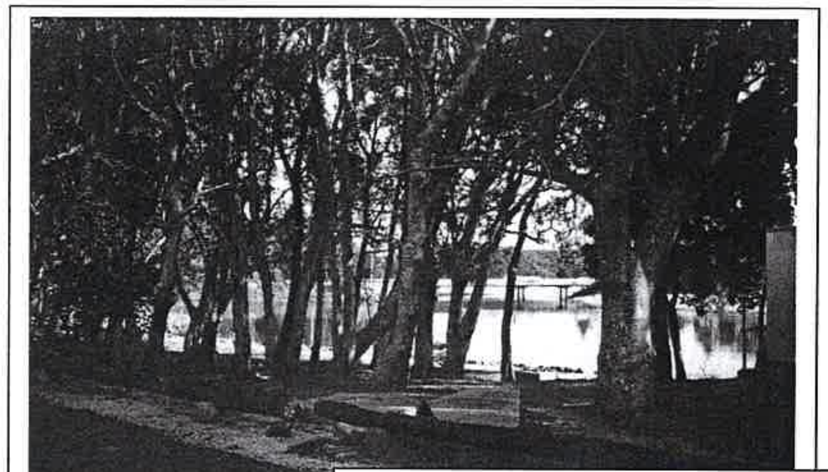
— Continued —

HASTINGS

URBAN STORMWATER MANAGEMENT PLAN



April 2000

6.0.

TABLE 7.1: COST-BENEFIT ANALYSIS

The table below contains specific options are shown to link to each of the issues (and their caused with specific locations). Each option was examined in terms of its estimated cost (capital and operating) and a timeframe was determined for each option, which was based on a 5-year expenditure program.

PORT MACQUARIE

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Water quality						
Litter in waterways (bottles, plastic bags, cigarette butts, leaf litter, garden clippings)	Hastings River, Kooloonbung Creek Settlement City, Shopping Centres, in town area, Flynn Street at Surf Street intersection, stormwater outlet onto beaches (especially Oxley Beach) Building sites Wrights Ck Corridor	Inadequate enforcement of littering laws.	Rigorous enforcement of littering laws	5000	1000	2001
		Lack of knowledge. Increase during tourist seasons	Education programs such as Yellow Fish Rd., or targeting tourist activities.	5000	1000	2002
		Inadequate regular maintenance of GPT's and outlets	Increase frequency of GPT maintenance	NA	1000/ea GPT/yr	
		Litter from shopping centres entering the river	Install devices to trap litter before it reaches receiving waters (Nettech litter socks, or Stormwater Systems Pratten Traps on outlets, or proprietary devices such as CDS units.	Nettech – 20000/ea Prattern Trap – 2,500/ea	17500	
		Grease and oils and their by-products may possibly pollute creek next to industrial area.	Structural solutions in the industrial area have been addressed by **WBM**. Non-structural options could include: • Undertake regular audits of industrial premises as part of trade waste program		2000 every 3-5 yrs	2001/02

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Industrial/commercial pollution – grease and oil (NOTE: COUNCIL IS AUDITING THE SITE AT PRESENT)	Kooloonbung Creek Hastings River Milton Circuit	Poison, pesticides, chemicals	Education of business owners/operators in terms of chemical storage and disposal, equipment washing, etc.	2000	2000-every 3-5 yrs	
		Pollution eg. Paint entering the Marina via stormwater channels.	Implement trade waste program			
		Industrial pollution due to inadequate planning eg. Insufficient gutters and piping	Dependant on outcomes of audit			
		Animal droppings	Supply bins and plastic bags in popular dog walking areas for disposal of droppings.	5000	1500	2001/02
Virus/bacteria	Hastings River – toxins accumulate in oysters Kooloonbung Creek Catchment wide	Occasional high Faecal Coliform Levels	Education program targeting pet owners.	1500	1500	2001/02
		Runoff from roads.	Investigate potential sites for installing silt traps/reinforce policies	2000	NA	2002/03-2006/07
Elevated levels of suspended solids	Catchment wide	Hosing of concrete wastes down the drains.	Education of builders/concrete industry	1000	1000	2001/02

