HASTINGS COUNCIL

LAND & WATER CONSERVATION

Maps

CAMDEN HAVEN ESTUARY PROCESSES STUDY

FINAL REPORT

Issue No. 3
JANUARY 1999

Document Amendment and Approval Record

Issue	Description of Amendment	Prepared by [date]	Verified by [date]	Approved by [date]
1	Preliminary Draft Report (*not incl. biological processes*)	Chris Thomas (*6/5/98*)	Ali Stone (*6/5/98*)	
2	Final Draft Report – Issue for Committee Review	Ali Stone / Bill Rooney (*9/6/98*)	Bruce Druery (*9/6/98*)	
3	Final Report (*incorporating additional data*)	Chris Thomas (*25/1/99*)	AES (*25/1/99*)	CRT (*29/1/99*)

Note: This document is preliminary unless it is approved by a principal of Patterson Britton & Partners.

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level 2
104 Mount Street
North Sydney 2060

PO Box 515
North Sydney 2059
Australia

telephone (02) 9957 1619
facsimile (02) 9957 1291
Email: patbrit@ozemail.com.au
ACN 003 220 228

Patterson Britton & Partners Pty Ltd

consulting engineers

FIGURE 2

Location of the Camden Haven River Catchment

N

Scale

1000 0 1000 2000 3000 4000 5000

Metres

HERONS CREEK CATCHMENT

BOBS CREEK CATCHMENT

BONNY HILLS CATCHMENT

WATERLOO CREEK CATCHMENT

LIMEBURNERS CREEK CATCHMENT

CAMDEN HAVEN RIVER CATCHMENT

HERONS CREEK

Herons Creek

BONNY HILLS

GRANTS HEAD

GRANTS BEACH

QUEENS LAKE

COMBOYNE

Black Creek

Upsalls Creek

UPSALLS CREEK

KENDALL

NORTH HAVEN

PERPENDICULAR POINT

LAURIETON

DUNBOGAN

CAMDEN HEAD

Camden Haven River

DELLWARD

Batar Creek

Camden Haven River

LAURIETON CATCHMENT

DUNBOGAN CATCHMENT

DUNBOGAN BEACH

SOUTH PACIFIC OCEAN

STONEY CREEK CATCHMENT

Stoney Creek

WATSON TAYLORS LAKE

HANNAM VALE

Stewarts River

STEWARTS RIVER CATCHMENT

Washtub Inlet

Bensons Inlet

DIAMOND HEAD

JOHNS RIVER

LEGEND

- Catchment Boundary
- Sub-catchment Boundary
- Estuary/River
- Pacific Highway
- North Coast Railway

J2747/R1805
Figure 2.dgn

CATCHMENT OF THE CAMDEN HAVEN RIVER

FIGURE 13

LEGEND

- Catchment Boundary
- Sub-catchment Boundary
- Pluviograph
- 060022 ⊕ Daily Rainfall Station
- ▲ 207009 Stream Gauging Station
- Water Level Gauge
- Pacific Highway
- Great Northern Railway

N

Scale

1000 0 1000 2000 3000 4000 5000

Metres

⊕ Karawong

HERONS CREEK CATCHMENT

BOBS CREEK CATCHMENT

BONNY HILLS CATCHMENT

WATERLOO CREEK CATCHMENT

LIMEBURNERS CREEK CATCHMENT

GRANTS HEAD

Herons Creek

Herons Creek Bridge

Creek

CAMDEN HAVEN RIVER CATCHMENT

207009 ▲ LOGANS CROSSING

Upsalls Creek Bridge

QUEENS LAKE

060005 ⊕
COMBOYNE
060080 ●

KENDALL
060039 ⊕
060020

WEST HAVEN

PERPENDICULAR POINT

NORTH HAVEN

LAURIETON
060022 ⊕

CAMDEN HEAD

⊕ Delward

CAMDEN HAVEN RIVER

Citizens Bridge

Camden Haven River

SOUTH PACIFIC OCEAN

STONEY CREEK CATCHMENT

Middle Brother

WATSON TAYLORS LAKE

Stewarts River

STEWARTS RIVER CATCHMENT

207008 ▲ ⊕

DIAMOND HEAD

J2747/R1805
Figure 13.dgn

LOCATION OF RAINFALL AND STREAM GAUGING STATIONS

FIGURE 17

LOGANS CROSSING
KENDALL
KEW
North Coast Railway
Pacific Highway
HERONS CREEK
QUEENS LAKE
LAKEWOOD
STINGRAY CREEK
NORTH HAVEN
GRANTS HEAD
GRANTS BEACH
SOUTH PACIFIC OCEAN
PERPENDICULAR POINT
GOGLEYS LAGOON
79m
CAMDEN HEAD
LAURIETON
DUNBOGAN
CAMDEN HAVEN INLET
DUNBOGAN BEACH
CAMDEN HAVEN RIVER
WATSON TAYLORS LAKE
STEWARTS RIVER
DIAMOND HEAD

