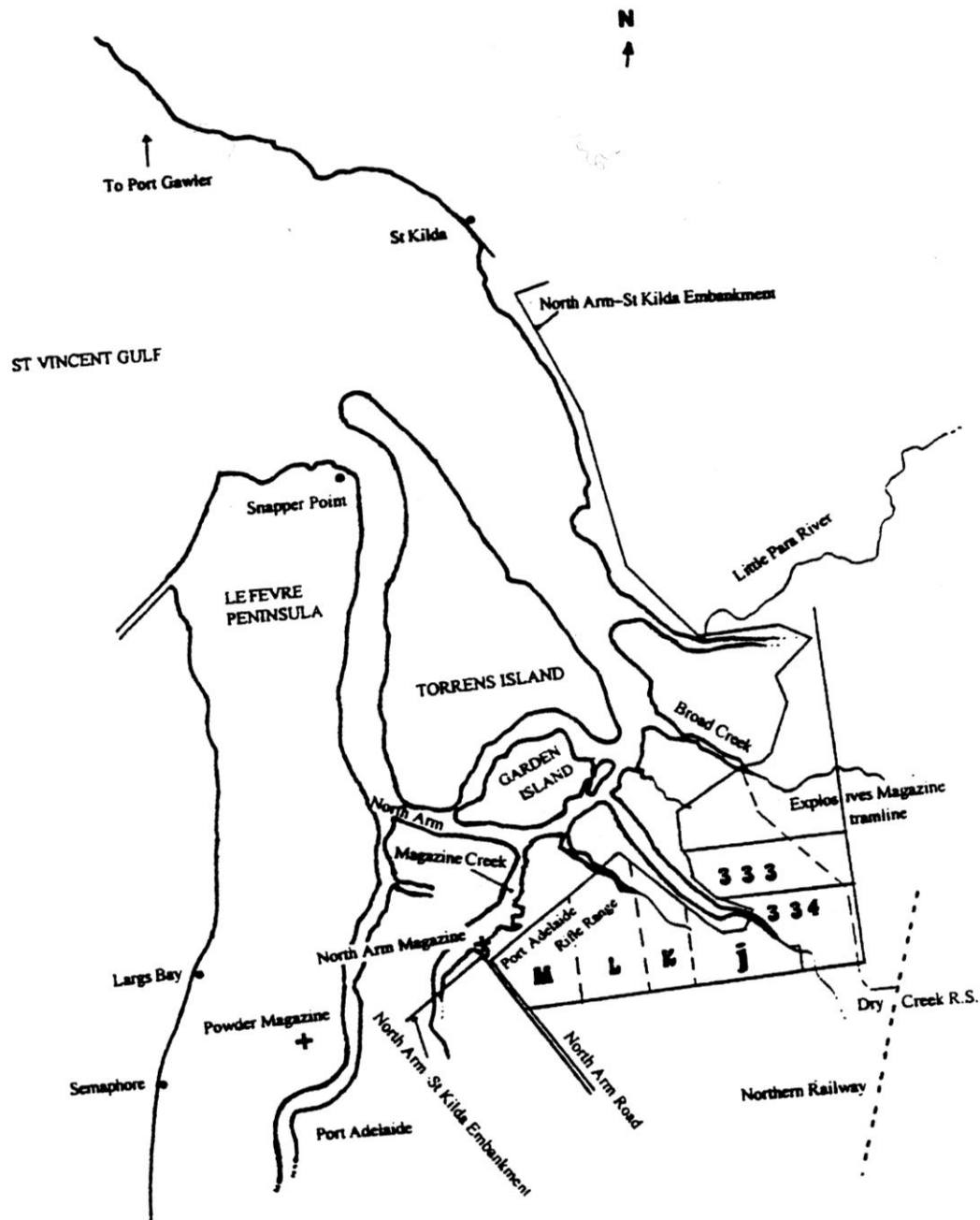


Figure 1. Section 334: Dry Creek Magazine Reserve M: Commonwealth land; L and K: Crown lands; J: Miscellaneous Lease land. Based on maps, Surveyor Generals Office, Adelaide, 'Port Adelaide', March 1896, in 'St Kilda Embankments', GRG 38/43, Box3/2; and Surveyor General's Office, 'Port Adelaide', 1878, in GRG 35/586/1060 (State Records).