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
		Urban runoff, fertilisers, chemical spray, inappropriate dumping of garden & parkclippings	Rigorous enforcement of littering/dumping laws.	2000	2000	2001/02
Nutrients	Catchment wide, especially into Kooloonbung Creek And Hastings River	Occasional high phosphorus levels	Council could introduce a green waste collection program either through supply of green waste bins, or periodic kerbside collections			Council introducing green waste collection bin (fortnightly) in September.
			Education regarding appropriate use of fertilisers, car washing, and disposal of garden wastes.	1000	1000	2001
		Sewage overflows	Council to investigate sewage overflows and reduce sewer overflows through system augmentation	5000 - investigate	NA	
		Runoff from roads/carparks	Review procedures that are in place for dealing with spills or accidents	NA	NA	
Grease and Oil pollution	Shopping centres	Erosion in upstream areas	Install inlet structures on car park areas (Council owned & private)			
			Identification and stabilisation of high priority erosion sites.	10000		
Siltation	Hastings River, Kooloonbung Creek, Wrights Creek	Erosion in upstream areas	Identification and stabilisation of high priority erosion sites.	10000		
Erosion						

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Lack of separation facilities at new development sites	Applies to whole catchment	Insufficient resources	Allocate staff to enforce erosion control procedures on building sites, home gardens, etc	5000	1000	
Insufficient enforcement of erosion control at construction sites (including individual sites)	Catchment wide, eg: Quarry off Ocean Drive and Lake Rd, Council's work depot, Koala Rd, Sandhurst Estate building site, Dahlesford Estate.	Lack of Kerb and Gutters	Sealing of road shoulders to minimise erosion (kerb & gutter)	500000	5000	2001/02 to 2006/07
Erosion of road verges	Pacific Drive (Southern side) and Northern side of Oxley Beach.	Creek in rainforest is unable to cope with an increased flow of water from roof tops from up the hill	Promote onsite storage of stormwater of roof run-off (catchment wide)	NA	NA	
Bank erosion of SEPP 26 Lighthouse Gully rainforest reserve.	Lighthouse Beach Rainforest Reserve. Wrights Creek	Removal of vegetation in creekbeds leads to bank erosion	Construct groynes/riffle zones	20000	1000	2006/07
		Removal of vegetation in creekbeds leads to bank erosion	Construct groynes/riffle zones	20000	1000	2006/07

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Impact on Aesthetics						
Aesthetics of catchment	Under wharf near the Fisherman's Co-op, Kooloonbung Creek	Litter	Education programs and enforcement of littering laws.	5000	1000	2001
		Open stormwater drains in some residential area is a concern to some residents	Revegetation of bare stormwater channel banks	20/tree	NA	2001
			Piping of some open drains			
			Investigate possibility of vegetating drains for visual amenity	5000		2004/05
Low visual amenity of open stormwater drains	Some residential areas		Promote water Sensitive Urban Design on new developments	NA	NA	2003/04
			Promote water Sensitive Urban Design on new developments	NA	NA	2003/04
Impact on Aquatic and Terrestrial Habitats						
Introduction of weeds	Catchment wide, eg top of Kooloonbung Creek, Wrights Creek.	Planting of introduced species (impatiens, lantana & elephant ear).	Encourage planting of native species in gardens	NA	NA	
		Due to altered flow regimes due to stormwater increase.	Investigate priorities for stormwater flow reduction through on-site detention, or construction of major detention/retention basins	20000	NA	
Changed habitat conditions	Catchment wide, eg. Kooloonbung Creek		Reduce the number of stormwater discharges into important habitat areas such as the wetland behind the racecourse.	60000	2000	2006/07 med/long term