N

Scale

500 0 500 1000 1500 2000 2500

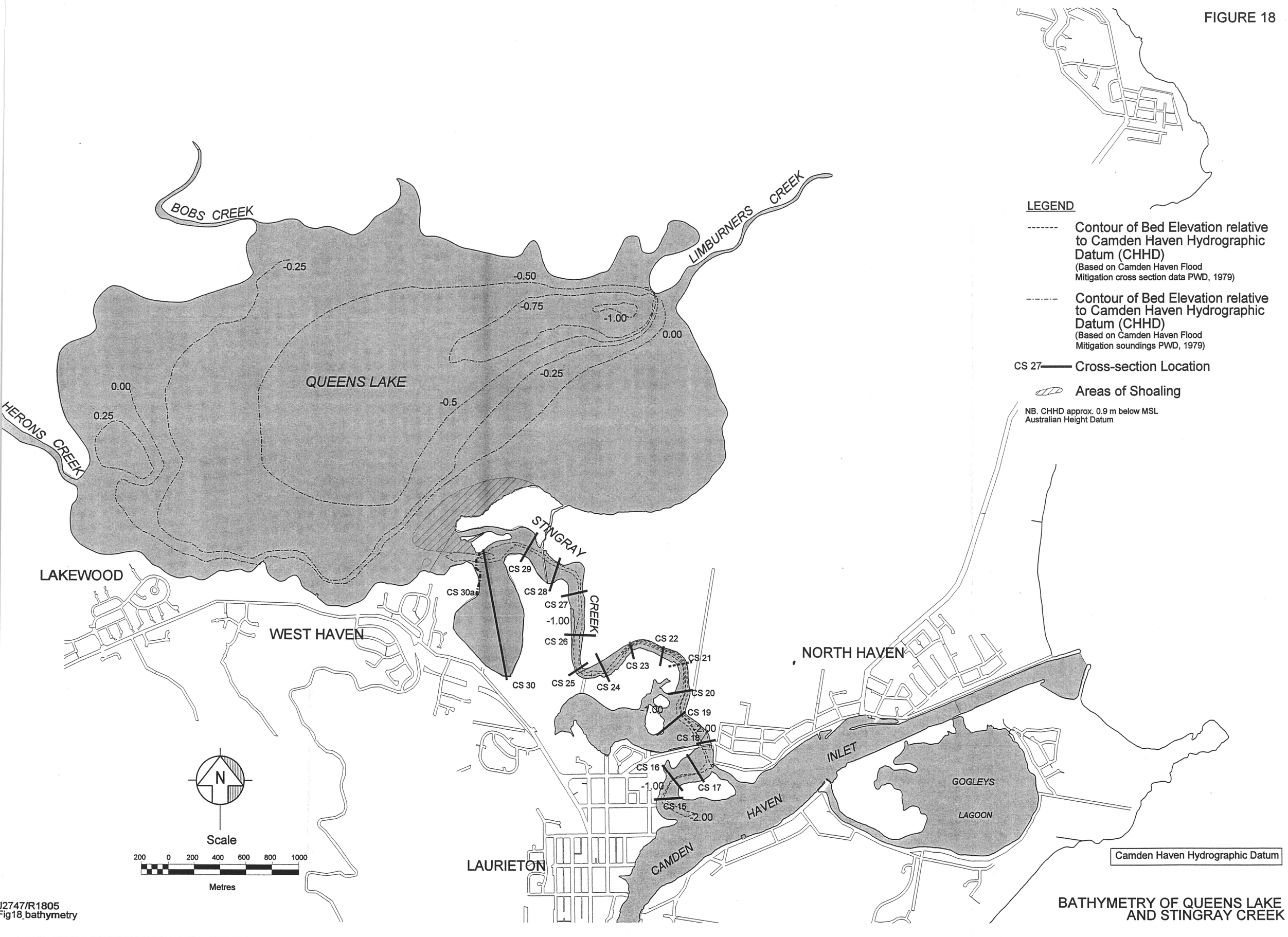
Metres

Contour spacing: 10m

J2747/R1805
Figure 17_topography.dgn

TOPOGRAPHIC DEFINITION OF THE LOWER CAMDEN HAVEN CATCHMENT

FIGURE 18



LEGEND

------- Contour of Bed Elevation relative to Camden Haven Hydrographic Datum (CHHD)
(Based on Camden Haven Flood Mitigation cross section data PWD, 1979)

-·-·-·- Contour of Bed Elevation relative to Camden Haven Hydrographic Datum (CHHD)
(Based on Camden Haven Flood Mitigation soundings PWD, 1979)

CS 27 —— Cross-section Location

Areas of Shoaling

NB. CHHD approx. 0.9 m below MSL Australian Height Datum

Camden Haven Hydrographic Datum

J2747/R1805
Fig18_bathymetry

BATHYMETRY OF QUEENS LAKE AND STINGRAY CREEK

FIGURE 19

CAMDEN HAVEN RIVER

CAMDEN HAVEN INLET

WATSON TAYLORS LAKE

STEWARTS RIVER

CS 1a
CS 1
CS 2
CS 3
CS 4
CS 5
CS 6
CS 7
CS 8
CS 9
CS 10
CS 11
CS 12
CS 13
CS 14
CS A
CS B
CS C
CS D
CS E
CS F

-1.00
-2.00
0.25
0.00
0.50
-0.25

LEGEND

------- Contour of Bed Elevation relative to Camden Haven Hydrographic Datum (CHHD)
(Based on Camden Haven Flood Mitigation cross section data PWD, 1979)

-·-·-·- Contour of Bed Elevation relative to Camden Haven Hydrographic Datum (CHHD)
(Based on Camden Haven Flood Mitigation soundings PWD, 1979)

CS 27 —— Cross-section Location

Areas of Shoaling

NB. CHHD approx. 0.9 m below MSL
Australian Height Datum

N

Scale

200 0 200 400 600 800 1000

Metres

Camden Haven Hydrographic Datum

J2747/R1805
Fig19_bathymetry

BATHYMETRY OF WATSON TAYLORS LAKE AND CAMDEN HAVEN INLET

FIGURE 26

QUEENS LAKE

HERONS CREEK

KENDALL

[210]
(262)
23%

PACIFIC HIGHWAY

[195]
(247)
23%

CAMDEN

HAVEN RIVER

[195]
(237)
7%

[53]
(94)
38%

[45]
(11)
76%

NORTH HAVEN

[0]
(0)
100%

PERPENDICULAR POINT

SOUTH
PACIFIC
OCEAN

GOGLEYS
LAGOON

LAURIETON

NORTH BROTHER
MOUNTAIN

DUNBOGAN 55%

CAMDEN
HEAD

[60]
(75)
57%

CAMDEN HAVEN INLET

DUNBOGAN BEACH

MOORES
ISLAND

(120)
[105]
33%

MUD BAY

GRASSY ISLAND

HUMBUG POINT

WATSON TAYLORS LAKE

[195]
(247)
24%

BENSONS
INLET

[195]
(255)
22%

STEWARTS RIVER

DIAMOND HEAD

LEGEND

[105]	Tidal Lag in minutes for high water (18th Sept. 1997)
(120)	Mean Tidal Lag in minutes for low water (18th Sept. 1997)
33%	Tidal Range as a percentage of ocean tidal range