The Port's only protection, it was popularly believed, was the Cromwellian advice to

'trust in Providence and keep your powder dry' (*SA Advertiser*, 26 November 1892). By 1899, further government procrastination was even less supportable. The former Inspector of Explosives had reported on the urgency of enlarged storage capacity, and his successor expanded the proposal for land stores (Marine Board, 1899: 1 September). The twin arms of 'public safety' (patently the more vocal) and 'convenience to the trade' (essential to placate) settled the argument (Treasury Office, 421/99). In 1899 the Board agreed that a new Magazine Reserve might embrace parts of sections 333, 334, and almost half of J – a larger area and with a greater number and different disposition of magazine buildings than was finally decided. The 112.5 hectare Reserve, on a resumed grazing lease, was gazetted in March 1903.

From 1883 to 1895 government departments acted to prevent the normal tidal flooding of this and adjacent land by building levees, 1.5 metres broad and 0.9 metres above highest tide, and with exit sluices. The Port Adelaide-St. Kilda embankment (Figure 1) was intended to allow the swollen creeks flowing from the east to deposit their silt load and to hold in fresh water to sweeten the government lands leased for pastoral grazing. The Reserve, established on estuarine flats, amongst grazing leases, and close to abattoir stock paddocks, was ensured isolation. But several spaced magazines, each bunded on three sides and of a maximum capacity, were intended to 'subdivide' any risk (South Australian Harbors Board (SAHB), 1810/15).

In July 1902 the president of the Marine Board and the Superintendent of Public Buildings, Owen Smyth, planned to visit the Explosives Station in Victoria (probably at Truganina) for information on 'size, construction etc. of the Magazines recently erected [there in ?1901]' (Marine Board, 1902: 374). In May 1903 the Board approved magazine plans submitted by Smyth, but four months later the omission of essential items originally referred to – due perhaps to Smyth's argumentative antagonism towards the development – left the scheme incomplete, and the Board anxious (Marine Board, 1903: 136).

Fear of accidents continued even after the Dry Creek Magazines were operating. Explosives cargoes were traditionally unloaded at the Powder Anchorage (several miles offshore in St. Vincent Gulf) and trans-shipments were off-loaded for storage before vessels entered the Port. In 1913 the Powder Mound at Snapper Point (Figure 1) was established mainly in response to a fire in 1910 aboard the explosives ship *SS South Africa* while at the North Arm, and consequent fears for Port Adelaide's safety. The Mound was used to inspect storage conditions in ships' holds, to move cargo in lighters to Broad Creek, and to store in-transit explosives in excess of the quantity allowed into Port Adelaide.

The *South Africa* was a regular freighter in this lucrative trade. To 1918 the steamer made about 36 trips to South Australia (probably from 1909, when it first appeared in South African waters), an average of four trips annually. The Magazine Keeper noted that the ship 'probably had fires in her bunkers every trip', and in 1915

finally gave out 60 miles [97 km] from Cape Borda [north-western Kangaroo Island], the voyage completed by using scrap timbers and maize oil mixed with engine oil and tar as fuel. [*South Africa*] made 4 knots on one ton of maize etc. ... [The] temperature in the magazines (with 170 tons of explosives) probably [was] not affected by any of the fires (Dry Creek Magazines (DCM), no. 2: f.49).

Despite this trader's buccaneering luck, such potential danger had determined the Port Adelaide community's earlier opposition to co-existence with high explosives.

The Dry Creek Magazines and their estuarine port

Although the tramline in front of the Magazines was operational by February 1904, staff still boarded importing vessels at the North Arm and transported explosives by horse and dray along North Arm and Junction Roads to Dry Creek. Road cartage was discontinued from January 1906 when the north-western tramline (of about 2 kilometres on an embankment causeway) from the magazines to Broad Creek was finished and when a tramline from the Reserve was laid eastward some 2.4 kilometres to Dry Creek Railway Station. The first explosives were landed at Broad Creek (Figure 1), probably from the Port Pirie and Areas Shipping Company's schooner *Mary Webster*, on 9 January 1906.

The first buildings, eight 20-ton magazines, were completed on 25 November 1903. At Christmas-time 1903 the North Arm Magazine was emptied of powder kegs and detonator cases and, with the quantities moved from Port Gawler, the need for extra magazines at Dry Creek was immediately apparent. Magazines Nos. 12 and 13 (the detonator sheds, one moved from its piles from the North Arm) were erected in 1904. (These were demolished in late 1936). Two additional magazines (completed in mid-1904), and an Examination Shed (completed probably in August 1907) which became known as Magazine No. 11, followed. Two 30-ton magazines (Nos. 14 and 15) were begun in April 1915.

