Alice Springs Town Council

Proposed Eastside Levee, Alice Springs

Public Environmental Report

May 2000

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1. Executive Summary

1.1 Title of Proposal

The title of the proposal is:

Todd River Flood Mitigation - Development of the Eastside Levee

1.2 Name and Address of Proponent

The proponent is:

Alice Springs Town Council
Todd Street, Alice Springs NT 0870

Contact: Mr Roger Bottrall, Director, Planning and Infrastructure
Phone: 08 8950 0500 Fax: 08 8953 0558

1.3 Background

The *Alice Springs Floodplain Management Study* (GHD, 1996) examined a range of methods for reducing the frequency of flooding in Alice Springs. One of the options investigated was the construction of levees along the banks of the Todd River, to provide flood immunity for the CBD and residential areas up to the Q100 river flood event.

From the public consultation process associated with the Floodplain Management Study, it was determined that the construction of levees along the Todd River banks was not considered an acceptable solution, mainly due to the visual impact of such a system. However a partial levee system constructed along Sturt Terrace between Gosse Street and Mills Street was seen as having fewer potential impacts, while providing an increased level of flood immunity for part of Alice Springs. As a result, construction of the Eastside levee was included as one of the recommendations of the *Alice Springs Floodplain Management Study*.

In 1999, the Alice Springs Town Council commissioned an engineering feasibility report on the Eastside Levee (GHD, 1999). This study evaluated the benefits, consequences and other issues associated with the levee construction. Conceptual design and costing of the works was also carried out.

Before implementation of the project can be approved, the Department of Lands Planning and Environment (DLPE) has required that the project be assessed in accordance with the provisions of the Environmental Assessment Act at the level of a Public Environment Report (PER).

1.4 Need for the Proposal

Under existing development conditions in Alice Springs, it is estimated that approximately 630 residential properties and 240 commercial properties lie within the Q100 flood zone. The estimated flood damages cost for the Q100 flood event is approximately $16 million, of which $6 million would be incurred by residential properties (refer the *Alice Springs Floodplain Management Study*, GHD, 1996).

Construction of the Eastside levee would provide Q100 flood immunity for an additional 160 residential properties, compared to current conditions. This would reduce Q100 flood damage costs by an estimated $1.5 million.

Although there are other areas of Alice Springs which are flooded more regularly and to greater depths, the costs and potential environmental impacts of providing increased flood immunity to these areas are considerably higher.

The Eastside levee provides increased flood protection to a significant number of residential properties at a relatively small cost, with minimal impact . Hence, Alice Springs Town Council has sought funding to enable construction of the levee.

1.5 Objectives of Proposal

The objective of the Eastside levee proposal is as follows:

- To provide Q100 flood protection to an additional 160 residential properties in Alice Springs, compared to existing conditions.

1.6 Description of Proposal

The proposed levee will be located along the eastern bank of the Todd River in parkland between Gosse Street and McMinn Street. It will consist of an earth embankment approximately 550m in length, with a maximum height of 1.5m. A floodgate will be constructed across Schwarz Crescent. The floodgate will normally be open allowing for traffic movement. During flood warning periods, the gate would be closed to complete the levee.

The objective of the levee proposal is to provide flood protection for the Eastside residents for Q50 to Q100 flood events.

It is intended that the levee alignment and shape be designed to blend in with the existing topography and parkland qualities of the area. The levee will be revegetated with a combination of couch and native grasses to provide stability and resistance to soil erosion, as well as to blend into the surrounding environment.

1.7 Summary of Environmental Impacts

Identified environmental impacts particular to this project are summarised as follows:

- Removal of approximately 160 residential properties from the estimated Q100 flood inundation area.
- Up to 70mm increase in Q100 flood levels within the CBD area. The incremental increase in flood level results in an estimated 5 commercial properties being inundated in the Q100 flood event, which would not have been inundated prior to levee construction.
- Approximately 120mm increase in Q100 flood levels at Joint Australian US Geological & Geophysical Research Station, Schwarz Crescent.
- Approximately 40mm increase in Q100 flood levels at St Philips College.
- Reduced flooding frequency for the Coolibah Swamp due to blocking of overflows through the Eastside area. This is not expected to have an impact, as other sources of re-charge are available for the Coolibah Swamp (refer Section 5.1.3 of this report).

Temporary impacts which would occur during the levee construction period include:

- Restricted access to parkland area for the duration of the contract.
- Deterioration of Sturt Terrace and other access roads due to construction traffic. Restoration of damaged road surfaces would be a requirement of the contract. Long term impacts are therefore unlikely.
- Construction noise.
- Temporary loss of vegetation cover in areas required for storage of contractor's equipment and materials, and stockpiling of fill material. Restoration of damaged areas would be a requirement of the contract. Long term impacts are therefore unlikely.

The project area included 211 trees between Sturt Terrace and the river bank (refer to vegetation survey). Impact of the proposal on these trees is considered to be minimal.

An inspection of the area confirmed the presence of sacred sites including trees to be protected, such as River Red Gums, native gum trees and a Coolibah. These would need to be protected from disturbance pursuant to AAPA Certificate No. C1999/076. The AAPA Certificate issued to ASTC gives consent for works to be undertaken and sets outs conditions of the approval under the Aboriginal Sacred Sites Act 1989.

It is anticipated that the only vegetation clearance to occur will be removal of existing grass from the construction area and selected clearing of existing trees. Until detailed designs are prepared, it is difficult to determine how many trees will require removal. However, the following guidelines would apply:

- All identified trees identified in AAPA Certificate No. C1999/076 are to be retained and protected from any disturbance.
- All healthy River Red Gums and other endemic species to be retained and protected from any disturbance.
- Where trees need to be removed to provide a sufficiently wide corridor, the alignment would be selected so that only weed species, introduced species, recent plantings and/or sick plants require removal.

The levee itself and all disturbed areas will be rehabilitated with grasses immediately after construction. This will reduce the risk of scouring of the levee.

The alignment and profile of the levee will be constructed to blend with the existing environment. Steep slopes will be avoided where possible. A curvilinear alignment with varying side slopes may also be adopted to avoid trees and provide a more natural contour.

In addition to establishing grassing to the levee, selected planting of indigenous riverine species will further blend the levee into the riverside parkland.

1.8 Proposed Environmental Management Principles and Monitoring Procedures

Environmental management and monitoring procedures will be implemented for the construction and maintenance of the levee. The responsibility for these activities will rest with ASTC.

Monitoring and management requirements are as follows:

Construction Phase

- Control extent of clearing and vegetation stripping
- Ensure construction vehicle access is via approved routes only. Monitor condition of access roads
- Ensure compliance with AAPA Certificate

Ongoing Management and Monitoring

- Monitor levee embankment for erosion, structural damage and impact of pedestrian traffic. Repair when necessary.
- Monitor condition of vegetation on levee. Water and mow as necessary. Control the spread of weeds.
- Undertake regular testing and maintenance of Schwarz Crescent floodgate.

1.9 Methodology

The development of the PER has been carried out according to the following methodology;

- Review of existing relevant documentation.
- Site visit to the levee site to identify areas which could potentially be affected by the proposal;
- Vegetation survey to identify existing vegetation and assess landscaping, tree protection, soil conservation, and rehabilitation requirements;
- Liaison with key community and government groups to discuss, specific requirements and issues for the report and existing legislation and polices relevant to the levee proposal;
- An assessment of the existing environment that may be affected, ie topography, hydrology, vegetation, and sites of cultural significance;
- Identification of environmental impacts
- Hydraulic analysis to assess impacts on local drainage and flooding
- Review the levee design, engineering and construction;
- Analysis of environmental management needs and monitoring procedures;
- Identification of maintenance and operation procedures; and
- Preparation of the report.

1.10 PER Structure and Scope

Scope

The purpose of this PER is to allow for public input, assessment of the existing environmental conditions at the proposed levee location, and identification of actual and potential environmental effects of the proposed construction. This will allow for the design and development of appropriate and effective management strategies aimed at minimising environmental risks and adverse consequence.

Structure

The PER is structured in accordance with the guidelines prepared by DLPE for the preparation of a PER. There are 6 sections within the PER, as follows:

Section 1 - Summarises PER and introduces the project;

Section 2 - Provides a description of the project, including its major components, location, design requirements, construction and operation;

Section 3 - Describes the existing environment in which the project will be constructed and will operate;

Section 4 - Summarises public consultation undertaken regarding the project.

Section 5 - Analyses possible environmental impacts and safeguards to mitigate these impacts, management and monitoring procedures, control measures.

Section 6 - References

A glossary which defines technical terms and abbreviations used in the PER text is provided in Appendix A. Technical data and correspondence relevant to the project is provided in Appendices B to E.

Relevant Legislation and Polices

NT legislation and polices that are pertinent to the proposal are:

- Aboriginal Sacred Sites Act
- Environmental Assessment Act
- Water Act

2. Description of the Proposal

2.1 Reasons for the Proposal

Under existing development conditions in Alice Springs, it is estimated that approximately 630 residential properties and 240 commercial properties lie within the Q100 flood zone. The estimated flood damages cost for the Q100 flood event is approximately $16 million, of which $6 million would be incurred by residential properties (refer the *Alice Springs Floodplain Management Study*, GHD, 1996).

The *Alice Springs Floodplain Management Study* (GHD, 1996) examined a range of methods for reducing the frequency of flooding in Alice Springs. One of the options investigated was the construction of levees along the banks of the Todd River, to provide flood immunity for the CBD and residential areas up to the Q100 river flood event.

From the public consultation process associated with the Floodplain Management Study, it was determined that the construction of levees along the Todd River banks was not considered an acceptable solution, mainly due to the visual impact of such a system. However a partial levee system constructed along Sturt Terrace between Gosse Street and Mills Street was seen as having fewer potential impacts, while providing an increased level of flood immunity for part of Alice Springs. As a result, construction of the Eastside levee was included as one of the recommendations of the *Alice Springs Floodplain Management Study*.

Construction of the Eastside levee would provide Q100 flood immunity for an additional 160 residential properties, compared to current conditions. This would reduce Q100 flood damage costs by an estimated $1.5 million.