NB. Based on data collected by DLWC for period 18th August to 19th September, 1997

N

Scale

500 0 500 1000 1500 2000 2500

Metres

VARIATION IN TIDAL LAG AND MEAN SPRING TIDAL RANGE

FIGURE 34

HERONS CREEK

NORTH COAST RAILWAY

PACIFIC HIGHWAY

HERONS CREEK

KENDALL

CAMDEN HAVEN RIVER

STEWARTS RIVER

LAKEWOOD

WEST HAVEN

NORTH HAVEN

LAURIETON

GRANTS BEACH

DUNBOGAN BEACH

Direct catchment runoff of coarse sand and gravel

Direct catchment runoff of coarse sand

Natural fluvial sediment load comprising mainly silt/sand clays as suspended load (ie. detrital sand component is insufficient to mask local coarse bed sediment)

Direct catchment runoff of coarse sand and gravel gives channel a coarse bed sediment

Mud Basin - filling with mud supplied mainly by Herons Creek, northern shoreline bank erosion and urban runoff from Lakewood and West Haven. Rate of infilling is probably an order of magnitude less than Watson Taylors Lake. Biogenic build-up with shellfish more significant in Queens Lake due to lack of detrital inputs.

Prograding distal front of marine delta comprising fine sand, detrital shell and mud build-up along with in situ growth of molluscs (ie. significant biogenic contribution)

very small sediment supply

Distal front of Herons Creek fluvial delta

Dominant wind fetch

Sandy spit due to longshore transport

Prograding fine sand beach

Eastern portion of lake very shallow due to mud transfer by wind action

Longshore transport and sorting of bed sediment leading to sand supply to eastern beach

Limit of marine delta (ie. effective transport of marine sand)

Net infeed of marine sand

Temporary longshore transport reversal and possible sand feed into estuary during summer NE seas and NE swell

Longshore bypassing in slugs during dominant south-easterly storms

Local runoff causing deposition

Minor infeed of marine sand

net longshore transport as slugs in depths out to -6 to -8m AHD, most longshore transport in surf zone in depths of about -3 to -4m AHD

High north and south gross longshore transport in centre of Dunbogan Beach

Onshore / Offshore sand movement with periodic pronounced shore parallel surf bars due to storm action. Bar formation not likely to extend beyond depths of -8m AHD

Direct catchment runoff of coarse sand

Overbank fine sands during major floods

Main sediment supply to lake from Camden Haven River - Predominantly suspended sediment (silts, clays and fine sand)

Prograding distal slope of fluvial deltas of Camden Haven and Stewarts Rivers. Sandy mud build-up with in situ growth of molluscs (ie. significant biogenic contribution)

Prograding mud flats due to NE wind driven redistribution of basin muds and shells

Dominant wind fetch

Mud Basin - filling with sandy shelly muds supplied by Camden Haven and Stewarts Rivers. Over 50% silt and and clay and sands very fine. Shell content comprises in situ whole molluscs. Sediments interlayed with organics of sticks, leaves and charcoal. Infilling probably in the order of 1mm/yr

Limit of marine sand transport

Prograding distal slope of marine delta - fine sand, detrital shell and mud build-up along with in situ growth of molluscs (ie. significant biogenic contribution)

Prograding distributary levees where fine sand deposited by floods and subsequently reworked by tides. Tides tend to form crescent-shaped bars which can cause tidal dominance (and navigability) to switch between distributaries.

Lobe of fluvial deposition which has potential to block primary lake/river link

Fluvial supply mostly silts, clays and organics

Shell lag deposits which occur in areas of local concentrationof velocities (indicative only)

N

CONCEPTUAL MODEL OF SEDIMENTARY PROCESSES

J2747/R1805
Figure 34.dgn

747/R1805
ure 50.dgn

WQ ZONE F
Zone of very poor tidal exchange with the lower estuary due to highly stratified water column and areas of localised deep holes in the bed of the river. Flushing of the zone is almost entirely reliant on freshes / floods. Water quality is characterised by:
~ very low DO levels in bottom waters
~ elevated levels of TP and TN concentrations due to organic detritus in bed
~ relatively high bottom water salinities due to poor flushing and mixing with freshwater
~ flushing times of >70 days

WQ ZONE E
Zone of poor tidal exchange with Stingray creek due to shallowness of lake and flow resistance of aquatic flora.
Poor exchange leads to high summer water temperatures and hypersalinity
~ flushing times up to 25-70 days increasing northwards
~ dry weather salinity temperatures of up to 32C salinities increase northwards and can exceed 37 ppt in extended dry summer weather
~ dissolved oxygen increases west to east probably due to seagrass abundance but is generally less than 6mg/l

Indicative flood tide currents showing jet towards mouth of Heron Creek. The lack of lateral tidal exchange is reflected in very sharp south to north temperature gradient in summer.

Eastern half retains good dissolved oxygen in summer extended dry weather

Local mixing due to NE and S/SW wind regimes, but very weak tidal currents and limited hydraulic exchange with stingray creek

Dissolved oxygen gradient in summer stress conditions varying from 6 mg/l in east to less than 3 mg/l in west reflecting sea grass photosynthesis in east

KENDALL

Local WQ gradient - flushing times, temperature salinity variability, dissolved oxygen, nutrient concentrations deteriorate in south to north direction. The western corner of WTL is the only area where total phosphorus levels are greater than 0.05 mg/l

WQ ZONE D
Zone of effective tidal flows and mixing bordered by relatively sharp thermocline in extended summer dry weather. This tidal transition zone between Stingray Creek and Herons Creek characterised by:
~ flushing times 15-35 days
~ dry weather summer water temperatures 26-28C
~ salinities not exceeding ocean salt and little variability in extended dry weather

WQ ZONE C
Zone of weak and very little mixing leading to transient stratification and generally poor water quality
~ flushing times generally exceed 35 days and exceed 70 days in extended dry weather conditions
~ summer water temperatures reach up to 32C
~ salinity variations between seasons is generally > 5 ppt and varies from fresh to 20 ppt near tidal limit

TURBIDITY NOTE
Because of the muddy substrate of the lakes and their shallow depth, wind waves constantly stir up the bed, sediments resuspending mud and keeping the lakes very turbid. Turbidity in both lakes greatly exceeds ANZECC guidelines. In the deeper more protecte
Flusing time over 70 days because of small freshwater base flow and small tidal prism.