The construction on the western line of a further two 20-ton magazines (Nos. 16 and 17), and formation of the mounds and tramline which connected the western magazines to the existing line, was done departmentally between March and July 1919 (Figure 2). The intermittent but regular overflow of explosives was housed in floating barges in Broad Creek.

Magazine design

The imperative of light-weight building must have determined the magazine structure; the form probably originated from Nobel's Explosives Company of Glasgow. Certainly the bungalow-cum tent-house design departs from the masonry barrel vault and domed magazines of earlier periods, and is similar to the Nobel's Glasgow Robb Jetty (West Australia) magazine of 1900 (Ewers, 1971: illustrated between 110-111).

The main environmental enemies of explosives are heat, damp, and grit. A 1990 study noted that it 'was reasonably cool inside the [magazines]', concluding that 'the walls must contain some insulation' (Donovan & Associates, 1991: 173). It is unlikely that wall insulation material was ever used. In December 1904 the temperature in the shade at Adelaide was 45.5°C: the temperature in the Detonator magazine was 41°C, and 37.8°C in Magazine No. 7 (DCM, 1904-1907: 30 December). Such 'low' temperatures were due to the magazines' three-wall construction: a vertical fluted galvanised iron exterior, a 76 mm air space, a lining of small fluted galvanised iron set horizontally, on to which battens were fastened (providing a further 76 mm air space) and which took the internal composition board lining. A ventilating shaft, which passes from the inside roof through the fly roof, is complemented at some 170 mm above

interior floor level by 10 S-shaped conduits ('sealed', like the roof shaft, with wire gauze), which allow air (but not sand or other grit) to be drawn in from beneath the building (Hargreaves, n.d.: 11). The later addition of glazing inside the shaft behind the metal ventilator louvres probably served 'as a spark and dust deflector' (Department of Chemistry, 1022/60). The magazines' exteriors were normally limewashed. Yet, was there serious concern about the regular flooding of this swamp plain and its corrosive saline soil?