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Concentration of stormwater drains emptying onto buffer zones of wetlands.	Behind racecourse.		Install pollution control devices	50000	3000	2006/07 med/long term
			Install pollution control devices	50000	3000	2006/07 med/long term
Impact on Community Health and Safety						
Safety	Detention ponds on playgrounds and on new subdivisions eg Richard Place, Marian Drive. Easement in northern end of Dixie Park. Oxley, Lighthouse, Shelly, Heart Street.	Flooding and swift flows in channel and drainage	Fence off most dangerous areas	100000	2000-03-23 maintenance	2006/07
		Stormwater drains onto beaches	Fence off most dangerous areas Minimise the number of stormwater channels discharging onto the beaches in future	100000 NA	2000-03-23 maintenance NA	2006/07
		Stagnant water in detention ponds	Increase water depth of detention ponds (this may increase the safety issue)	20000	10000	1 area /yr ongoing
Mosquito breeding	New development estates with retention facilities	Lack of GPT's.	Investigate opportunities for installation of GPT's on stormwater systems leading to beaches.	2000	NA	\
Stormwater outlets feed into the ocean, carrying pollutants and rubbish	Oxley Beach, Town Beach, Lighthouse Beach, Shelly Beach	Lack of GPT's.	Investigate opportunities for installation of GPT's on stormwater systems leading to beaches.	2000	NA	\
Insufficient Community Awareness						
Lack of awareness in terms of urban Stormwater Issues Dangers of playing in beach discharges.	Catchment wide		Discourage hosing down of shop fronts	NA	1500	2001
			Discourage hosing down of shop fronts	NA	1500	2001

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Lack of Planning						
Drainage	Kooloonbung Creek	Blocked drains as a result of construction of "Settlement Shores" canal estate. The stormwater drainage stops at the public reserve land and hence, water inundates reserve land.	Extend/augment drainage system to avoid inundation of reserve	300000	5000	2002/03
Insufficient drainage	Public Reserve Land.	Natural streams have been converted to concrete lined drains.	Investigate priorities for stormwater flow reduction through on-site detention, or construction of major detention/retention basins	2000	NA	2006 (maybe one or two per yr)
Increased velocity of stormwater	Astronomers Terrace to Oleander Avenue.	Lack of Council Resources	Review allocation of staff.			
Bad Supervision of stormwater structures at new development sites	Applies to the whole catchment	Lack of understanding of what is required on new development sites in terms of stormwater structures	Education and Enforcement of erosion control procedures on building sites, home gardens, etc	1000	1000	Ongoing Every 3-5 yrs
			Investigate priorities for stormwater flow reduction through on-site detention, or construction of major detention/retention basins (consideration needs to be given to public acceptance of detention basins, ongoing maintenance, mosquitoes, etc)	2000	NA	

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Gutters are not deep enough to cope with stormwater flows.	Hopeton Close		Investigate possibility of redirecting stormwater	2000	NA	
Drainage entering natural area (wetland).		Bad design of kerb and gutters as point of entry into stormwater channels is inappropriately sited.	Investigate possibility of redesigning kerb and gutter	2000	NA	
Design	Catchment wide, eg. Hopeton Close, ie. It is not designed to take large amounts of water or exceptionally high rainfall events.	Limited policy	Increase preparedness for potential accidents, spills by educating industries re: drainage networks	1000	2000	Ongoing Every 3 – 5 yrs
Lack of chemical spill strategies (eg. Booms)		Lack of Planning, no maintenance strategies No LEP provisions, no Section 94 Plans, no DCP's No trunk drainage strategies	Develop LEP provisions, Amend Subdivision Code 94	20000	NA	2001/02
Lack of Regulatory documentations	Applies to the whole catchment	Lack of Planning, no maintenance strategies No LEP provisions, no Section 94 Plans, no DCP's No trunk drainage strategies	Develop LEP provisions, Amend Subdivision Code 94	20000	NA	2001/02
Localised Flooding from Stormwater						

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Localised Flooding	Short Street (CBD), Subdivision behind race course, Industrial Area (Belah Rd) Albert Cir., Denham Street, Bellbowrie Street, Milton Circuit. Soccer field at Dixie Park		Increase maintenance of the stormwater system	NA		
			Consider the findings of Flood Studies in planning and decision-making processes.	NA	NA	ongoing
			Consider the findings of Flood Studies in planning and decision-making processes.	NA	NA	ongoing
Insufficient Infrastructure/Maintenance issues						
Lack of monitoring program in terms of discharges into stormwater	Applies to whole catchment	High cost of maintaining stormwater channels	Divert more rates towards stormwater maintenance strategy (this is a funding issue)	NA	200000	ongoing
Lack of maintenance and resources to maintain capacity of the stormwater system Lack of access to stormwater system	Applies to whole catchment	High cost of maintaining stormwater channels	Seek low cost/low maintenance solutions to stormwater issues (see **WBM** options)	NA	NA	ongoing