WQ ZONE B
Zone of weak tidal flows and reduced mixing leading to:
~ flushing times up to 45 days
~ highly variable salinity due to dynamic trapping of local freshwater inputs
~ dry weather summer water temperatures up to 30C
~ dissolved oxygen probably variable and likely to drop below 6mg/l due to BOD (not sufficient data)
~ very high turbidity due to shallowness and constant wind wave stirring

WQ ZONE A
Zone of strong tidal flows and effective mixing leading to:
~ flushing times < 15 days
~ dry weather salinity (high water slack) within 1-2 ppt of ocean
~ dry weather summer water temperatures do not exceed 26-27C
~ dissolved oxygen generally do not fall below 6mg/l in Camden Haven / WTL area but can drop between 4-6mg/l in Stingray Creek

Indicative flood tide currents showing good penetration of Zone A and poor penetration and flushing of Zone B. (as a function of length of arrow tail)

Flushing times over 70 days because of small freshwater base flow and small tidal prism

Conceptual compartmentalisation of lake into Zone A and Zone B due to prograding distal slopes of the fluvial deltas of Camden Haven and Stewarts Rivers - refer conceptual model of sedimentary processes.

N

Local WQ gradient - flushing times, temperatures, salinity variablility, dissolved oxygen, and nutrient concentrations, deteriorate in a south to north direction.
The north-western corner of WTL is the only area where total phosporus levels are greater than 0.05 mg/l and chlorophyll-a levels are in excess of ANZECC guideline values.

CONCEPTUAL MODEL OF WATER QUALITY PROCESSES

FIGURE 50

J2747/R1805
Figure.51.dgn

QUEENS LAKE

NORTH HAVEN

GOGLEYS LAGOON

LAURIETON

DUNBOGAN

CAMDEN HAVEN INLET

DUNBOGAN BEACH

WATSON TAYLORS LAKE

511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 528a 529 530 531 532 533 535 536 537 538 539 540 541 542 542a 542b 542c 543 544a 544b 544c

LEGEND

- Gazetted SEPP 14 Coastal Wetland (based on DUAP mapping, Nov. 1997)
- 543 SEPP 14 Wetland identification number
- Proposed additional SEPP 14 Wetland (Ecovision, 1998)
- Wetland of Regional Value (Ecovision, 1998)

N

Scale

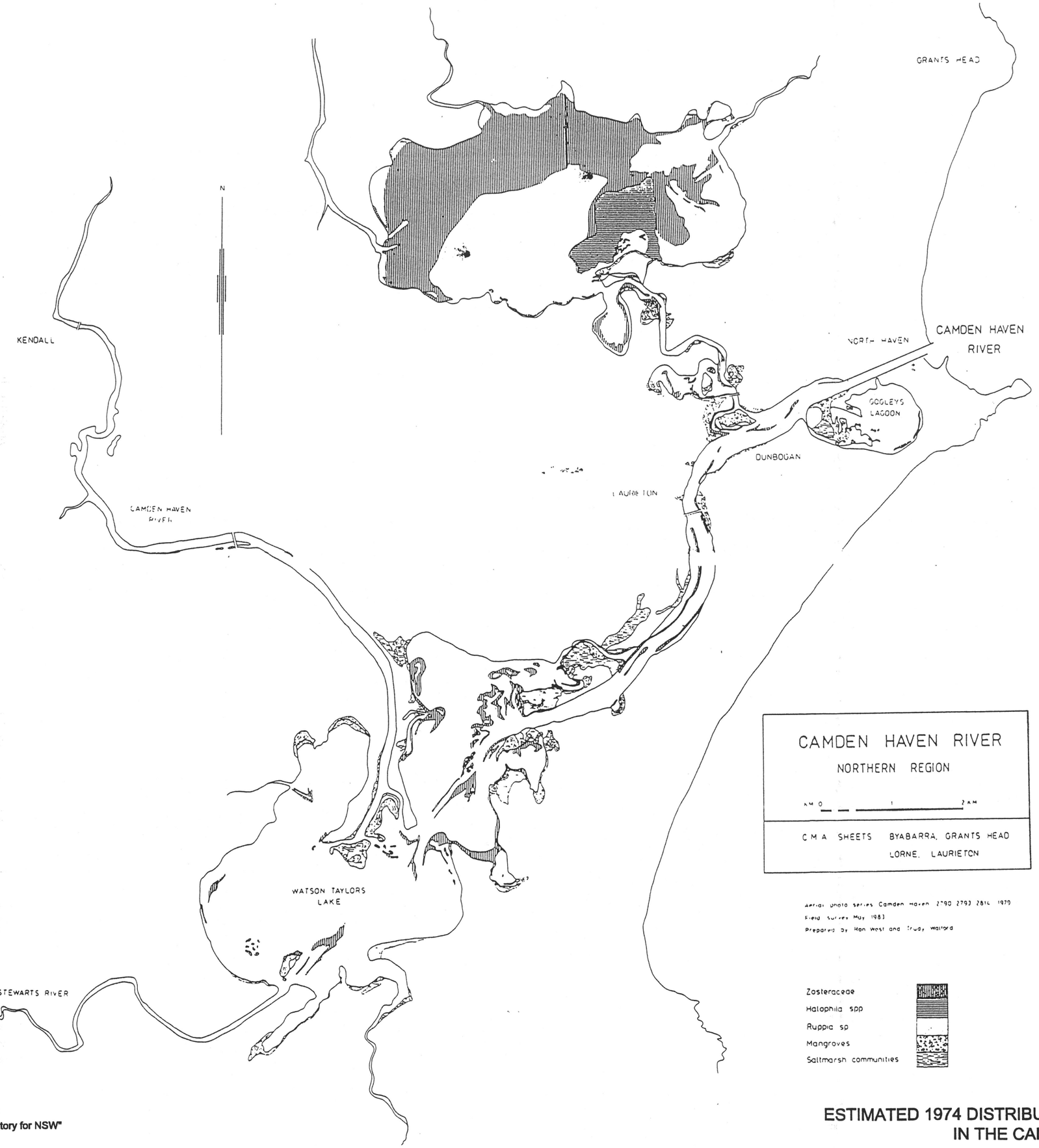
500 0 500 1000 1500 2000 2500

Metres

COASTAL WETLANDS OF THE CAMDEN HAVEN ESTUARY

FIGURE 51

FIGURE 53



Source: West et at (1985)
"Fisheries Bulletin 2: An Estuarine Inventory for NSW"