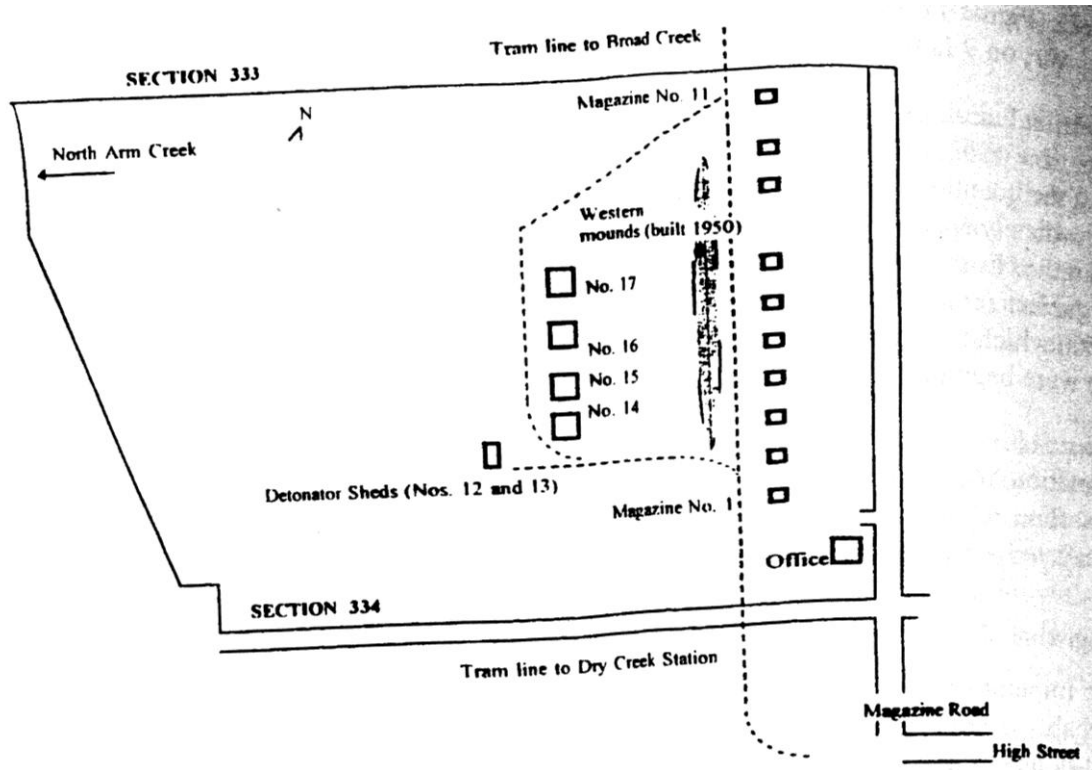


Figure 2. Explosives Magazines at Dry Creek erected 1903 to 1919. The Tramway Reserve (across section 332 and the Government Produce Department Reserve section 333) was proclaimed in September 1906. Based on SASH site plan, '20 Ton Explosives Magazine at Dry Creek. 2 Magazines Required', drawing no. 532/17, 17.1.1919 (held at Department for Administrative and Information Services, Keswick).

Water management

The maintenance of the coastal embankments was continual, and certain parts became the responsibility of Magazine staff in charge of large gangs of labourers. At Swan Alley Creek, to the north, the clay deposited by the Little Para River was more useful for repairing and 'sodding' the embankment than the light peat and fine shellgrit of the dunes more generally used and which contributed to the regular embankment washaways and periodic inundations fought by the Reserve. The tramline from the Magazines to a wharf running alongside the mangroves (and later to a jetty) at Broad Creek, was recurrently damaged by floods and required frequent lifting and repairing.

The year 1917, although momentous, was not unique. In August a 'stupendous tide' came over the Port Adelaide Rifle Range embankment (Figure 1), and washed the levee workmen's gear 'to purgatory', taking all their 'barrels, planks, bags of silt, barricades — everything' (Works and Buildings Department, 38/43). At the highest tide recorded to July 1917 (3-8 metres) Broad Creek jetty (3.6 metres above low water mark) was awash. In 1917 the Melbourne-based Sabulite company, which leased section 332A (Figure 3) for the production of a nitro-compound powder, had good reason to cease production. The factory opened in April 1913, but by 1916 the company made frequent 'bitter complaints' of the sea incursions which damaged its machinery and made access to its works possible only by wading knee-deep through water (SAHB, 812/16). By July 1917 the president of the Marine Board repeated his advice to the Minister of Marine that a decision to place the embankment under the control of the Board was 'Urgent & Important' (SAHB, 312/16; 812/16). Impatient for improvement, Sabulite vacated its 17 buildings — which included mixing houses, a magazine, cartridge filling shed, casing house, paraffin house, and crushing and drying houses, as well as an office-store-laboratory. The rail lines were lifted and the ground was levelled by the end of November 1922. The government thereby lost rent revenue. Yet, another threat — from the south — promised some recompense for its nuisance.

The outflow stream from Islington Sewage Farm (6 kilometres north of Adelaide) deposited on to the Reserve 'by no means a clear effluent' but a 'black, thick fluid in which lumps of all sizes of human excreta and other refuse' were visible (Figure 3). The magazines were about 360 metres from where tonnes of this sediment, filthy 'beyond description', settled, fermented and rotted, producing an awful stench (DCM, no. 2: ff. 321, 488). In 1917 the Magazine Keeper estimated the quantity of sediment at 2000-3000 tonnes when dried; on the sea side of the embankment there was more. In the same month he noted an ambiguous responsibility: although the Reserve fence brought the whole of the outfall creek and outlets in the Reserve, 'the Section for a Magazine Reserve does not include the creek or shutes & [he had] no recollection of this extra strip having been taken over' by the Board (DCM, no. 2: ff. 394-395).

In September 1920 the Keeper despaired over the want of 'reclamation' gained by the outfall, its 'only effect being to partly fill the old salt water creeks with offensive sediment' (DCM, no. 2: f. 354). In early 1921 he suggested that 'Sewerage Manure' was best handled by scooping it on to the bank in summer and allowing it to dry to powder: the material on the sea side would have to be scooped into punts. He knew 'that a little of this manure used in a garden gives good results' (DCM, no. 2: f. 452). In 1921, chemical analysis showed the organic nitrogen sediment as 'similar to nitrogen in Bone Manure': the yield from Dry Creek manure promised nearly 18 shillings per ton, whereas fresh horse dung returned 9 shillings per ton (Chapman, 1921: f. 424A). But the Marine Board did not, evidently, pursue fertiliser markets.