CAMDEN HAVEN

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Decreased Water Quality						

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Sedimentation from new and existing subdivisions and new works	Siltation of Queens Lake as stormwater outlet feeds into the Loss of depth near Fish Co-op at Mills Street.	Lack of erosion control. Rural runoff	Drainage to be constructed first at new development sites (ie amend codes & policies & erosion control)	NA	NA	2001/02
			Education and Enforcement of erosion control procedures on building sites, home gardens, etc	NA	5000	2001 ongoing & catchment wide
Nutrients/virun & bacteria	North Haven Upstream in Camden Haven River Longworth Rd & Bell St, Dunbogan	Dog droppings	Education program targeting pet owners.	NA	1500	Implemented as part of Companion Animal Pogram
			Supply bins and plastic bags in popular dog walking areas for disposal of droppings.	1000	1000	2001/02
		Fertiliser/pesticide use Leaf litter	Education regarding appropriate use of fertilisers, car washing, and disposal of garden wastes.	1000	1000	2001
Litter	Longworth Rd & Bell St, Dunbogan Creeks through private property on Batar Creek Rd RSL outlet, Lake St. Outlets into waterways that serve residential subdivisions	Leaf litter, bottles, plastic bags	Rigorous enforcement of littering laws	5000	1000	2001
			Education programs such as Yellow Fish Rd., or targeting tourist activities.	5000	1000	2002
			Install devices to trap litter before it reaches receiving waters (Nettech litter socks, or Stormwater Systems Pratten Traps on outlets, or proprietary devices such as CDS units.	Nettech 20000ea Prattern 2500ea		

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Industrial Pollution – discharge to host water body	Laurieton Industrial Centre North Haven	Leachate from abandoned land-fill sites	Investigate and control occurrences of leachate from abandoned sites			
		Petrol station hosing down forecourt and driveway	Rigorously enforce regulations such as the POEO Act (1997)			
Siltation	David Campbell Ave, North Haven (NOTE: THIS HAS BEEN LOOKED AT) Laurieton Queens Lake and Watson Taylor Lake and Googly's Lagoon	Silt settles out due to incorrect level of box culvert entry	Implementation of Council's Plans to deal with North Haven drainage issues	130000	2000	This has been addressed by Council
		Siltation around stormwater outfalls	Investigate potential for installation of silt traps	2000	NA	2002/03
		Siltation of the Lakes				
Localised Flooding from Stormwater						
Flooding	Throughout the catchment	Low capacity of box culvert	Implementation of Council's Plans to deal with North Haven drainage issues	NA	NA	done
		High water tables	Promotion of on site detention/storage of stormwater and stormwater re-use.			
		Limited inlet and pipe capacities				
Impact on Aquatic and Terrestrial Habitats						

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Changed Habitat Conditions	Beachfront Caravan Park, North Haven North Haven CBD network discharges The Boulevard (Dunbogan) Ocean Drive (North Haven) – near bottle shop	Proposed drainage of wetland could threaten populations of the endangered Wallum Frog and koala	Ensure any drainage works do not impact on the wetland communities.			
Environmental Weeds	David Campbell Ave, North Haven	Weeds along the constructed channel draining the wetland	Undertake weed control	20000	5000	2003/04
		Bitou Bush, Prickly Pear, Lantana, Morning Glory	Promote Landcare groups and activities	NA	NA	
		Weed infestation in easement on western side of Beachfront Caravan Park	Replant areas with native vegetation	10000	1000	2002/03
Erosion						
Erosion	David Campbell Ave, North Haven. Dunbogan, Laurieton Weed infestation on Northern bank of Queens Lake	Along the wetland drainage channel	Implementation of Council's plans regarding North Haven Drainage Issues	NA	NA	done