Although there are other areas of Alice Springs which are flooded more regularly and to greater depths, the costs and potential environmental impacts of providing increased flood immunity to these areas are considerably higher.

The Eastside levee provides increased flood protection to a significant number of residential properties at a relatively small cost, with minimal impact . Hence, Alice Springs Town Council has sought funding to enable construction of the levee.

2.2 Location and Design Requirements

2.2.1 Location of Development

The proposed levee will be located along the eastern bank of the Todd River between Gosse Street and McMinn Street, Alice Springs. The levee will be constructed in existing parkland located between Sturt Terrace and the river bank. The levee centreline has been nominally located 15m from the edge of the Sturt

Terrace road reserve. However the final alignment may vary within the parkland during detailed design, in order to avoid existing trees.

The proposed location and extent of the levee are shown in Figure 1.

2.2.2 Land Tenure and Planning

The proposed levee will be located on Lots 5140 and 5806 Alice Springs. These lots are classified as reserves under the Crown Lands Act. The land is described as being for municipal purposes, to be known as Reserve No 1708.

The land is also subject to Native Title rights and interests held by Alice Springs Arrernte people. As a result of the acceptance by the National Native Title Tribunal of the Native Title Application for the area in question, the registered claimants have the right to be consulted on works proposed for the area.

2.2.3 Design Layout and Standards

The main components of the levee are:

- an earth embankment, approximately 550m in length
- a flood gate across Schwarz Crescent, near the intersection with Sturt Terrace.

Design standards proposed for the levee are summarised below:

Flood Standard

A Q100 flood immunity will be adopted as the design standard for the levee. The Q100 (1% AEP) flood has been adopted by the NT Government as the design standard for land use planning and floodplain management in Alice Springs.

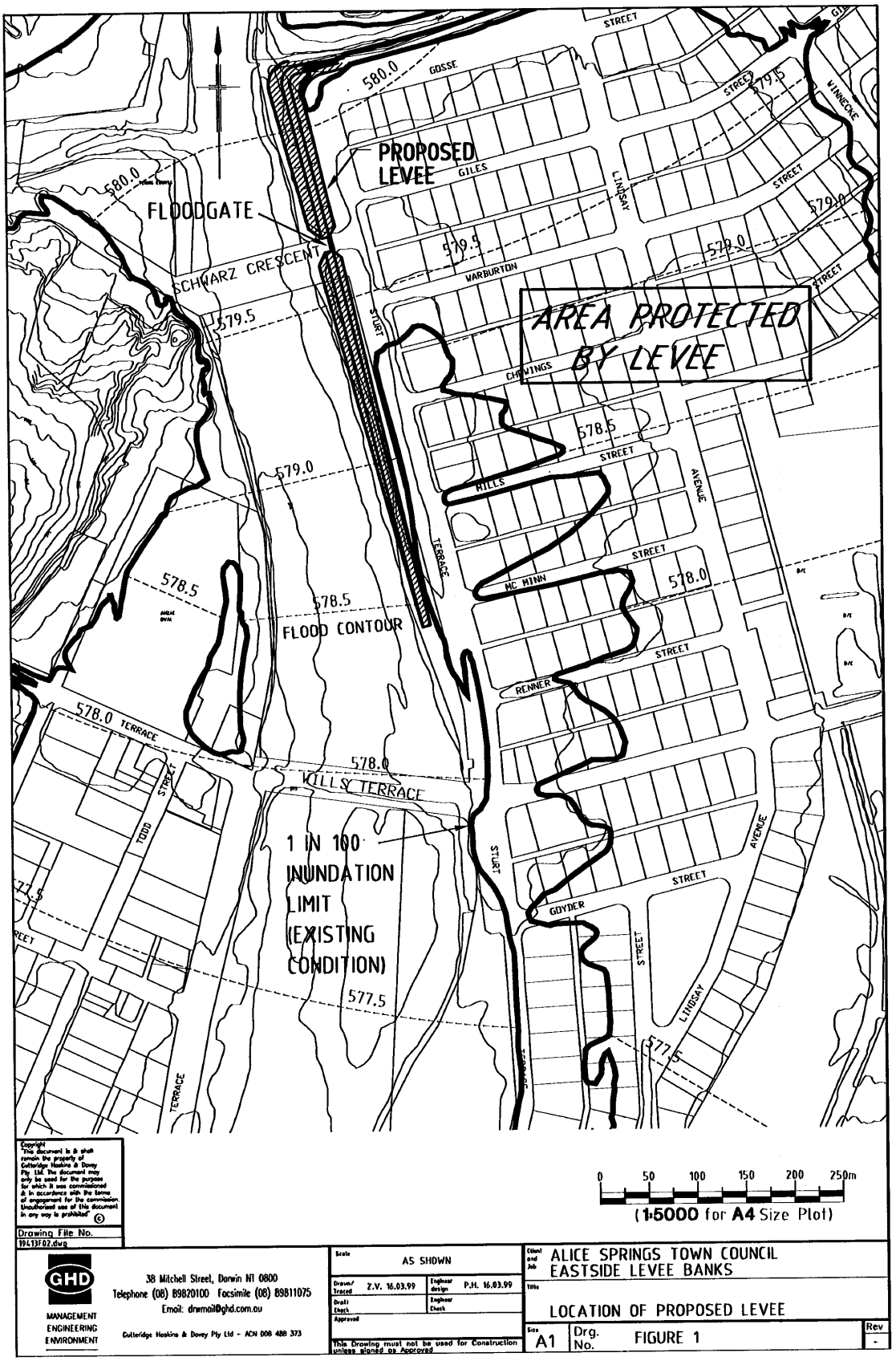
Predicted Flood inundation limits for Alice Springs are shown in Figure 2. These are based on Todd River hydraulic modelling and floodplain mapping undertaken by GHD for DLPE in 1999.

Levee Height

Levee heights will be based on the Q100 flood levels calculated along the proposed levee alignment, with an additional 300mm freeboard allowance.

Based on ground levels obtained from available Alice Springs topographic mapping, the levee will have an average height of 0.8m. The maximum height will be 1.5m, at the Sturt Terrace/Schwarz Crescent intersection.

Required levee heights at various locations along the Todd River are summarised in Table 1.


PROPOSED LEVEE
FLOODGATE
AREA PROTECTED BY LEVEE
1 IN 100 INUNDATION LIMIT (EXISTING CONDITION)
578.5 FLOOD CONTOUR
SCHWARZ CRESCENT
GOSSE
GILES
WARBURTON
CHOWINGS
MILLS
MC MINN
RENNER
GOYDER
STURT
TODD
LINDSAY
VINNECOMBE
KILLS TERRACE
TERRACE
STREET
AVENUE
580.0
579.5
579.0
578.5
578.0
577.5
0 50 100 150 200 250m
(1:5000 for A4 Size Plot)
Drawing File No.
19413F02.dwg
GHD
MANAGEMENT ENGINEERING ENVIRONMENT
38 Mitchell Street, Darwin NT 0800
Telephone (08) 89820100 Facsimile (08) 89811075
Email: drwmail@ghd.com.au
Cutteridge Haskins & Davey Pty Ltd - ACN 008 488 373
Scale AS SHOWN
Drawn/ Traced Z.V. 16.03.99
Engineer design P.H. 16.03.99
Drafting Check
Engineer Check
Approved
This Drawing must not be used for Construction unless signed as Approved
Client and Job ALICE SPRINGS TOWN COUNCIL EASTSIDE LEVEE BANKS
Title LOCATION OF PROPOSED LEVEE
Size A1
Drg. No. FIGURE 1
Rev -