The Magazine Keeper viewed the government's suggestion (SAHB, 1603/20) to move the outflow (or the Sewage Farm itself) to Broad Creek as 'an absurd idea', which would condemn the Magazines' harbour. The Farm's present site, close to 'hundreds of acres' of housing and railway workshops, was 'badly wanted for settlement'; and in 1920 he suggested suitable land about 10 kilometres north, 'say between Salisbury and the sea', a district 'not [ever] likely to be troubled by a dense population' (DCM, no. 2: f.412). In 1922 the Harbors Board built an embankment against sewage on the Reserve side of the outfall channel into Sewer's Creek (now called North Arm Creek).

In 1925 the Hydraulic Engineers' reports on city and suburban sewers recommended abolition of Islington Sewerage Farm. At the time, four systems delivered to the screen house: the Main Outfall Area from Adelaide (constructed in 1880), the Hindmarsh Sewer (1898), the Relief Sewer (1922), and the Subsidiary Systems

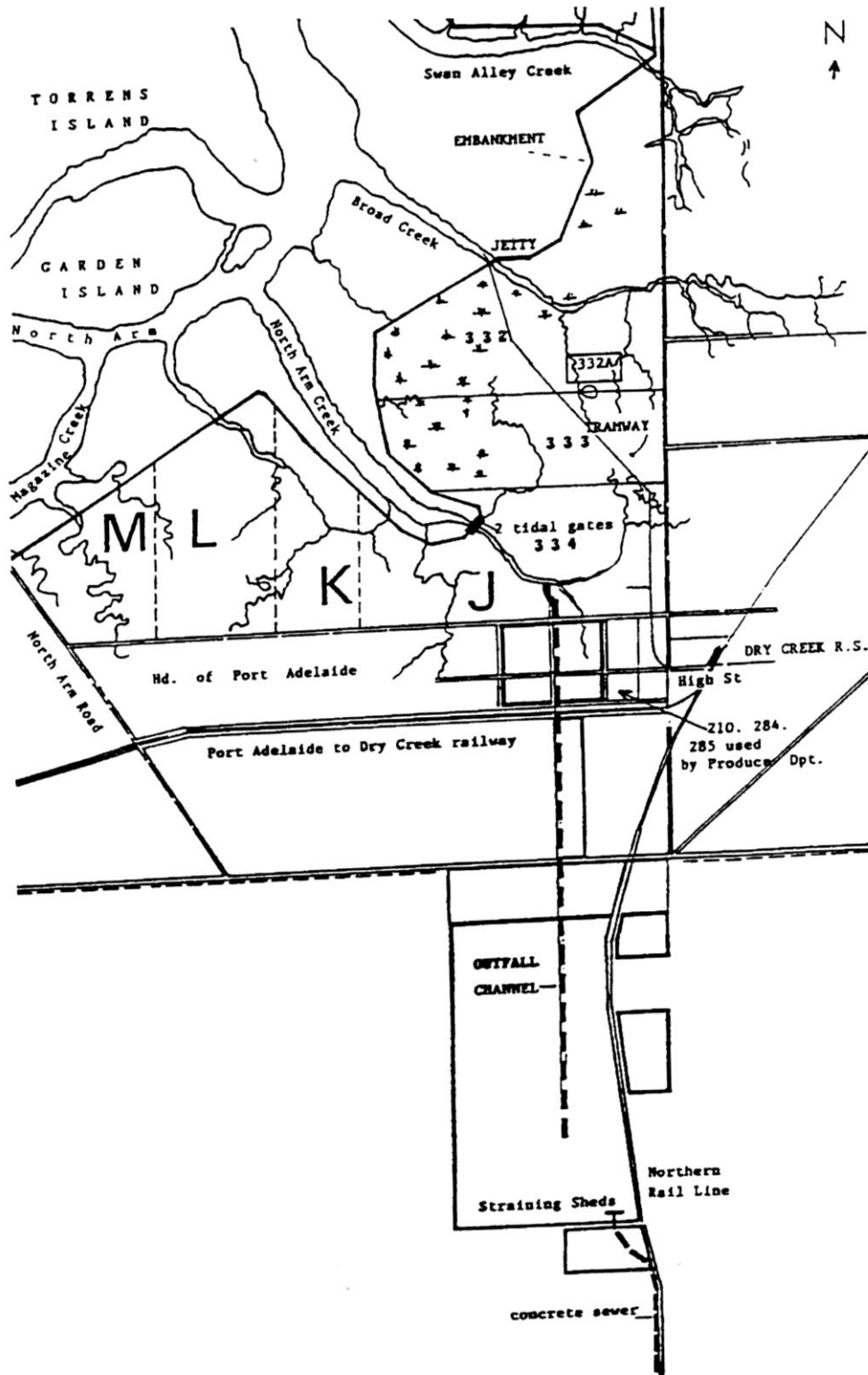


Figure 3. Sewerage Reserves (1917) (Outlined in bold). Based on map in 'Newspaper Cutting. Reg.,' 19.10.1917 in SAHB, GRG 51/1981/1917 (State Records SA).