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Aesthetics						
Aesthetics		Odour (possibly methane)	Discourage the stagnation of water by improving drainage by provision of kerb & gutter			
		Stagnant water in channel, due to problems with box culvert	Investigate re-alignment when appropriate			
		Open drains/channels	Vegetate banks of drains/channels	20/tree	NA	
Health & Safety						
Community Safety	David Campbell Ave, North Haven The Boulevard, Dunbogan	Flooding of road shoulders	Reduce amount of run-off through on-site detention and storage			
			Promote stormwater re-use			
Mosquito Breeding	Impact on Aesthetics	Stagnant water in channel and low lying and wetland areas	Discourage the stagnation of water by improving drainage by provision of kerb & gutter			
Open Channels	Channel at end of David Campbell Ave, North Haven Crossing Edith St to the end of David Campbell Ave, North Haven Lakewood along Ocean Dr.	Possibility of being "swept away" during high flows	Restrict access to high velocity, high risk stormwater flows by signpost			
Community awareness						
Community Awareness (in particular tourists and casual fisherman)	Graham Street, Fagans Crescent	People not sweeping up leaf litter	Implement education programs such as streamwatch or Yellow Fish Road	5000	1000	2002

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
		Lack of education programs such as streamwatch	Use local media to report on stormwater issues, including good news stories	NA	NA	2001/02
		Lack of awareness in terms of car washing on roads, lawn clippings, fertilisers	Encourage/enforce correct car washing practices, and disposal of garden wastes	NA	1500	2001/02
			Discourage hosing down of shop fronts	NA	1500	2001
Lack of Planning/Design						
Design Issues	Box culvert under Beachside Caravan Park	Stagnant water in channel upstream due to difficulty of cleaning the existing structure	Implementation of Council's plans dealing with North Haven Drainage Issue	NA	NA	Done
Lack of Regulatory documentations	Crossing Edith St to the end of David Campbell Ave, North Haven · North Haven; Laurieton · Edith Street, North Haven	No LEP provisions	Council's planning and assessment processes should address potential stormwater issues with new development.			
		Limited policy	Review with other factors when Council's Management Plan is next revised.	NA	NA	
		Lack of Planning				
		No trunk drainage strategies				
		No maintenance strategies				
		No Section 94 Plans No DCP'S	Develop a DCP similar to Newcastle City Council's DCP 50, dealing with stormwater run-off from new development	10000	NA	

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Maintenance						
Maintenance	Catchment Wide	Channel needs cleaning out, it is blocked and needs re-opening	Increase maintenance frequency, for activities such as street sweeping in areas where litter and leaf litter are potential problems	220000	10000 (additional street sweeper)	
		Maintenance frequency should be increased, particularly for roadside gutters				
		Lack of staffing resources to maintain GPT's and other stormwater structures	Allocate more funding towards maintenance and cleaning of stormwater treatment structures.			

LAKE CATHIE/BONNY HILLS

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Decreased Water Quality						
Nutrients	Lake Cathie Bonny Hills	Leaf litter	Increase street sweeping frequency to prevent leaf litter from entering stormwater system via gutters	220000	10000	
			Promote low maintenance, native garden species	NA	NA	2001/02
		Excess fertiliser use	Education with regard to appropriate fertiliser use	1000	1000	2001

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Virus/bacteria	Immediately downstream of Ocean Drive bridge (area known as 'stinky corner') Catchment wide Catchment wide, but now mostly overcome Bonny Hills	Elevated bacterial concentrations	Install GPT	30000	3000	2001/02
		Dog droppings	Supply bins and plastic bags in popular dog walking areas for disposal of droppings	5000	1500	2001/02
		Illegal sewerage connections to the stormwater system	Smoke and dye testing to identify illegal stormwater connections			
		Effluent from Sewage Treatment Plant	Investigate potential for effluent re-use, reducing the amount of effluent discharged	20000 (investigate) 500000 (build)		
Litter	Lake Cathie	Bait bags, drink bottles, plastic bags – increases during tourist season	Rigorous enforcement of littering laws	5000	1000	2001
			Education programs such as Yellow Fish Rd., or targeting tourist activities.	5000	1000	2002
			Install devices to trap litter before it reaches receiving waters (Nettech litter socks, or Stormwater Systems Pratten Traps on outlets, or proprietary devices such as CDS units.	Nettech 20000ea Prattern 2500ea	17500	
Sedimentation	Vinegar Creek, Bonny Hills	Silt accumulation	Education and Enforcement of erosion control procedures on building sites, home gardens, etc	NA	5000	2001
			Investigate sealing of road shoulders to minimise erosion	20000	1000	2001/02
			Investigate potential for installation of silt traps	2000	NA	2002/03