J2747 / R1805

ESTIMATED 1974 DISTRIBUTION OF SEAGRASSES IN THE CAMDEN HAVEN ESTUARY

FIGURE 54

KENDALL

NORTH HAVEN

LAURIETON

DUNBOGAN

A

B

C

D

E

F

G

LEGEND

- Sand Bar (exposed at low water)
- Zostera capricorni Seagrass
- Halophila ovalis Seagrass
- Ruppia sp. Seagrass
- Mixed Zostera & Halophila Seagrass
- Mixed Rupia & Halophila Seagrass
- Unconfirmed Halophila
- Unconfirmed Zostera
- Unconfirmed mixed Zostera & Halophila
- •A Sediment sampling sites

Mapping completed by WS Rooney and Associates (1997)

1997 MAPPING OF SEAGRASSES OF THE CAMDEN HAVEN ESTUARY

FIGURE 55

FEWER SPECIES IN MORE BRACKISH AREAS OF THE ESTUARY

SEDIMENT LOAD SMOTHERING SEAGRASS. LARGE AREA OF BARE SUBSTRATE DUE TO SEDIMENT SETTLING AS A RESULT OF TURBID WATER INFLOW FROM FLOOD TIDE

GREATER NUMBER OF INDIVIDUALS IN ESTUARINE HABITATS AS COMPARED TO THE MORE MARINE ENTRANCE CONDITIONS. BECAUSE THERE IS LESS COMPETITION FOR FOOD & SPACE, MORE ADAPTABLE SPECIES CAN INCREASE IN NUMBER AS WELL AS SIZE. THE MORE MARINE CONDITIONS OF THE ENTRANCE HAVE A SEDIMENT BEHAVIOUR THAT IS MORE DYNAMIC AND A GREATER RATE OF REWORKING. THIS COULD AFFECT THE NATURE OF FAUNA THAT ARE ABLE TO ESTABLISH HERE

SHARP TRANSITION FROM BARE SUBSTRATE TO SEAGRASS BEDS

STINGRAY CREEK BANK SCOUR CONTRIBUTING TO SEDIMENT LOAD SMOTHERING SEAGRASS

GREATESET NUMBER OF SPECIES PER UNIT AREA. FEWER SPECIES CAN TOLERATE THE FLUCTUATING CONDITIONS OF THE UPPER ESTUARY

UPPER ESTUARY FAR HAS FEWER SPECIES THAN AT THE ENTRANCE, BUT BIOMASS MANY TIMES GREATER. IE. SPECIES THAT CAN TOLERATE FLUCTUATING SALINITY, DO,TEMP ETC. ENJOY LESS PREDATION AND LESS COMPETITION FOR RESOURCES

FRINGING SEAGRASS BEDS OF INTEREST BECAUSE RIVER EXPERIENCES CONSIDERABLE SURFACE WATER SALINITY FLUCTUATIONS WITH EACH RAIN EVENT

N

MOLLUSCS DO NOT TOLERATE THE BRACKISH CONDITIONS OF THE UPPER ESTUARY. MOLLUSCS ONLY FOUND IN LAKES & LOWER CHANNELS

THE SEAGRASS BEDS OF QUEENS LAKE, GOGLEYS LAGOON, EASTERN WATSON TAYLORS LAKE ARE THE MOST IMPORTANT BIOLOGICAL AREAS WITHIN THE ESTUARY. THE ADDED EPIPHYTIC FOOD RESOURCES OF THE SEAGRASS BEDS & STRUCTURAL PROTECTION CAN SUPPORT A CONSIDERABLY COMPLEX COMMUNITY STRUCTURE

FEWER SPECIES IN THE MORE BRACKISH AREAS OF THE ESTUARY

LAKES PROVIDE GOOD FEEDING AREAS FOR LARGER BOTTOM FEEDING FISH. DURING PERIODS OF STABLE WATER QUALITY FISH ENCOURAGED TO UPPER REACHES OF ESTUARY.