comprising mainly drains from the close southern suburbs. The system of sewers for Port Adelaide and Semaphore districts was also lifted 6.5 kilometres to Islington Farm: this sewage was 'septicised', whereas that from the other areas was 'comparatively fresh' (Bellamy, [1925]: 35). The existing Bolivar Sewage Treatment Works, several kilometres north of the Magazine Reserve, was established in 1966.

Decline of the Reserve

By late 1925 the recent change to large-quantity and less frequent explosives shipments from Victoria resulted in retrenchment of the daily paid Reserve stevedores. During the Great Depression the Classification and Efficiency Board sought wherever possible to reduce government expenditure, and pressured the Harbors Board to justify the magazines' continuation. The Victorian railway concessions given to Nobel (Australasia) in 1933 for transport of explosives made at Deer Park – mainly to Broken Hill – intensified the problem, and were a sore point unsuccessfully negotiated by the Harbors Board with Nobel.

Increasingly from 1931 South Australian water-carried trade competed with more efficient rail and road transport. Consequently, movement of explosives through the outport jetties declined and revenue was lost. From 1934 Deer Park explosives sent to South Australia were railed direct to the Reserve. By mid 1947 all supplies came this way. By 1934 the Broad Creek wharf piles, waling pieces, and sheet piling were badly weakened mainly from shipworm, that 'pernicious mollusc' and 'pest to civilized humanity' (*Illustrated Australian Encyclopedia, II*, 1926: 134), which departmental neglect had abetted. A new wharf was begun four years later. In 1950 the jetty needed immediate safety repairs (carried out only in September 1952), but it was not renewed. As revenue from port trade decreased, so the maintenance (including dredging) of the Broad Creek landing markedly declined. The last explosives ketch was loaded at Broad Creek in February 1970. The jetty was demolished about 1976.

Industry competition

In response to state government encouragement of industrialisation, from 1936 Imperial Chemical Industries Australia & New Zealand (ICIA&NZ) began pumping sea water from 30 kilometres north of the Reserve for salt extraction. The current southern crystallising ponds, adjacent to the Reserve and operated by Penrice Soda Products, date from this period. In 1936 the western part of the Reserve was leased to ICIA&NZ. The company took over the four large western magazines for stores and workshops (Figure 2). In late April 1936 the Harbors Board permitted the company to construct a 'boundary wall between the two rows of Magazines ... [and] to use the western end of the Magazine Tramway Embankment near Broad Creek' as part of an evaporation pan boundary wall (SAHB, 349/36), subject to assurance that the change would not impair the work of the Board.

Later, in contravention of the Explosives Act 1936, ICI was permitted to erect an 'igloo' repair workshop on land granted to it inside the Reserve's western boundary (measuring 376 metres by 15 metres). The building was 82 metres from the magazines – well inside the protection distance for buildings near explosives stores (DCM, no. 7, 1950: f. 707) – and because of this encroachment, bunds were built by drag-line on the western side of the magazines in April 1950 (Brown, 1976: 8). Eventually, the Reserve was bounded, from the west around to the north-east, by mineral salt leases.

By 1952 the serious need to control protection of the magazines and explosives

transport against encroaching light-industrial development was recognised. Additionally, for protection against the likely expansion of the salt pans and associated works, in 1960 the Chemistry Department outlined an exclusion zone of one kilometre radius centring on the Broad Creek jetty. In late 1961, the decision to retain the Dry Creek Magazines led to proposed immediate construction of new magazines to the north-east, with provision for future expansion further north-east and north, and for the acquisition of enlarged buffer zones (totalling some 190 hectares) to increase and establish new protection distances (Figure 4).