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	**Operating (pa)**	
Localised Flooding from stormwater						
Flooding	Only if Lake entrance is closed and water levels build up	Saltwater Creek, Bonny Hills – due to siltation under bridge in Beach Street halved capacity of bridge.	Selective dredging of accumulated material under bridge in Beach Street and of the beach			
Habitats						
Changed Habitat Conditions	Aquatic habitats and SEPP 14 wetlands deteriorating	Stormwater runoff	Ensure stormwater system maintenance and works do not impact on aquatic or terrestrial habitats			
Environmental Weeds	Lake Cathie, Panorama Dr low points(Bonny Hills), Fiona Cres (Lake Cathie), runoff from Ocean Dr.	Bitou Bush, Lantana	Undertake weed control	20000	5000	2003/04
	Lake Cathie/Lake Innes, Upstream in catchment, Creek near Hill St/Jordan Ave, Bonny Hills	Garden escapees	Promote plating of native species	NA	NA	2001/02
Erosion						
Erosion		Beach erosion from stormwater outfalls	Investigation of diversion of stormwater outfalls away from beach			
		Unsealed road shoulders	Investigate and seal high priority/high erosion road shoulders.	50000	1500	2003/04

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Aesthetics						
Aesthetics		Occasional Odour problems	Improve drainage to discourage stagnation of water.			
		Open channel, often with stagnant water				
Health & Safety						
Mosquito Breeding	Jabiru Park,Cathie Channel, Lake Innes	Due to low lying, stagnant waterways	Review design guidelines & maintenance practices	2000		
Open Channels	Rainbow BeachOcean Drive	Open channel with steep banks, and children's playground adjacent	Regrade banks	10000	1000	2002/03
			Relocate playground equipment to another area of reserve.	5000	NA	2004/05
Sewage Leakage	'Stinky Corner', Lake Cathie, Mulloway Rd, behind Community Hall, Vinegar Creek, Bonny Hills	Overflows during heavy rain	Review infiltration into sewage system	NA	NA	
Community awareness						
Community Awareness	Impact on Community Health and Safety	Little communication from Council	Implement education programs such as streamwatch or Yellow Fish Road	5000	1000	2002
	Northern side of Lake Cathie (Kenwood Drive, Lakeview Woods), Mulloway Rd. Saltwater Creek – siltation causing pooling	Community involvement decreases with effort required	Use local media to report on stormwater issues, including good news stories	NA	NA	2001

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
	Mulloway Rd, behind Lake Cathie Community Hall	Lack of community education programs re: litter, fertilisers, pets, car washing, etc.	Encourage/enforce correct car washing practices, and disposal of garden wastes	NA	1500	2001/02
			Discourage hosing down of shop fronts	NA	1500	2001
Lack of planning						
Planning Issues	Bonny Hills	Lack of inter-lot drainage	Council's planning and assessment processes should address potential stormwater issues with new development.			
Lack of Regulatory documentations		No DCP'S	Implementation of a DCP similar to Newcastle City Council's DCP 50, dealing with stormwater run-off from new development	10000	NA	
		No LEP provisions	Council's planning and assessment processes should address potential stormwater issues at new developments.			
		Limited policy Lack of Planning No trunk drainage strategies No maintenance strategies No Section 94 Plans	Review with other factors, when Council's Management Plan is next reviewed	NA	NA	
Lack of Maintenance						

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Maintenance	Catchment wide	Lack of street cleaning	Increase frequency of street cleaning in areas with high litter/leaf litter generation	220000	10000	
		Siltation under bridge	Undertake selective maintenance dredging under bridge in Beach Street			