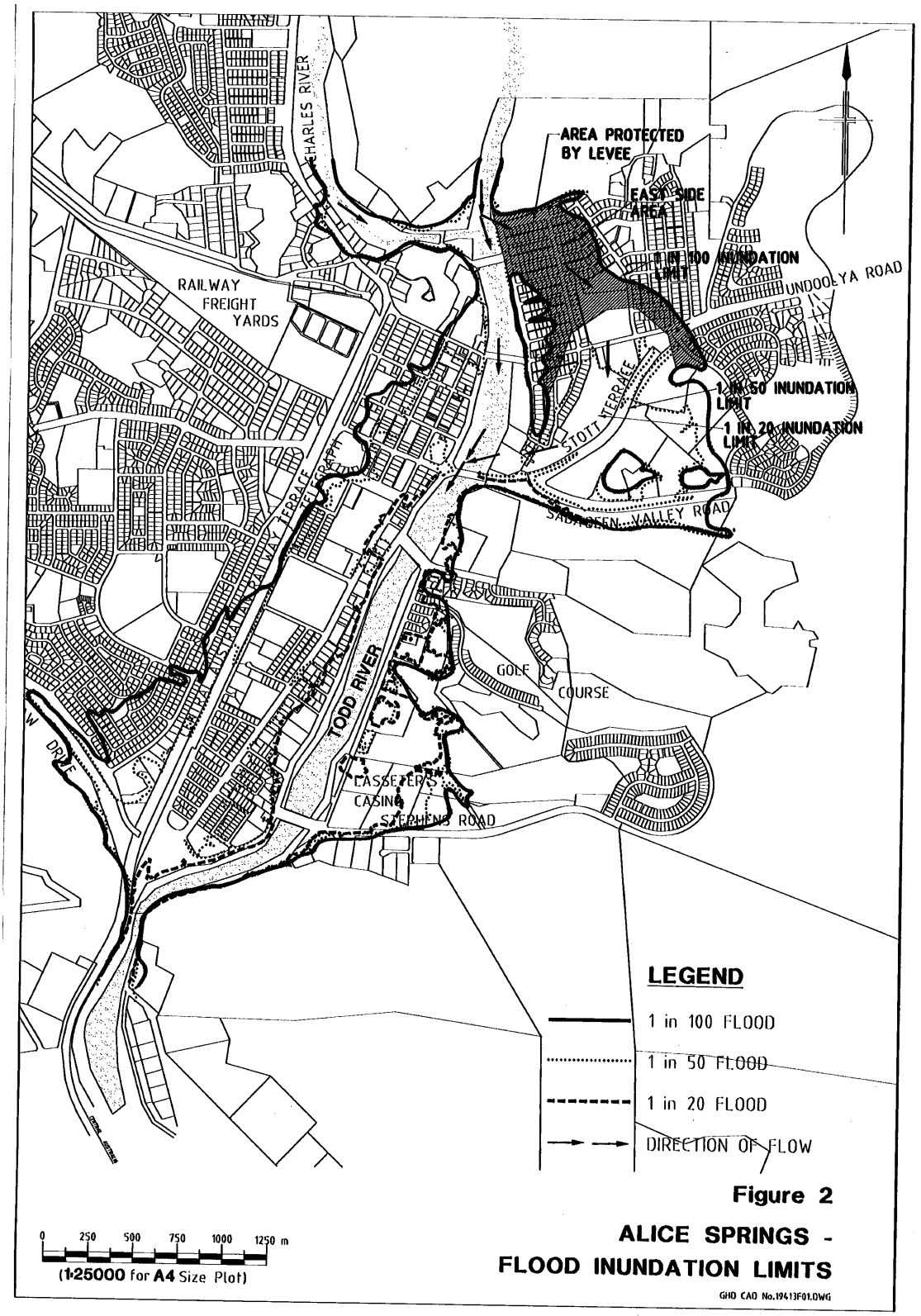

AREA PROTECTED BY LEVEE
EAST SIDE AREA
1 IN 100 INUNDATION LIMIT
1 IN 50 INUNDATION LIMIT
1 IN 20 INUNDATION LIMIT
CHARLES RIVER
RAILWAY FREIGHT YARDS
UNDOOLYA ROAD
STOTT TERRACE
SADDLEEN VALLEY ROAD
TODD RIVER
GOLF COURSE
CASSEDY'S CASINO
STEPHENS ROAD
LEGEND
1 in 100 FLOOD
1 in 50 FLOOD
1 in 20 FLOOD
DIRECTION OF FLOW
0 250 500 750 1000 1250 m
(1:25000 for A4 Size Plot)
Figure 2
ALICE SPRINGS - FLOOD INUNDATION LIMITS
GHD CAD No.19413F01.DWG

Table 1
Estimated Levee Heights

Location	Ground Level (m AHD)	Q100 Flood Level (m AHD)	Levee Height inc. 300mm freeboard (m)
Gosse Street	580.0	580.19	0.5
Giles Street	579.4	579.94	0.8
Schwarz Crescent	578.6	579.82	1.5
Warburton Street	579.1	579.60	0.8
Chewings Street	578.4	579.29	1.2
Mills Street	578.2	578.99	1.1
McMinn Street	578.6	578.58	0.0

Levee Cross Section

The levee will be constructed of compacted earth. Proposed levee design details are shown in Figure 3.

The maximum embankment slope will be 1 in 6. A 1 in 6 slope is normally considered the steepest slope that can be safely accessed by grass-cutting machinery. With adequate embankment compaction, topsoiling and grass cover, a 1 in 6 slope is normally sufficient to minimise bank erosion during rainfall events.

Where the levee is not constrained by locations of existing trees, services or other features of the park area, flatter slopes will be used. This will enable a more natural shape to be achieved, which can be blended into the existing topography of the parkland.

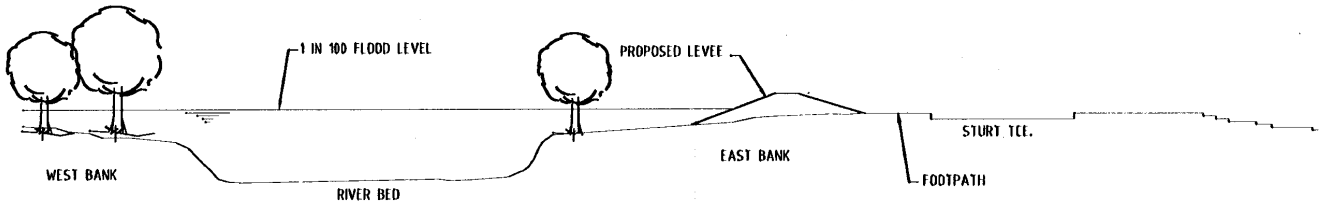
Schwarz Crescent Floodgate

To provide the nominated Q100 flood immunity, the proposed levee must be extended across Schwarz Crescent, near the intersection with Sturt Terrace. This will be achieved using a movable floodgate. The floodgate would normally be open to allow for movement of traffic, but would be closed during a flood warning situation.

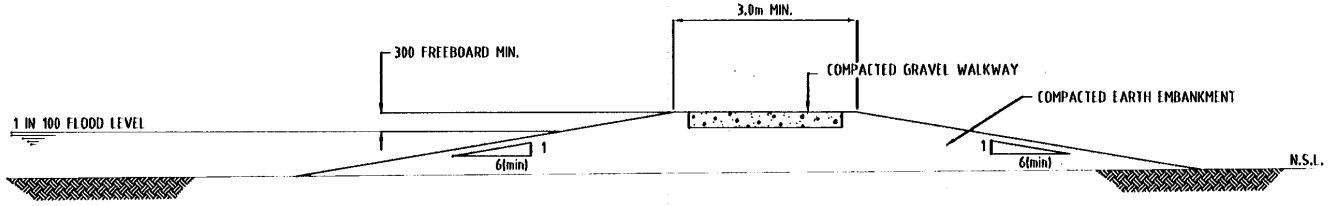
The floodgate would need to be approximately 1.5 metres high to provide the required flood immunity. A preliminary design for the structure is shown in Figure 4.

2.2.4 Design Limitations Imposed by Site Characteristics

The proposed levee will be located in an area used as a public park. The levee will therefore need to be designed so that it will blend in with the existing environment, as well as being structurally sound for flood protection.



TYPICAL SECTION THROUGH TODD RIVER FLOODPLAIN
N.T.S.



TYPICAL SECTION THROUGH LEVEE

(1:100 for A4 Size Plot)

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Drawing File No.: FIGURE3.dwg				

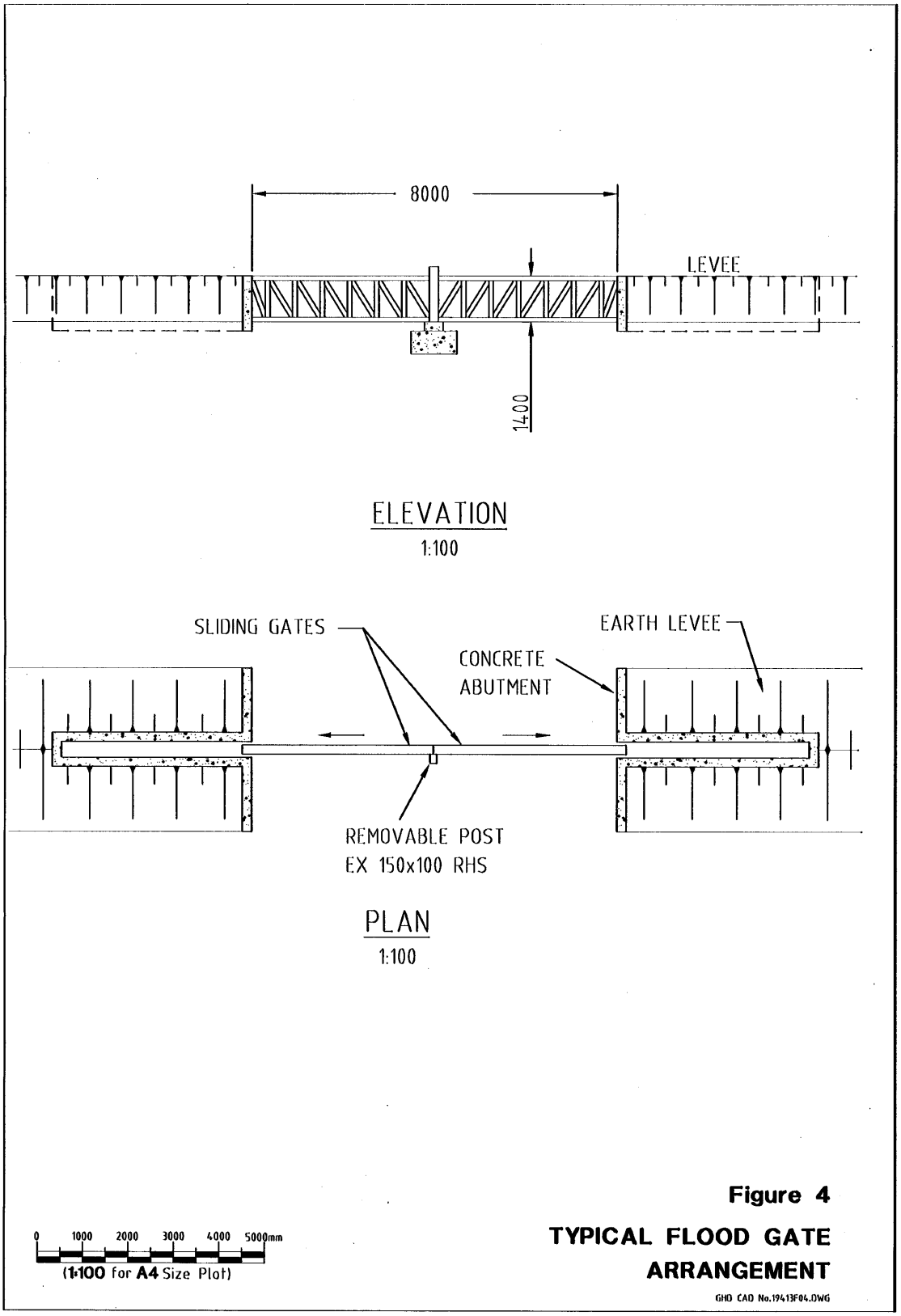


Figure 4

TYPICAL FLOOD GATE ARRANGEMENT

To ensure the amenity of the reserve is not diminished, the levee will be constructed of earth and appropriately landscaped using a combination of native and introduced grasses. The levee's aesthetic appeal will be assisted by contouring to the existing topography so as to blend in with the natural undulations and features in the parkland.