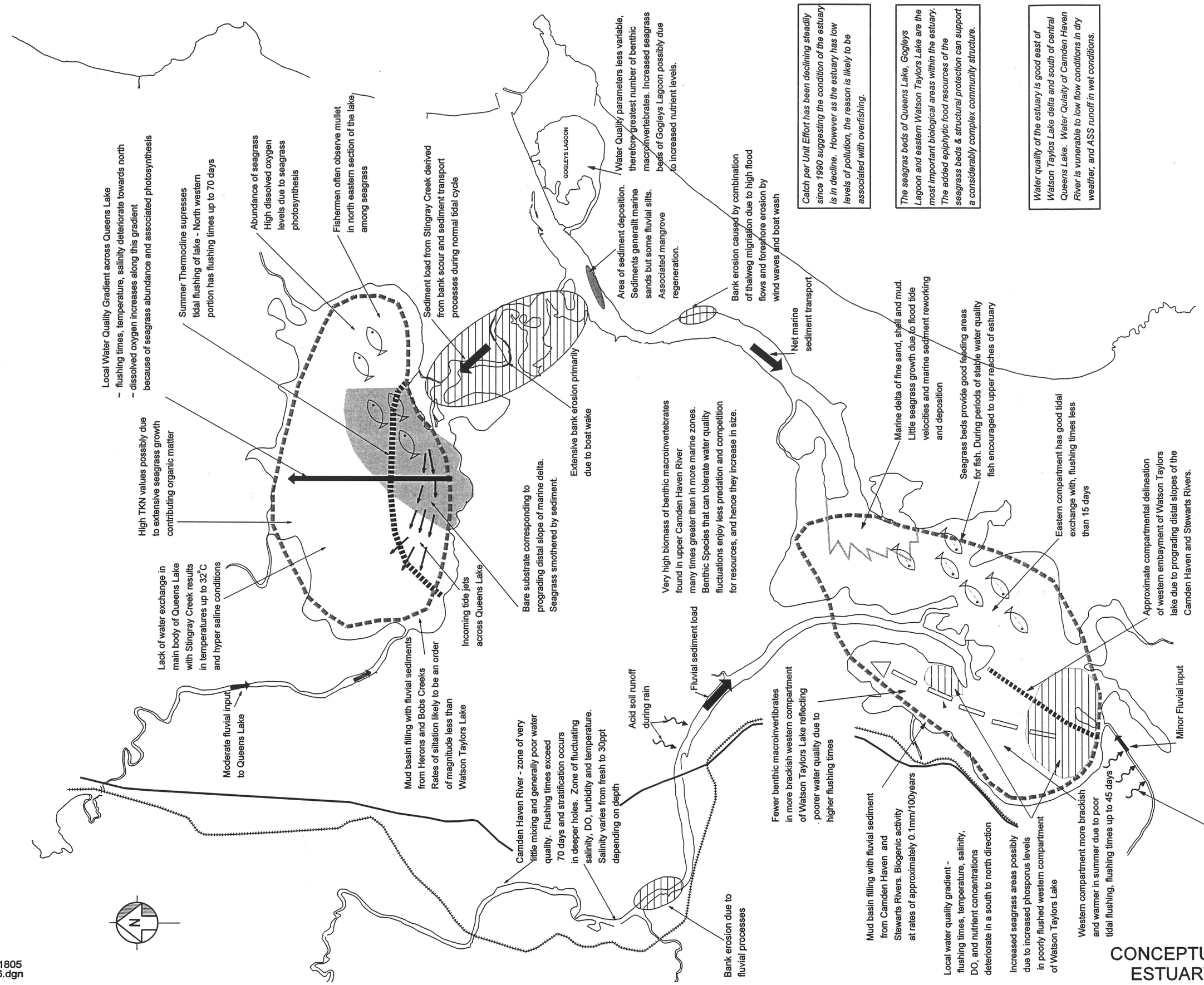
SEAGRASS DISTURBANCE; POSSIBLY A RESULT OF DRAGGING MESH NETS

SEAGRASS AREAS INCREASED SINCE 1985 DUE TO INCREASE IN PHOSPHORUS LEVELS

CATCH PER UNIT EFFORT HAS DECLINED SINCE 1990 INDICATING THERE MAY HAVE BEEN OVERFISHING IN THE ESTUARY RESULTING IN REDUCED CATCHES OVER TIME

CONCEPTUAL MODEL OF BIOLOGICAL PROCESSES

FIGURE 56



Catch per Unit Effort has been declining steadily since 1990 suggesting the condition of the estuary is in decline. However as the estuary has low levels of pollution, the reason is likely to be associated with overfishing.

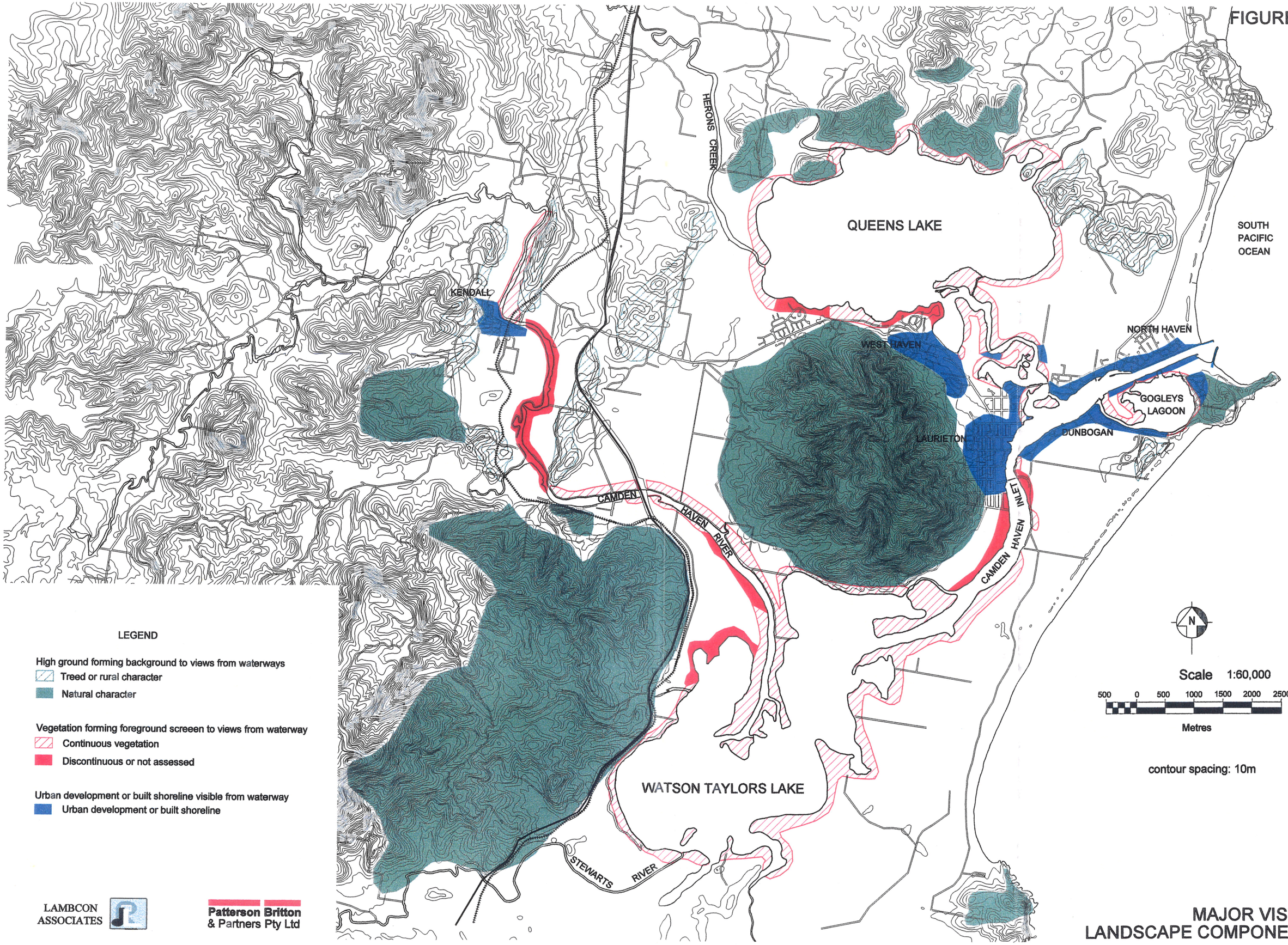
The seagras beds of Queens Lake, Gogleys Lagoon and eastern Watson Taylors Lake are the most important biological areas within the estuary. The added epiphytic food resources of the seagrass beds & structural protection can support a considerably complex community structure.