Relocation of explosives storage to the Weapons Research Establishment's Smithfield munitions magazines (some 20 kilometres to the north-east) was negotiated, but Commonwealth department offers were unsatisfactory. Additional buffer land considered for acquisition included sections 1024, 1017, 1013, 1022, 1019, and 1004. The minimum approved distance between a 20-ton magazine and public road or building was 581 metres. The 'Islington-Elizabeth' highway, with a proposed route from south of the magazines across the eastern 'Stock Paddocks', threatened to limit the capacity of the three southern magazines to less than one ton.² In July 1967, in order to avoid close buildings and activity, a siding from the northern rail line across sections 1002 and 999, and motor trucking from the southern end of the reserve across the salt pans to Broad Creek, were considered (Figure 4).

In the early 1960s new Electricity Trust high voltage lines laid through the coastal mangroves also posed a possible (eventually unproven) danger to the storage of electric detonators, and the Trust's attempt to have the Broad Creek landing place moved downstream was another inconvenience. To the south, Hume Broadcasters (whose power input into its aerial was a potential trigger to explosion) leased sewerage reserve sections 284, 285, 287, 430, 432 from the Minister of Works: these were to be resumed in 1969, rededicated as an explosives magazine reserve and released by the Minister of Agriculture.³

By June 1975 about 170 hectares were held as buffer and storage areas, about 40 hectares of which were proclaimed as Explosives Magazine Reserves. Some of the remaining 130 hectares were administered under the Explosives Act 1935-1972. As late as November 1976 the Chemistry Division remained unsure if part of the 'Stock Paddocks' would be required (sections 1019 and 1022), their long uncertain status leading the lessee, Metropolitan Wholesale Meat Company, to seek intercession from the Ombudsman.

But the main Reserve faced collapse. The decline in its work caused by land transport of explosives was later joined to technological progress in explosives' use. From early 1978 ammonium nitrate came into wide use as an ingredient of explosives mixtures prepared on-site and, with further refinements in safety, and explosives users' responsibility for storage, the formerly necessary inspection, sampling, and storage of cargoes ceased.

The future?

Throughout its 92 years of service, for civic safety and its own security, the existence of the Reserve was not widely known. Whereas in its early operation there was a frequent 'rush of works' which required the hire of daily-paid 'glut assistants' (DCM, no. 2: f. 210), when the Reserve closed in 1995 it had operated for two decades at less than full steam.