2.2.5 Landscape Design

The landscape philosophy has three objectives:

- Blend the levee bank into the existing parkland to minimise its visual impact.
- Ensure the levee bank is stabilised with suitable vegetation cover to minimise risk of erosion and scouring.
- Adapt an alignment and profile for the levee to minimise loss of trees and to maximise its potential to be an asset in the parkland.

These objectives are closely related in the way the landscape design resolves them. Key aspects of the design are described below:

Curvilinear Alignment

A curvilinear alignment will be adopted. The primary reason for the curvilinear alignment is to minimise the need to remove Sacred Site trees and other endemic species. The alignment will be selected to minimise the need to remove existing trees. However, it is anticipated that due to the width of the levee, some trees may require removal. The actual numbers would be determined as part of the design and documentation phase. The following guidelines would apply:

- All identified trees identified in AAPA Authority Certificate No. C1999/076 are to be retained and protected from any disturbance.
- All healthy River Red Gums and other endemic species to be retained and protected from any disturbance.
- Where trees need to be removed to provide a sufficiently wide corridor, the alignment would be selected so that weed species, introduced species, recent plantings and/or sick plants only require removal.

While tree preservation will be the primary determinant, the resulting alignment will also help blend the levee into the parkland and minimise its visual impact.

Further amelioration of the visual impacts would be achieved by adopting a range of side slopes to the levee. A slope of 1:6 is preferred due to long term stability, suitability for mowing and minimising amount of fill (and hence costs). However, gentler slopes may be selectively utilised to further soften the profile of the levee. In some instances, additional earthworks may be undertaken to provide semi enclosed areas that would act as seating mounds and meeting areas.

The crest of the levee would provide an interesting pathway for cyclists and pedestrians. The elevated position would offer a different viewpoint of the river and the curvilinear alignment would provide variety.

Grassing

The area is currently well grassed, with the primary species being couch (*Cynodon dactylon*). It is recommended that couch and native grasses be used to rehabilitate and stabilise the levee. These species are hardy, vigorous species that will provide good ground cover and soil holding capabilities. They will require ongoing management and maintenance to maintain a full and healthy cover that will provide the required erosion protection.

Additional Tree Planting

As identified earlier, the alignment will be determined to avoid all Sacred Site trees and other healthy, indigenous plantings. In selected areas, additional endemic tree planting will be undertaken. While this does not serve any direct purpose in the flood control function of the levee, the additional planting will improve the overall visual and physical amenity of the parkland.

2.3 Construction Phase

2.3.1 Program

The levee is expected to take approximately 3 months to complete, from commencement of construction. Construction is proposed over the months July-September 2000.

2.3.2 Physical Requirements for Construction

The construction process will involve the following activities:

- Stripping of topsoil and vegetation over the area of levee construction
- Removal of unsuitable levee foundation material (if present) and replacement with suitable soil
- Transport of earth fill material to the site and construction of compacted earth embankment
- Construction of two concrete retaining walls (approximately 1.5m in height) at Schwarz Crescent
- Fabrication of steel floodgate (off site), transport of floodgate to the site and fixing to retaining wall at Schwarz Crescent
- Installation of levee watering system
- Topsoiling of the levee and any other disturbed areas, establishment of grass cover and native shrubs, and general landscaping works

- Cleanup and restoration of construction areas.

The most significant and time consuming of these tasks will be the construction of the levee embankment. This will involve haulage of suitable fill material to the site, and spreading and compaction of the material in layers of approximately 250mm up to the design level.

The floodgate would be fabricated in a workshop and then transported to site. On-site construction associated with the floodgate would include pouring of retaining walls on each side of Schwarz crescent to act as supports for the gate. Retaining wall construction would be of short duration (1-2 days).

2.3.3 Sourcing and Transport of Materials

Based on the preliminary levee layout, the estimated fill quantity required for construction of the levee is 4000m^3. The required physical properties of the fill material would be similar to those normally specified for embankments in road construction. The material would most likely be sourced from one of a number of existing borrow pits in the Alice Springs area which are used for supply of road construction materials.

Assuming a truck capacity of 10m^3, approximately 400 truckloads of fill material would be required, over a period of approximately 2 months. This amount of heavy traffic is likely to cause significant deterioration of the Sturt Terrace road surface, and possibly other roads leading to the site.

It would be a requirement of the levee construction contract that the roads used for fill haulage be restored to there pre-existing condition, once construction activities have ceased.

A supply of water would also be required for use in compaction of the earth fill and for dust suppression. This would be sourced from non-potable water supplies in the Alice Springs area, and trucked to the construction site.

Once levee construction activities are complete, an irrigation system would be installed, and connected to the town water supply system.

2.3.4 Construction Standards, Techniques, Site Management and Supervision

The proposed levee is a relatively simple structure to construct, and would not require specialised construction techniques. A number of civil engineering contractors based in Alice Springs would be capable of undertaking the work.

Contract documentation would be based on standard technical specifications for civil engineering construction work, which have been prepared by the Department of Transport and Works and are commonly used in Alice Springs.

Construction supervision would be undertaken by qualified engineers independent of the construction contractor. Supervisory staff would be sourced either from the Alice Springs Town Council, or local engineering consultants.

As the works are likely to be awarded to an Alice-Springs based contractor, a construction camp would not be required. An area of parkland would be required for storage of construction equipment and dumping of fill prior to placement along the levee alignment. The contractor would be required to restore the site storage area to its original state upon completion of construction work.

Trees and other features requiring protection would be clearly shown on construction drawings. Contract documents would require that these features be protected from damage for the duration of construction work activities.

2.3.5 Wastes and Disposal Methods

Waste materials accumulated during construction would consist of:

- vegetation cleared from the levee alignment
- unsuitable foundation materials

Waste materials including soil and vegetation and any other material will be disposed in accordance to Alice Springs Waste Management guidelines for waste disposal. Disposal charges will be met by the construction contractor.

2.3.6 Vegetation Clearance and Site Preparatory Works

In accordance with the Aboriginal Areas Protection Authority, Authority (AAPA) Certificate No C1999/076 (Appendix C), there is to be no disturbance or impact to River Red Gums or other gum trees within the subject sacred site lands or adjacent sacred sites. All other vegetation clearance on site will be minimised for the construction of the levee with no disturbance to native vegetation outside boundary areas.

The levee will be constructed to blend in with the existing topography of the park, and will be shaped around existing gum and eucalypt trees in accordance with the AAPA Certificate.

A vegetation survey undertaken for this PER indicated there was no vegetation species that would be threatened by the construction of the levee (refer Appendix B).

2.3.7 Landscaping, Soil Conservation and Rehabilitation Measures

While the use of native grasses is preferred for environmental reasons, it is recognised that the area is currently extensively covered by couch (*Cynodon dactylon*) which is well established and would be difficult to eradicate. There are also extensive sources of couch upstream from the site that will ensure an ongoing recruitment supply. It must therefore be accepted that couch grass will be present on site.

A combination of native grasses and couch will provide good surface protection. Their general hardiness ensures their suitability for the stabilisation role. However it must be recognised that in flood conditions, some scouring and erosion would be

anticipated. Ongoing monitoring and maintenance of the grass cover will be required.

An irrigation system would be installed as part of the landscape rehabilitation works. The area south of Schwarz Crescent is currently irrigated from the town basin. This supply would be utilised to establish the landscape works in this area. North of Schwarz Crescent, it will be necessary to extend an irrigation system, either from the town basin or the town supply, to this area.

All planting will require irrigation and intensive maintenance in the initial stages to establish the landscape works. Depending on the final design and timing of the works, it is anticipated that the establishment period should be a minimum of 26 weeks.

Establishment of the grassing and planting will require appropriate preparation. The levee itself is an engineering structure typically not suited to planting because of unsuitable fill material and high level of compaction. Topsoil stripped from the site prior to construction of the levee would be stockpiled for later use on site. As necessary, it would be augmented by imported topsoil to provide suitable depth of topsoil for the planting. Topsoil will be free of weeds, free draining and of a sandy nature that matches the existing site topsoil.

The engineering design of the levee will ensure long term stability and provide adequate drainage. Depending on the final design alignment, there may be a need for some localised filling and regrading to ensure ponding does not occur behind the levee. All park areas on the eastern side of the levee will drain freely towards Sturt Terrace.

2.4 Operational Phase

Ongoing maintenance will be required to ensure that the levee can provide effective flood protection when required. Maintenance activities for the earth embankment would typically include:

- regular mowing, weed control, watering
- inspection after periods of heavy rainfall to ensure the bank is not scoured or undercut
- repair of minor scouring or erosion of the embankment, where necessary.

The Schwarz Crescent floodgate would normally be open to allow for movement of traffic, but would be closed during a flood warning situation. Maintenance activities would typically include:

- regular testing of gate operation.
- periodic lubrication of hinges

- painting of metal components

The responsibility for ongoing maintenance of the levee and floodgate would rest with the Alice Springs Town Council, and would be undertaken as part of the normal maintenance program for parkland in Alice Springs.

3. Existing Environment

3.1 Topography

The proposed levee will be constructed in a long established parkland area on the eastern floodplain of the Todd River. The park gently slopes from a high point in Sturt Terrace, westwards to the Todd River. Residential areas are located on the opposite side of Sturt Terrace, to the east of the levee.

The area is generally open with good grass cover throughout.

While there are remnant River Red Gums in the area, the majority of trees are planted. In addition to River Red Gums, there are other Eucalyptus and native species. Some of these are endemic to the Alice Springs region, while others, primarily Eucalpyts and Casuarinas are from the eastern states and Western Australia. A number of introduced and exotic plants have been planted over the years. Full details of the plant species, size and an assessment of their general health is contained in the plant survey.

Near the proposed levee, the Todd River has a broad, flat, sandy bed approximately 100m in width. The Charles River merges with the Todd directly to the west of the levee.