Water quality of the estuary is good east of Watson Taylos Lake delta and south of central Queens Lake. Water Qulaity of Camden Haven River is vunerable to low flow conditions in dry weather, and ASS runoff in wet conditions.

CONCEPTUAL MODEL OF ESTUARY PROCESSES

747/R1805
gure 56.dgn

FIGURE 60



LEGEND

High ground forming background to views from waterways
- Treed or rural character
- Natural character

Vegetation forming foreground screeen to views from waterway
- Continuous vegetation
- Discontinuous or not assessed

Urban development or built shoreline visible from waterway
- Urban development or built shoreline

N

Scale 1:60,000

500 0 500 1000 1500 2000 2500

Metres

contour spacing: 10m

LAMBCON ASSOCIATES

Patterson Britton & Partners Pty Ltd

MAJOR VISUAL LANDSCAPE COMPONENTS

FIGURE 61

QUEENS LAKE

SOUTH PACIFIC OCEAN

HERONS CREEK

KENDALL

WEST HAVEN

NORTH HAVEN

GOGLEYS LAGOON

DUNBOGAN

LAURIETON

CAMDEN HAVEN INLET

CAMDEN HAVEN RIVER

CAMDEN

WATSON TAYLORS LAKE

STEWARTS RIVER

LEGEND

Regionally distinctive waterways

- Visual catchment boundary
- (A) Queens Lake
- (B) Stingray Creek
- (C) Camden Haven Inlet
- (D) Watson Taylors Lake
- (E) Camden Haven River

Waterways of distinctive local character

- Indicative boundary
- (1) Camden Haven River above Kendall road bridge
- (2) The river between Kendall road bridge and 'The Gap'
- (3) The river between 'The Gap' and Pacific Highway Bridge
- (4) River delta
- (5) Camden Haven Inlet above Dunbogan Bridge
- (6) Camden Haven Inlet below Dunbogan Bridge
- (7) Stingray Creek
- (8) Gogley's Lagoon

N

Scale 1:60,000

500 0 500 1000 1500 2000 2500

Metres

contour spacing: 10m

LAMBCON ASSOCIATES

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VISUALLY DISTINCTIVE WATERWAYS

FIGURE 62

HERONS CREEK

QUEENS LAKE

SOUTH PACIFIC OCEAN

KENDALL

WEST HAVEN

NORTH HAVEN

GOGLEYS

LAGOON

DUNBOGAN

LAURIETON

CAMDEN HAVEN INLET

CAMDEN HAVEN RIVER

WATSON TAYLORS LAKE

STEWARTS RIVER

N

Scale 1:60,000

500 0 500 1000 1500 2000 2500

Metres

contour spacing: 10m

LEGEND

⑫ Location of viewing place and access number

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LOCATION OF VIEWING PLACES AREAS OF DISTINCTIVE LOCAL CHARACTER

FIGURE 63

N

Scale 1:8,000

100 0 100 200 300 400 500

Metres

Rough Pasture

INLET

Conspicuous dwellings

14

Derelict farm buildings

Natural & cultural Vista

13

Water couch meadows

HAVEN

Swamp Oak

Swamp Oak & Sclerophyll woodland

Water couch meadows

CAMDEN

Mangrove Scrub

Swamp Oak

12

Natural Vista

Very extensive natural panorama

11

Swamp Oak

Mangrove Scrub & Salt Marsh

LEGEND

(3) Documented viewing place

Visible Elements

- Fringe vegetation - continuous
- Fringe vegetation - discontinuous
- Conspicuous buildings or structures
- Rock retaining walls
- Eroded shoreline
- Moored boats
- Oyster leases (indicative only)
- Derelict leases

View Qualities

- Viewing point
- Vista (direction)
- Fore or mid-ground restriction
- View zone (width)
- Filtered view

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VISUAL QUALITIES OF THE LOWER ESTUARY
AREA 5: CAMDEN HAVEN INLET ABOVE DUNBOGAN BRIDGE

FIGURE 64

N

Scale 1:8,000

100 0 100 200 300 400 500

Metres

Oyster farm depot

Cultural landscape panorama

INLET

Small marina

Conspicuous retaining walls

Tunis St Wharf

18

Swing moorings

HAVEN

CAMDEN

Laurie St

unattractive shore treatment

17

Mill St

Fish Co Op

Marina

Boat Ramp

DUNBOGAN BRIDGE

16

Partly screened reserves

Nature dominated views

15

Residences mostly screened from inlet views

Discontinuous screening of road

LEGEND

③ Documented viewing place

Visible Elements

- Fringe vegetation - continuous
- Fringe vegetation - discontinuous
- Conspicuous buildings or structures
- Rock retaining walls
- Eroded shoreline
- Moored boats
- Oyster leases (indicative only)
- Derelict leases