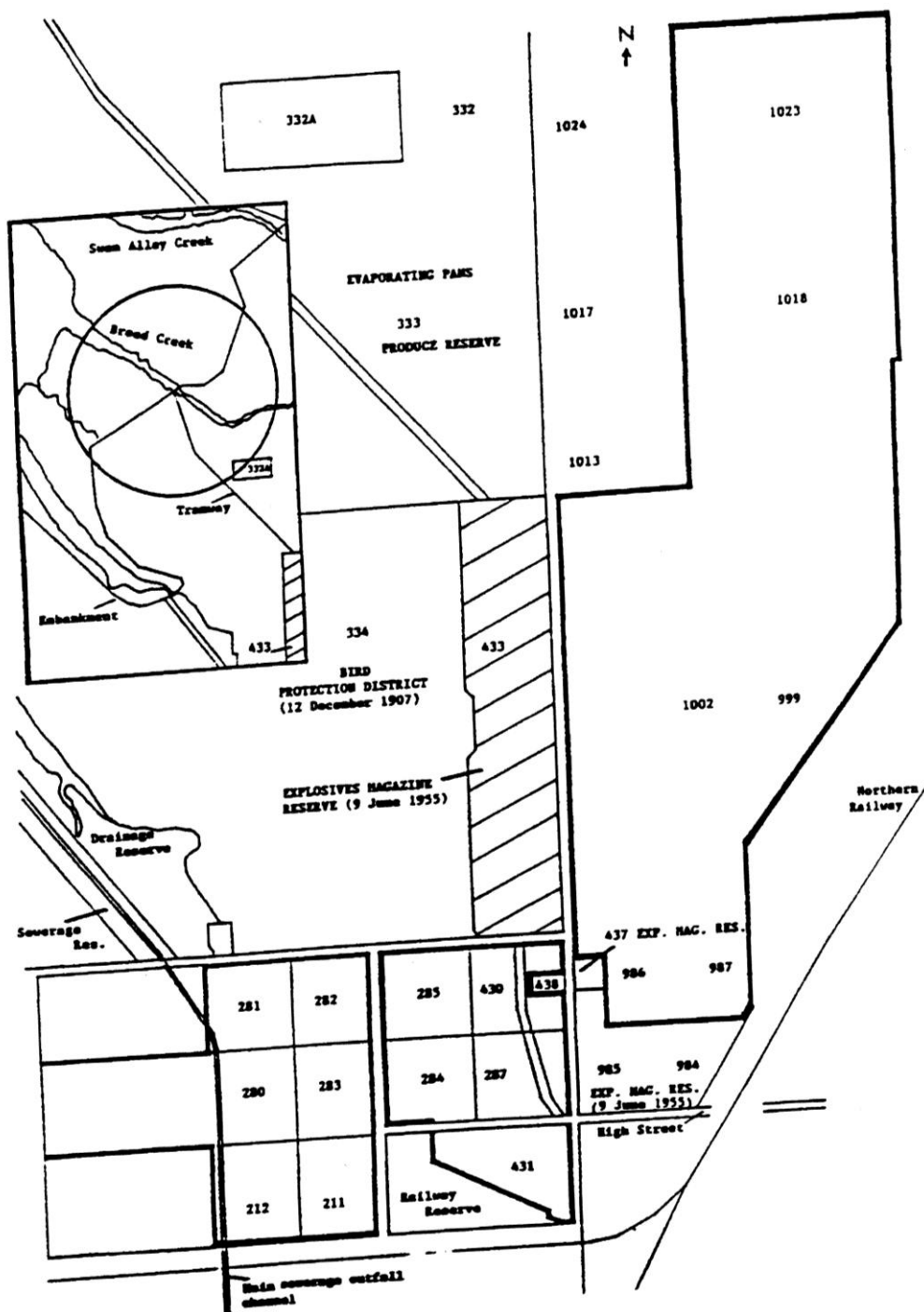


Figure 4. The original Magazine Reserve (now section 433) is 20.03 hectares. The main buffer zones are summarised in bold outline. Inset: area from which fishing and occupied buildings were prohibited. The Magazine Keepers' cottages, on sections 438 and 437, were condemned in 1969 (demolished 1973). Based on the annotated map, Department of Lands, SA, Sheet no. 6628-31, 1:10 000 Series, First Edition, 1977 (Held by the City of Salisbury); and map in 'CIE, Explosives Magazines, Dry Creek', GRS 1788/1/P, DC 85/1969 (State Records SA).

The magazines' heritage value was recognised by Multi Function Polis Australia (MFP)

when the Reserve was part of the Gillman remediation site (MFP Australia, 1992: 285). But improvement by Magazine staff was started even before occupation of the Reserve. A variety of more than 6000 trees (mainly tamarisk, eucalypts, and *Lagunaria* – probably the salt spray tolerant Norfolk Island Hibiscus) was planted to modify the climate and for explosion breaks; and reeds and grasses were grown experimentally around bores for stock fodder and as sea embankment binders. Five (or six) bores which watered these plants and whose overflow ponded the eastern borrow pits, acting to reduce the temperature around the magazines and provide fire protection, became inoperable after Imperial Chemical Industries began its own bore pumping for brine production, and were closed by 1958. Part of the 'swamp lands' omitted from consideration in Bellamy's report on sewerage – on account of 'being deemed to be uninhabitable for many years to come' (Bellamy, [1925]: 8) – the land will doubtless be restored to aspects of its unimproved nature under present local government plans for flood water drainage and wetlands expansion. The site has eco-tourism potential and the magazine buildings are capable of development as site interpretation centres. But without intervention, they will deteriorate further. A plan which maintains evidence of the Reserve's past, unique work practices, its maritime dependence, and its government management will contribute to their preservation.

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¹ But one, Harrold Brothers, Adelaide, was also the sole South Australian and West Australian agent for Krebs explosives, manufactured in the 19th century by the Australian Lithofracteur Co. of Victoria ('Waupmelta', 1885:38). By early 1934, of a total 809 cases of explosives delivered from the Reserve on behalf of six private and one government consignor, 668 were imported for Nobel by Elder Smith & Co. Nobel was considered to be enjoying a government-subsidised trade (SAHB 870/1933: [1-4]).

² The Salisbury Highway-South Road Connector opened in early 1995.

³ Transfer of administration of the *Explosives Act* 1936-1972 from the Minister of Agriculture to the Minister of Health was gazetted on 9 September 1976. Several boards, departments, and divisions managed the Act during the life of the Dry Creek Magazines.