3.2 Surface and Sub-Surface Hydrology

3.2.1 Todd River

The Todd River runs through the centre of Alice Springs, flowing in a southerly direction. Development of the town has extended outwards from the river on each side.

Catchment Conditions

At the northern boundary of Alice Springs, the Todd River is joined by the Charles River. The Todd River catchment covers an area of 400km^2 at the northern town boundary, increasing to 450km^2 at the confluence with the Charles River near the proposed levee location.

The maximum elevation in the Todd catchment is approximately 900m AHD on Bond Springs Station to the north, and falls to 570m AHD at Alice Springs, about 45km downstream. This steep bed slope (1 in 135) leads to relatively high flow velocities. Because of the relatively sparse vegetation cover and steep slopes within the catchment, there is a potential for large flash floods to occur with little warning in Alice Springs

River Bed Conditions

Due to the steep slopes and sparse vegetation characteristic of the Todd River catchment, significant volumes of sediment are carried along the Todd River with storm runoff. This sediment is carried downstream with the river flow as suspended sediment (principally fine particles such as clays and silts) and along the river bed as bed load (principally sand and gravel).

Temporary river bed changes during the course of a flood can be significant. Barlow (1988) reported river bed disturbance during the March 1988 flood occurring to a maximum depth of 3m below bed level in the river channel adjacent to ANZAC Oval.

Although removal of bed material is considered a natural occurrence during significant river flows, the river bed remains stable over time due to the constant supply of material from the upstream catchment soils.

Flooding Conditions

A number of significant Todd River flood events are known to have occurred since the town of Alice Springs was first settled. The largest flood recorded in the last 90 years occurred in March 1988. This flood caused inundation of a significant number of residential and commercial properties in Alice Springs.

Several flood studies and flood mitigation investigations have been undertaken since the occurrence of the 1988 flood. Flood maps for the Q20, Q50 and Q100 river flows were produced as part of the *Alice Springs Floodplain Management Study* (GHD, 1996).

In 1999, the flood maps were updated to incorporate new topographical mapping prepared for Alice Springs. Based on current flood mapping studies (1999), the extent of flooding for various river flows is as follows:

Q20 Flood

- flooding of parts of South Terrace, Leichhardt Terrace and Barrett Drive
- inundation of properties adjoining South Terrace between Stott Terrace and the Casino causeway.
- inundation of parts of the Casino grounds and an area immediately upstream of the Gap at the junction of the Bradshaw and Bloomfield drains.

Q50 Flood

- inundation of the CBD area west to Hartley Street.
- backup of floodwaters from the Stott Terrace bridge through the Coolibah Swamp area, as far as Undoolya Road.
- inundation of the Gap area west to the railway line, excluding an area of high ground between South Terrace and Gap Road

- inundation of Barrett Drive, parts of the golf course and most of the Casino grounds

Q100 Flood

- overflow of the eastern river bank and inundation of the Eastside area of town.
- inundation of the CBD area west to Hartley Street, and parts of Bath Street.
- inundation of the Gap area west to the railway line
- inundation of Barrett Drive, parts of the golf course and most of the Casino grounds

Estimated flow rates for the Q100 flood event (based on 1999 flood mapping studies) at various locations through the town are summarised in Table 2.

Table 2
Q100 Peak River Flows - Existing Conditions

Section No.**	Location	Peak Flow (m^3/s)			
		Eastern Floodplain	Todd Channel	Western Floodplain	Total
1	Gosse Street	-	1470	-	1470
2	Giles Street	60	1610	-	1670
3	Warburton Street	130	1540	-	1670
4	Mills Street	130	1490	50	1670
5	Wills Terrace	120	1480	45	1645
6	Parsons Street	115	1455	40	1610
7	Gregory Terrace	110	1450	40	1600
8	Stott Terrace	-	1600	40	1640
9	Tuncks Road	-	1600	40	1640
10	Heavitree Gap	-	1710	-	1710

** Locations of section listed in Table 2 are shown in Figure 5.

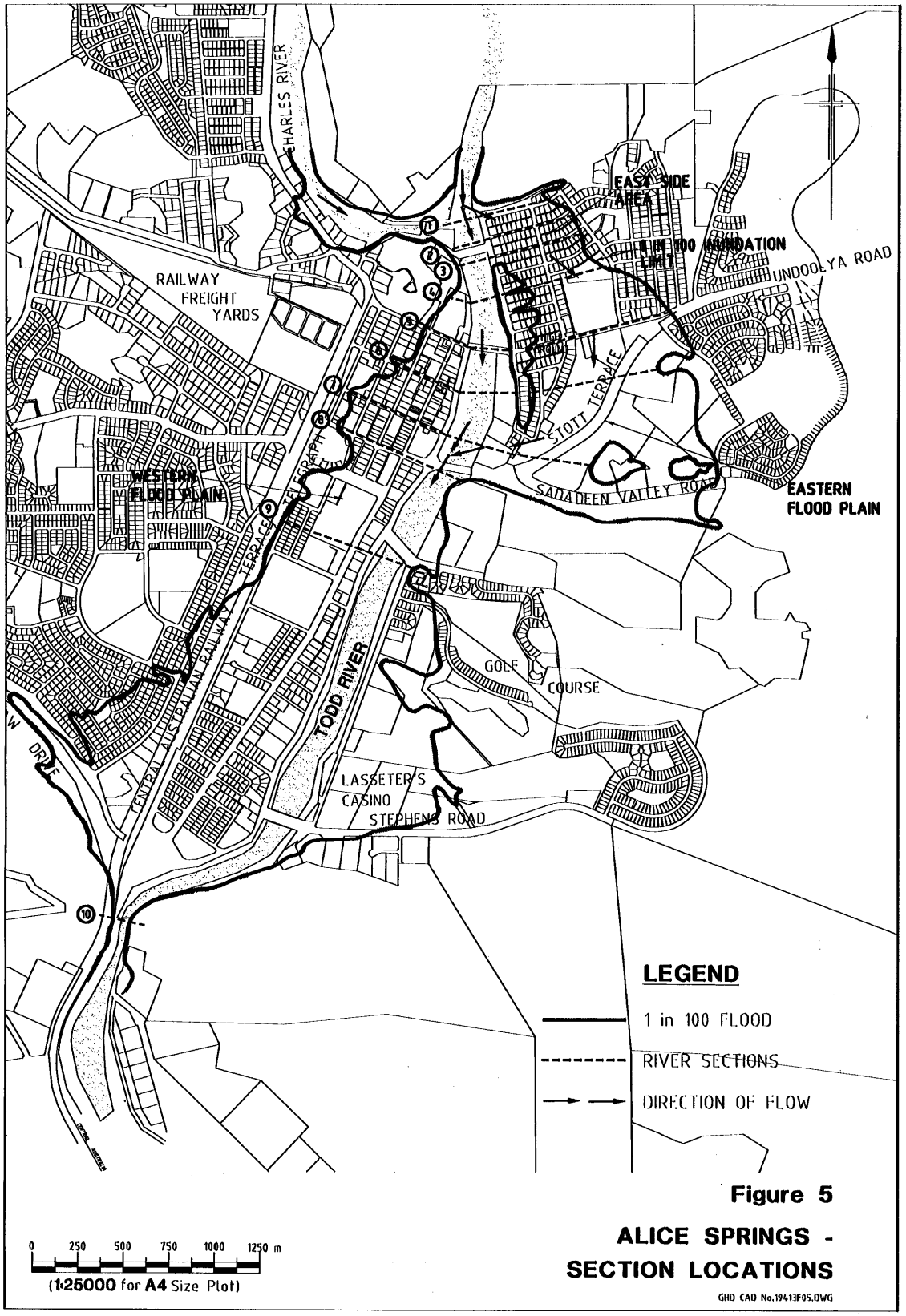
3.2.2 Sub-Surface Hydrology

Town Basin

The proposed levee site is located over the groundwater aquifer known as the *Town Basin*.

The Town Basin extends from the Todd/Charles River confluence in the north to Heavitree Gap in the south. It is a relatively small aquifer, covering an area of about $6km^2$ and extending to a maximum depth of 30m.

The Todd River is the major recharge source for the Town Basin. Recharge also occurs from the town drains and the Charles River.


CHARLES RIVER
EAST SIDE AREA
1 IN 100 INUNDATION LIMIT
UNDOOLYA ROAD
RAILWAY FREIGHT YARDS
STOTT TERRACE
TELEGRAPH TERRACE
SADADEEN VALLEY ROAD
WESTERN FLOOD PLAIN
EASTERN FLOOD PLAIN
CENTRAL AUSTRALIAN RAILWAY
TODD RIVER
GOLF COURSE
DRIVE
LASSETER'S CASINO
STEPHENS ROAD
LEGEND
1 in 100 FLOOD
RIVER SECTIONS
DIRECTION OF FLOW
0 250 500 750 1000 1250 m
(1:25000 for A4 Size Plot)
Figure 5
ALICE SPRINGS - SECTION LOCATIONS
GHD CAD No.19413F05.DWG

Significant variations in Town Basin groundwater levels can occur over time. The key factors determining groundwater levels in the Town Basin are:

- the height and duration of flow in the Todd River
- the extent of groundwater extraction.

Until the early 1960's, the Town Basin was the principal water supply for Alice Springs. Roe Creek borefield was established south of Alice Springs in the 1960's and replaced the Town Basin as the source of town potable water. As a result, Town Basin extraction declined significantly in the 1970's and early 1980's. In the mid 1980's, groundwater extraction from the Town Basin was increased to meet non-potable water supply requirements (irrigation, etc.).

In 1964, recorded Town Basin groundwater levels at the proposed levee site were in the range of 571-572m AHD, approximately 7-8m below surface level.

As a result of a series of wet years in the mid-1970's combined with the decrease in groundwater extraction, groundwater levels rose significantly. In 1976, recorded Town Basin groundwater levels at the proposed levee site were in the range of 576-577m AHD, approximately 2-3m below surface level.

By 1991, groundwater levels had reduced to 572-573m AHD, approximately 6-7m below surface level at the levee site.