View Qualities

- Viewing point
- Vista (direction)
- Fore or mid-ground restriction
- View zone (width)
- Filtered view

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VISUAL QUALITIES OF THE LOWER ESTUARY
AREA 6 (PART): CAMDEN HAVEN INLET BELOW DUNBOGAN BRIDGE

FIGURE 65

VISUAL QUALITIES OF THE LOWER ESTUARY
AREA 7:STINGRAY CREEK

N

Scale 1:8,000

100 0 100 200 300 400 500

Metres

Extensive natural panorama

Informal boat ramp

STINGRAY

Cultural landscape panorama

22

21

Oyster farm depot

Conspicuous Dwelling

23

CREEK

Picnic Areas

Nature dominated panorama

8

Natural Vista

Cultural landscape vista

Bunns Corner

10

32

INLET

HAVEN

CAMDEN

360° Panorama

24

Oyster farm depot

LEGEND

3 Documented viewing place

Visible Elements

- Fringe vegetation - continuous
- Fringe vegetation - discontinuous
- Conspicuous buildings or structures
- Rock retaining walls
- Eroded shoreline
- Moored boats
- Oyster leases (indicative only)
- Derelict leases

View Qualities

- Viewing point
- Vista (direction)
- Fore or mid-ground restriction
- View zone (width)
- Filtered view

LAMBCON ASSOCIATES

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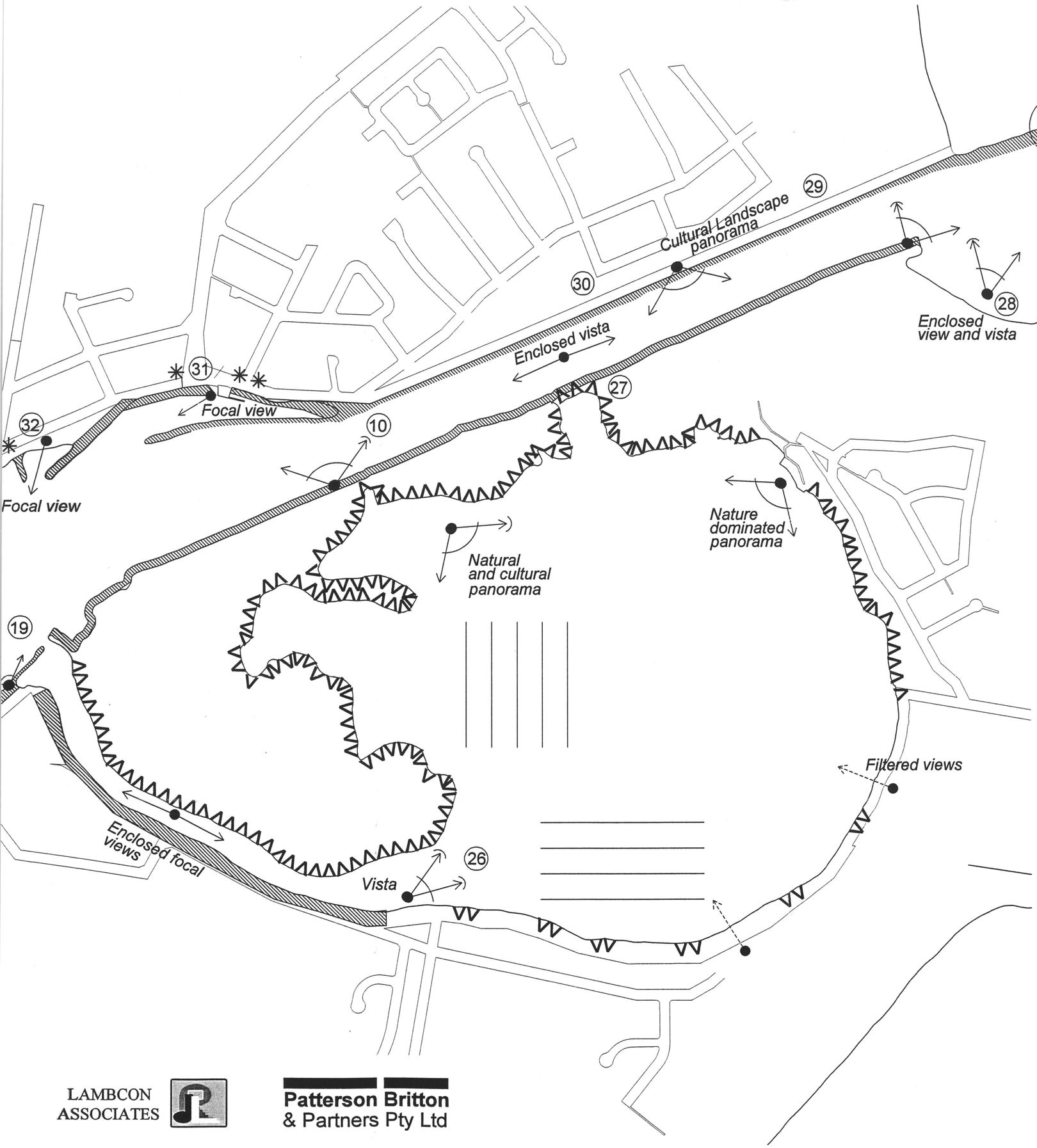
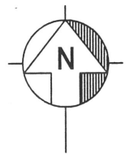
FIGURE 66





Scale 1:8,000

100 0 100 200 300 400 500

Metres

LEGEND

(3) Documented viewing place

Visible Elements

- Fringe vegetation - continuous
- Fringe vegetation - discontinuous
- Conspicuous buildings or structures
- Rock retaining walls
- Eroded shoreline
- Moored boats
- Oyster leases (indicative only)
- Derelict leases

View Qualities

- Viewing point
- Vista (direction)
- Fore or mid-ground restriction
- View zone (width)
- Filtered view

LAMBCON ASSOCIATES

Patterson Britton & Partners Pty Ltd

VISUAL QUALITIES OF THE LOWER ESTUARY AREA 6 (PART) AND AREA 8: GOGLEYS LAGOON