High groundwater levels in the Town Basin have resulted in a soil salinity problem at several locations in Alice Springs. High soil salinity levels are particularly evident in low-lying areas in the southern parts of the town, near Heavitree Gap. These problems are also evident in the Coolibah Swamp area in the eastern parts of Alice Springs. However they are not evident in the parkland where levee construction is proposed.

Coolibah Swamp

During consultation carried out for this report, concern was expressed at the possible effects of the levee on recharge of the Coolibah Swamp area. The Coolibah Swamp is a low-lying area of natural vegetation located between Undoolya Road and Stott Terrace.

Re-charge of the Coolibah Swamp can occur by several processes as follows:

- Runoff from the local Eastside area catchments. This would be expected to occur relatively frequently (possibly several times per year) during local storm events.
- Backup and ponding of Todd River floodwaters due to elevated flood river levels near the Stott Terrace bridge. This is expected to occur when flood levels in the Stott Terrace bridge area exceed the predicted Q20 river level.
- Overflow of Todd River floodwaters from the north through the Eastside area, downstream into the swamp area. This is expected to occur when flood levels at the Todd/Charles River confluence exceed the predicted Q50 river level.

For floods which exceeding Q50 levels, the Coolibah Swamp would be inundated by floodwaters from all three sources listed above.

3.3 Soil Characteristics

The soils at the proposed levee site are alluvium deposits typical of the Town Basin area. Soils are generally sandy, exhibit good drainage but have a low water holding capacity.

There are no visible rock outcrops at the levee site. The nearest visible rock outcrops are at ANZAC Hill to the west, Spencer Hill to the north and a small outcrop located adjacent to Winnecke Avenue to the east.

The Todd River bed, adjacent to the levee site, consists predominantly of medium to very coarse sand with grain sizes in the range 0.25-2.0mm. This sandy bed can be up to 5m thick.

Most of the established trees in the area would be tapping into the Town Basin to extract water. The couch grass would also have deep roots that are able to access water from up to several metres deep.

3.4 Terrestrial vegetation

A vegetation survey was undertaken to identify all trees in the study area. The survey identified 211 species in the area of the proposed works between Sturt Terrace and the river bank. River Red Gums, both remnant and planted account for 109 of the surveyed plants. Other endemic species and Australian natives are found in the area. Full details are included in the vegetation survey.

There are introduced species of which seven are considered weeds (Kilpatrick, 1991) and should ideally be removed from the river corridor. The identified weed species are *Schinus molle* (Peppercorn),*Celtis australis* (Nettle Tree), *Dalbergia sissoo* (Himalayan Raintree), *Melia azaderach* (White Cedar), *Grevillea robusta* (Silky Oak), *Albizia lebbeck* (Raintree) and *Brachychiton sp* (Kurrajong).

3.5 Existing Infrastructure

Based on information supplied by service authorities, there are no significant services which run along the proposed alignment of the levee. Services such as power, water mains, sewers etc are generally located in the Sturt Terrace road reserve, away from the levee alignment.

However, several services cross the levee alignment. A 200mm diameter PAWA watermain extends from Gosse Street, under the levee alignment and across the Todd River to Ulpaya Road. PAWA electrical cables extend from Giles Street, under the levee alignment and across the Todd River to Schwarz Crescent.

To the north of the levee site, an open unlined channel (known as the Spencer Hill drain) discharges to the Todd River. This channel intercepts runoff from the hills to the north of Alice Springs. An existing levee constructed along this channel, parallel to Gosse Street, prevents channel overflows from entering the Eastside residential area.

The proposed levee is located along an area of high ground separating the river channel from the floodplain. Local catchments will generally drain away from the levee embankment. The Council stormwater drainage system for the Eastside area drains away from the levee, towards Ross Park. There are no underground drainage systems located along the levee alignment.

3.6 Sites of significance

3.6.1 Aboriginal Sacred Sites

An application was lodged by ASTC to the Aboriginal Areas Protection authority to confirm the presence of sacred sites on lots 5140 and 5806, reserve No 1708 in accordance with the Northern Territory sacred Sites Act. The search recorded Sacred Site 5650-041 is classified as a registered site and Sacred site 5650-202 is classified as recorded site.

ASTC Springs Town Council lodged an application for an Authority Certificate by the Aboriginal Areas Protection Authority for works to be carried out on the subject land. Authority Certificate No C1999/076 was issued to ASTC. The conditions of the Authority certificate are outlined in Appendix C

This Authority certificate sets out conditions under the *Aboriginal Sacred Sites Act 1989* which consents to works to be carried out or use made of the land. This certificate ensures the holder of the certificate is indemnified against prosecution under any of the offences provisions of the Act, subject to complying to the certificates conditions.

3.6.2 Heritage and Archaeological Sites

The Environment & Heritage Division of the Department of Lands, Planning and Environment conducted a search of the NT Heritage Sites Register and Archaeological Site Database and has declared there are no listed heritage sites on the proposed levee alignment (refer Appendix E). However, it is possible that this may reflect the lack of survey work in this area, rather than an actual absence of sites. The only way to ensure that there are no archaeological sites in any given area is to conduct an archaeological survey of the site. Such a survey has not been carried out for this PER.

4. Public Consultation

Prior to, and during the preparation of this PER, the public consultation process has involved the following:

- liaison with key agencies and community groups;
- a community public meeting;
- letterbox drop of fact sheets prepared by ASTC;
- newspaper articles; and
- collection and review of letters and submissions from the public on the levee issue.

These activities and submissions are discussed below:

4.1 Key Agencies and Community Groups

Consultation with key agencies were undertaken to discuss specific requirements for the report and existing legislation and polices relevant to the levee proposal. The following agencies were formally consulted during the preparation of the PER:

- Department of Lands Planning and Environment, Alice Springs;
- Parks and Wildlife Commission;
- Greening Australia;
- Central Land Council;
- Aboriginal Areas Protection Authority; and
- Alice Springs Town Council.

The following community groups were consulted during the preparation of the PER:

- Eastside Residents Association; and
- Arid Lands Environment Centre.

4.2 Community Public Meeting

A public meeting was held on Wednesday 13th October 1999, at 5pm on site at the proposed levee site. This meeting was held to provide the public with information regarding the proposed construction of the levee and to seek public comment.

The Eastside Residents Association in conjunction with ASTC provided two advertisements which were placed in the Centralian Advocate inviting attendance from interested community members,. Approximately 15 people attended, including local alderman, members of the Eastside Residents Association, the ABC media,

DLPE Regional Manager (Peter McDonald), Director Natural Resources South (John Childs) and Council's Director of Planning and Infrastructure (Roger Bottrall).

4.3 Media Releases

A fact Sheet was developed providing information on the proposed levee. Leaflets were delivered to all eastside residences. The general public were able to obtain a copy from Council Civic Centre. These leaflets were made available for a period of three months.

A similar fact sheet was reproduced in the Centralian Advocate Column 'Talk of the Town'.

4.4 Community Issues Raised

The various consultation processes undertaken highlighted a number of common issues and similar opinions among the general public. There was generally no strong objections to the concept of a levee in the proposed location. However, there was general concern that the project would only benefit a small section of Alice Springs and that the available funds may be better spent on other flood mitigation projects which would benefit a larger proportion of the town. Therefore, much of the public comment centered on other methods of flood mitigation for Alice Springs.

Issues raised and comments made included:

- Other techniques were suggested for flood mitigation which would suit the town better, ie dredging/removing sand, couch and saplings from the river bed.
- Flood mitigation to other areas along the Todd would achieve a far greater economic benefit for the wider community in respect to flood damage.
- A greater priority should be given to protecting other areas along the Todd River that received more frequent flooding.
- Concerns were raised that the levee would act as a dam by not allowing water to run-off from behind the levee.
- The levee would only cause more severe flooding downstream to areas already receiving flooding during a flood event.
- Construction of a levee where there is a combination of water draining from three points (Spencer Drain, Charles River, and Todd River) into one area may cause water to not to get away quickly, causing erosion and flooding upstream and on the west bank of the river.
- Costs involved in flood protection would only serve a small section of the community rather than benefiting a larger portion with a greater need for flood protection.

- Impacts to areas downstream and in the Q100 flood area.
- Impacts to flow of river and the Coolibah swamp which is situated further downstream.
- Need to monitor stream flow during extreme flows
- Prioritising the use of indigenous grasses/shrubs species for revegetation
- Scouring and its affects of tree erosion, and the natural movement of the waterway
- The effects of Charles inflow into the Todd after construction of levee.
- Greater chance of St Philips Boarding School on the opposite side of the Todd River being flooded.

5. Environmental Impacts

5.1 Surface and Sub-Surface Hydrology

5.1.1 Effects on River Flood Levels

The proposed levee would provide protection from river floods with annual exceedance probabilities between 2% (Q50) and 1% (Q100). The Eastside area is not at risk from Todd River flooding until the Q50 level is exceeded (refer Section 3.2.1 of this report). It is estimated that approximately 160 properties would be removed from the Q100 flood inundation area if the levee was constructed.

One of the disadvantages of levees is that protection is not provided for floods exceeding the design frequency. If a flood occurs which exceeds the design Q100 level, the levee would be overtopped and inundation of properties behind the levee would occur.

Construction of the levee would block flow into the Eastside area for floods which exceed the Q50 level. The levee would have no effect on Todd River flows for floods up to and including the Q50 event.

Under existing conditions, a peak flow rate of 130m^3/s is estimated to flow through the Eastside area during the Q100 event. By blocking off the Eastside flowpath, this 130m^3/s is re-directed along the main channel.

Estimated peak Q100 river flows after levee construction are summarised in Table 3.

Table 3
Q100 Peak River Flows - After Levee Construction

Section No.**	Location	Peak Flow (m^3/s)			
		Eastern Floodplain	Todd Channel	Western Floodplain	Total
1	Gosse Street	-	1470	-	1470
2	Giles Street	-	1670	-	1670
3	Warburton Street	-	1670	-	1670
4	Mills Street	-	1620	50	1670
5	Wills Terrace	-	1595	50	1645
6	Parsons Street	-	1565	45	1610
7	Gregory Terrace	-	1550	50	1600
8	Stott Terrace	-	1600	40	1640
9	Tuncks Road	-	1600	40	1640
10	Heavitree Gap	-	1710	-	1710

** Locations of section listed in Table 3 are shown in Figure 5.

Comparisons between Table 2 and Table 3 indicate that peak Q100 flows in the river channel are increased by approximately 8% after levee construction. This increase in river flow would cause an increase in Q100 flood levels along the river channel. Hydraulic modelling of the Todd River was carried out to determine the effects of the increased flow rate. Estimated Q100 flood levels before and after levee construction are summarised in Table 4.

Table 4
Q100 Peak Flood Levels - Todd River Channel

Section No.**	Location	Peak Flood Level (m AHD)		Level Difference (mm)
		Existing Conditions	Levee Construction	
	Todd River			
1	Gosse Street	580.10	580.19	90
2	Giles Street	579.80	579.94	140
3	Warburton Street	579.50	579.60	100
4	Mills Street	578.90	578.99	90
5	Wills Terrace	578.00	578.07	70
6	Parsons Street	577.50	577.54	40
7	Gregory Terrace	577.10	577.10	0
8	Stott Terrace	576.70	576.70	0
9	Tuncks Road	575.40	575.40	0
10	Heavitree Gap	568.90	568.90	0
	Charles Creek			
	Ulpaya Road Crossing	580.40	580.49	90
	Stuart Highway/Smith St Intersection	581.30	581.31	10
	Stuart Highway/Hele Cres Intersection	582.00	582.00	0

** Locations of section listed in Table 4 are shown in Figure 5.

Table 4 indicates that blocking the overland flowpath between Gosse Street and Chewings Street causes flood level increases upstream of Gregory Terrace. The maximum increase for the Q100 event is 140mm near Giles Street. Flood level increases also occur in Charles Creek from its confluence with the Todd River to a point opposite the intersection of the Stuart Highway and Smith Street.

Effects on Residential Areas

Todd River flood level increases upstream of Gregory Terrace will not have any significant effect on flooding conditions in residential areas. On the eastern floodplain, properties are protected by an area of high ground extending along Sturt Terrace

upstream to Chewings Street. Areas north of this point would be protected by the levee construction.

As described in Section 3.2.1, floodwaters from the Stott Terrace Bridge area backup through the Coolibah Swamp area as far as Undoolya Road during the Q50 and Q100 flood events. As the proposed levee does not cause increases in flood levels in the Stott Terrace bridge area, there will be no increase in the level of flood backup through the Coolibah Swamp/Undoolya Road area.

Effects on CBD Property Inundation

Expected Q100 flood level increases resulting from levee construction range from 70mm at Wills Terrace, to 40mm at Parsons Street, decreasing to 0mm at Gregory Terrace.

The effects of these flood level increases on properties within the CBD have been assessed, based on available CBD property floor levels listed in the Alice *Springs Flood Damages Study*, prepared by the PAWA Water Resources Section in November 1986. The floor levels for all properties in the area bounded by Gregory Terrace, Railway Terrace, Parsons Street and the Todd River were compared to predicted flood levels before and after level construction. Results of this assessment are summarised in Figure 6.

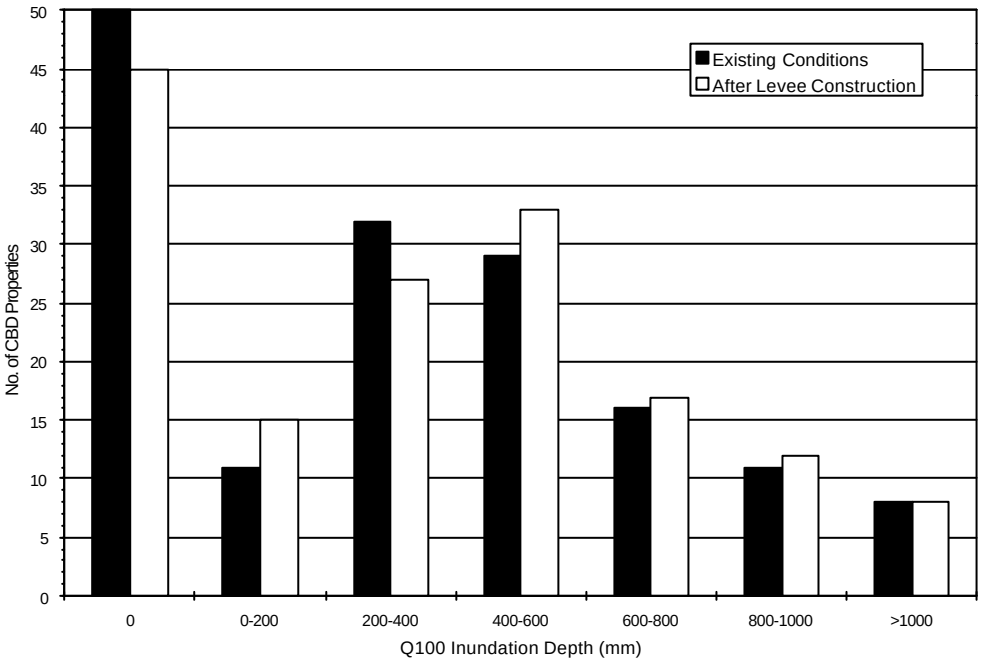


Figure 6
Effects of Levee Construction on CBD Property Inundation

The results indicate a total of 5 properties would be inundated after levee construction, which would not have been inundated under current conditions. They

would be inundated by up to 70mm, and would move into the 0-200mm range shown in Figure 6. One property moves from the 0-200mm range to the 200-400mm range.

For those properties where inundation occurs after levee construction, which would not have otherwise been inundated, it is likely that some form of individual flood protection measures could be provided. This could be in the form of a local raising of the floor at doorways, or could be a temporary measure such as sandbagging.

The effects of small increases in flood level on those properties which would already have been inundated during the Q100 flood would not be significant.

Effects on Joint Australian US Geological & Geophysical Research Station (JGGRS)

The Joint Geological & Geophysical Research Station (JGGRS) is located on Schwarz Crescent, adjacent to the confluence of the Todd and Charles Rivers.

The calculated Q100 flood level at the site is RL 580.0m AHD. It is calculated that Q100 flood levels at the site will rise by 120mm after construction of the levee, giving a post-levee Q100 flood level of RL 580.12m AHD. A comparison of floor levels and Q100 flood depths before and after levee construction is given in Table 5. Actual floor levels at the facility are sourced from the *Charles River Flood Study Report* (PAWA, 1990).

Table 5
Q100 Peak Flood Depths - JGGRS

Building No.	Floor Level (mAHD)	Peak Q100 Flood Depth (m)	
		Existing Conditions	Levee Construction
A	579.50	0.50	0.62
B	579.40	0.60	0.72
C	578.80	1.20	1.32
D	579.40	0.60	0.72
E	579.40	0.60	0.72
F	579.40	0.60	0.72

As shown in Table 5, all JGGRS buildings experience significant flooding during the Q100 event with or without the construction of the levee.

Effects on St Philips College

St Philips College is located on the western floodplain of the Todd River, north of the confluence of the Todd and Charles Rivers.

The calculated Q100 flood level at the site is RL 580.5m AHD. It is calculated that Q100 flood levels at the site will rise by 40mm after construction of the levee, giving a post-levee Q100 flood level of RL 580.54m AHD. Floor levels at several buildings within the school grounds are as follows:

School buildings	-	RL 580.3m AHD
Accommodation	-	RL 580.3m AHD

Floor levels at the site are sourced from the *Alice Springs Flood Damage Study - Tangible Damages* (PAWA, 1986). Based on these floor levels, buildings at the site would be inundated during the Q100 flood event by 200mm prior to levee construction and 240mm after levee construction.. It is unlikely that a 40mm increase would have significant impacts, considering that the buildings will be flooded irrespective of whether levee construction is undertaken.

5.1.2 Sub-Surface Hydrology

Town Basin

As described in Section 3.2.3 of this report, groundwater levels in Alice Springs can vary significantly from year to year. Historically groundwater levels in the area of the proposed levee have ranged from 2m to 8m below surface level. With this amount of vertical separation, the proposed levee would not impact on groundwater conditions, and the structural integrity of the levee would not be affected by groundwater.

The area proposed for levee construction does not appear to be subject to the soil salinity problems that are evident elsewhere in Alice Springs. Provided that the source of fill for embankment construction does not originate from an area with high soil salinity, then establishment and maintenance of a vegetation cover for the levee would not be inhibited by soil salinity problems.

Coolibah Swamp

Construction of the proposed levee will block Todd River overflows from the north from entering the Coolibah Swamp area. Other methods of swamp re-charge are not affected by the levee proposal.

As described in Section 3.2.3 of this report, under current conditions, overflow of the river from the north will only occur when river levels exceed the predicted Q50 levels. Given that the Coolibah Swamp is inundated by floodwaters from several other sources (ie. runoff from the local Eastside area catchments, and backup of Todd River floodwaters due to elevated flood river levels near the Stott Terrace bridge) during floods of this magnitude, construction of the levee will not have any impact on the swamp.

5.2 Potential for Increased Soil Erosion

5.2.1 Parkland Area

During the construction of the levee, there is an increased potential for soil erosion to occur, due to the stripping of vegetation and the movement of construction vehicles. The risk of soil loss occurring during construction can be minimised by undertaking the works during the winter months, when the likelihood of rainfall is reduced.

Upon completion of the works, establishment of an irrigation system and rehabilitation of cleared areas, there would not be an increased risk of soil erosion compared to pre-existing conditions.

5.2.2 River Bed

As described in Section 4.2, the construction of the levee would block flow to the Eastside area during the Q100 flood event. This increases the Q100 flow rate in the river channel by up to 8%.

By increasing the flow rate in the main channel, velocities in the river channel are also increased. A comparison of average channel velocities predicted for the Q100 flood before and after levee construction is given in Table 6.

Table 6
Estimated 1 In 100 River Velocities

Location	Average Channel Velocity (m/s)		Difference (%)
	Existing Conditions	Levee Construction	
Gosse Street	3.20	3.10	-3.1
Giles Street	3.40	3.30	-2.9
Warburton Street	3.05	3.20	+4.9
Mills Street	3.30	3.45	+4.5
Wills Terrace	2.40	2.55	+6.3
Parsons Street	1.60	1.70	+6.3
Gregory Terrace	1.95	2.10	+7.7
Stott Terrace	2.85	2.85	0.0
Tuncks Road	2.70	2.70	0.0
Heavitree Gap	5.20	5.20	0.0

The velocity increases identified in Table 6 would be expected to cause a slight increase in river bed scouring during the peak of the 1 in 100 flood event. However, the velocity increase is only small (5-8%) and the incremental increase in river bed scour would not be significant.

Scouring of the river bed is a natural occurrence during river flows. However, the river bed remains stable over time due to the constant supply of sediment from the upstream catchment soils. While significant river bed changes can occur during the flood peak, there is a natural deposition of sediment during the latter stages of the flood when velocities decrease. Due to the deposition of sediment towards the end of the flood, levee construction would not cause permanent degradation of the river bed.

5.3 Effects of Vegetation Clearance

A strip of land approximately 15m in width and 550m in length would need to be cleared of vegetation to allow for levee construction. It is proposed to align the levee so that clearing of aboriginal sites of significance does not occur, and that clearing of other native vegetation is kept to a minimum.

Until detailed designs are prepared, it is difficult to determine how many trees will require removal. However, the following guidelines would apply:

- All identified trees identified in AAPA Certificate No. C1999/076 are to be retained and protected from any disturbance.
- All healthy River Red Gums and other endemic species to be retained and protected from any disturbance.
- Where trees need to be removed to provide a sufficiently wide corridor, the alignment would be selected so that only weed species, introduced species, recent plantings and/or sick plants require removal.

5.4 Effects on Existing Infrastructure

As discussed in Section 3.5, the only services potentially affected by the proposed levee are a PAWA watermain which runs from Gosse Street, under the levee alignment and across the river and PAWA electrical conduits which run from Giles Street under the levee alignment and across the river. In the long term, it is not expected that construction of the levee would have any effects on these services. However, during construction, care will be required to ensure that the services are not damaged by construction activities.

The Council stormwater drainage system for the Eastside area drains away from the levee, towards Ross Park and the Eastside drainage channel. Based on available Council drainage records, there are no stormwater drains in the area which would be affected by levee construction. Therefore, there will be no impacts on the local drainage system as a result of levee construction.

In general, no special local drainage provisions are needed through the levee, as local catchments will drain away from the levee embankment. Drainage outlets to the river will not be required through the levee. However, a small amount of local filling maybe necessary at the toe of the levee between Chewings Street and Mills Street to prevent ponding.

5.5 Effects on Sites of Significance

During levee construction, it is the responsibility of the contractor to comply with the conditions outlined in AAPA Certificate No C1999/076. It is therefore expected that

there will be no impact on Aboriginal Sacred Sites as a result of the construction of the levee.

As described in Section 3.6, there are no identified heritage areas or archaeological sites of significance in the area.

5.6 Visual Impact

Construction of the levee will result in a visual impact for residents of Sturt Terrace, and for vehicles moving along Schwarz Crescent and Sturt Terrace. Construction of the levee may result in a reduced view of the Todd River from Sturt Terrace and adjacent properties.

With appropriate landscape design, some of these impacts can be minimised. Appropriate alignment and shaping of the levee will minimise impacts on existing trees and will provide a more natural appearance that will blend more effectively into the parkland setting than a straight, steep-sided levee.

The levee itself can be made into an interesting feature of the parkland infrastructure, and could possibly include a cycle path along the crest.

The floodgate to be constructed at Schwarz Crescent would be the most obvious component of the levee system. Depending on it's design, it could be difficult to blend the structure into the surrounding environment and may be viewed as unsightly.

Rather than adopting a swinging gate, it is proposed to slide the floodgate into the adjacent levee embankment when it is not required. This would minimise the visual impact of the gate, when not in use.

5.7 Summary of Environmental Control Measures and Safeguards

Potential environmental impacts of levee construction and proposed environmental control measures and safeguards are summarised in Table 7.

Table 7
Environmental Impacts and Safeguards

Area of Concern	Policy	Control measure	Effectiveness of safeguard
Soil Management	Manage soil erosion effectively so as to minimise environmental degradation and ensure structural integrity of levee.	**Design** • Provide embankment slopes of 1 in 6 or flatter. **Construction** • Strictly control extent of clearing. • Define contractor's equipment storage area and work areas. • Stockpile top soil stripped from the construction area and use later for later rehabilitation. • Schedule construction for mid-year to reduce chances of heavy rainfall interfering with construction **Ongoing Management** • Inspect levee after significant rainfall events to check for soil scouring and stability. • Routinely inspect pedestrian impact in regard to soil stability and erosion. - Repair scouring when evident	Management of soil erosion is required to ensure that the levee remains stable and effective during the design flood event. Minimising erosion will also enhance the visual appearance of the levee. The control measures proposed are considered sufficient to maintain the levee in a suitable condition for its intended purpose.

Area of Concern	Policy	Control measure	Effectiveness of safeguard
Vegetation Management	Minimise clearance of site and disturbance to existing vegetation. Provide appropriate rehabilitation and grass re-establishment.	**Design** • Specify re-seeding and replanting of earth levee and other areas disturbed areas with local native grasses and introduced grass (*cynodan dactylon*) • Clearly identify in contract documentation trees and plants to be retained and protected during construction **Construction** • Strictly control extent of vegetation stripping. • Clearly define contractor's equipment storage area and work areas. **Ongoing Management** • Monitor and manage establishment of vegetation cover after levee construction • Maintain levee with watering (as required) and mowing to ensure adequate and stable vegetation cover. • Monitor levee area for pedestrian impact to ensure minimal vegetation loss. - monitor and regularly control the spread of weeds over the levee.	The area is a significantly altered environment being managed as a parkland. The limited habitat value of the various mature trees will be retained.
Flood Level Increases	Minimise effect of flood level increase on functional buildings within the CBD	**Design** • Identify functional buildings inundated by the Q100 flood after levee construction, but not under existing conditions. • Provide flood protection against incremental flooding, for properties identified above.	Impact on properties is expected to be minimal.

Area of Concern	Policy	Control measure	Effectiveness of safeguard
Sacred Sites Management	Avoid disturbance to aboriginal sacred sites	**Design** • Plan levee alignment to avoid known areas of significance • Clearly identify sites of significance on construction plans **Construction** • Ensure that works are carried out in accordance with the conditions set down by the AAPA Certificate No C1999/076. **Ongoing Management** • Not required. No likely long term effect.	Compliance with AAPA certificate ensures that sacred sites will not be affected.
Visual Appearance	Minimise impact of levee on the visual amenity of the surrounding parkland	**Design** • Plan levee alignment to blend into the natural topography. • Specify native grass and shrubs for rehabilitation of the levee so that the vegetation will blend in with the natural surroundings. **Construction** • Minimise area of land clearing and disturbance during construction. **Ongoing Management** • Manage soil erosion and vegetation growth as detailed above.	The levee will have minimal visual impact following rehabilitation owing to using native grass and shrub species. The levee will contoured around existing trees and the natural topography. This will ensure minimal visual impact from Stuart Terrace.
Levee Operation	Maintain levee to ensure effective operation during design flood events	**Ongoing Management** • Manage soil erosion and vegetation growth as detailed above. • Undertake regular maintenance of floodgates. • Undertake annual testing of the flood gate to confirm that it is operational.	Ongoing monitoring and maintenance will ensure that the levee is able to function as designed. The maintenance of vegetation cover and minimising of soil loss from erosion or scouring is particularly important.

6. References

1. Cunningham G M., *et al.* (1992). *Plants of Western New South Wales*. Inkata Press, Melbourne & Sydney.
2. Gutteridge, Haskins & Davey. (1999*). Report on Engineering Feasibility for the Eastside Levee Proposal,* Alice Springs Town Council.
3. Gutteridge, Haskins & Davey. (May 1996). *Alice Springs Floodplain Management Plan*, Report 46/1996, Volumes 1 & 2, Power and Water Authority
4. Kilpatrick IE, *Todd River Vegetation Survey and Assessment With Emphasis on Exotic Species Control*, Internal CCNT Report.
5. Rural Water Commission of Victoria (April 1992), *Alice Springs Town Basin Salinity and Water Management Review*, NT Power and Water Authority.

Appendix A

Glossary and Abbreviations

Glossary and Abbreviations

AAPA	Aboriginal Areas Protection Authority
AEP	Annual Exceedance Probability
AHD	Australian Height Datum. Standard reference level for topographic mapping.
ASTC	Alice Springs Town Council
CBD	Central Business District
DLPE	Department of Lands, Planning & Environment
Freeboard	Height allowance added to a computed flood level to allow for limitations of hydraulic modelling, wave action etc.
GHD	Gutteridge Haskins & Davey
PAWA	Power and Water Authority
PER	Public Environmental Report
Q100 Flood	The Q100 flood has a 1% probability of occurring or being exceeded in any year. Statistically it would be expected to occur, on average, once every 100 years. However, this is only a statistical definition, and it is possible for a flood of this size to occur more or less frequently in any given period of time. It is also known as the 1% AEP Flood.
Q50 Flood	The Q50 flood has a 2% probability of occurring or being exceeded in any year. Statistically it would be expected to occur, on average, once every 50 years. However, this is only a statistical definition, and it is possible for a flood of this size to occur more or less frequently in any given period of time. It is also known as the 2% AEP Flood.
Q20 Flood	The Q20 flood has a 5% probability of occurring or being exceeded in any year. Statistically it would be expected to occur, on average, once every 20 years. However, this is only a statistical definition, and it is possible for a flood of this size to occur more or less frequently in any given period of time. It is also known as the 5% AEP Flood.
RL	Reduced Level

NOTE

APPENDICES B TO E NOT INCLUDED IN PDF FILE