WAUCHOPE

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Decreased Water Quality						
Nutrients	Catchment wide	Car washing Detergents Lawn fertilising	Education regarding appropriate use of fertilisers, car washing, and disposal of garden wastes.	1000	1000	2001
		Dog droppings	Supply bins and plastic bags in popular dog walking areas for disposal of droppings.	5000	1500	2001/02
Turbidity	Yippin Creek Hastings River, Blackbutt Ck	Increased due to insufficient erosion control on new development	Education/enforcement of builders, home gardeners, erosion control practices	NA	5000	2001
		Due to red soils of Comboyne Region	Investigate potential for installation of silt traps within catchments	2000	NA	2002/03
Litter	Particularly on highway and main roads CBD Blackbutt Ck., Cameron St.	Roadside litter	Rigorous enforcement of littering laws	5000	1000	2001

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
		Commercial litter – drink bottles, plastic bags, cigarette butts, etc	Education programs such as Yellow Fish Rd., or targeting tourist activities.	5000	1000	2002
			Install devices to trap litter before it reaches receiving waters (Nettech litter socks, or Stormwater Systems Pratten Traps on outlets, or proprietary devices such as CDS units.	Nettech 20000ea Prattern 2500ea		
Industrial Pollution	Wauchope Industrial area	Need to ensure controls are in place	Rigorous enforcement of regulations such as POEO Act (1997)			
Suspended Solids	New waste disposal site at Pembroke	Car washing in streets	Education regarding car washing practices	NA	1500	2001/02
	Catchment wide CBD	Cleaning of shop-fronts	Discourage "hosing down" of shop fronts	NA	1000	2001/02
Grease and Oil Pollution	Catchment wide	Run-off from roads, carparks, workshops	Install CDS unit or similar for carparks			
		Road side spillage and accidents, railway line	Ensure businesses and industries have appropriate control measures in place			
Localised flooding from stormwater						
Flooding	Eastern end of High Street adjacent to Timbertown Kitchens and Brandston's floorcoverings	Localised flooding from urban stormwater	Encourage onsite stormwater detention storage and re-use	500000	5000	2006
			Augmentation of the stormwater system			
			Increased maintenance to reduce pipe blockages			

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Impact on Aquatic and Terrestrial Habitats						
Environmental Weeds infest riparian vegetation	Catchment wide, eg. Blackbutt Ck – Mahogany Way	Disposal of garden wastes	Education programs regarding disposal of garden wastes	1000	1000	2001
			Encourage planting of native garden species.	NA	NA	2001
			Promote Landcare activities	NA	NA	2001
Erosion						
Erosion	Blackbutt Ck, Cameron St, Blackbutt Rd, Allan Rd & Mahogany Dr, upper Yippin Ck catchment	Stock on creek/river banks	Discourage stock access to river banks	NA	1500	Ongoing Every 3 yrs
		Unsealed road verges	Investigate areas of unsealed road verges			
		Removal of native vegetation	Replanting of bare soil			
		Inefficient erosion controls on new development/construction activities	Educate builders and homeowners and enforce correct erosion control procedures	NA	5000	2001
Impact on aesthetics						
Aesthetics	Blackbutt Ck. – Cameron St. Blackbutt Road, Allan Road and Mahogany Drive Particularly in upper Yippin Creek catchment	Current structures could be improved to improve aesthetics	Augmentation of stormwater system and vegetation of channels			
		Litter decreases aesthetics	Education and more rigorous enforcement of littering regulations	5000	1000	2001
Community Health & Safety						

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Mosquito Breeding		Stagnant water, permanent water bodies	Improve drainage to discourage the stagnation of water			
Safety		Open flood channel	Install signs warning of dangers associated with flood waters	1000	500	2002
			Restrict access to most dangerous sites			
Sewage Leakage (COUNCIL IS ADDRESSING THIS)	Blackbutt creek – through Golf Course/Timbertown/sportsfield Outlet into river, CBD	Surcharges through manholes during heavy rain	Undertake smoke and dye testing to identify illegal stormwater connections			
	Impact on Community Health and Safety		Sewerage system augmentation			
Lack of community awareness						
Community Awareness	Low lying areas	Lack of awareness of risks associated with high flows and flooding	Implement education programs such as streamwatch or Yellow Fish Road	5000	1000	2002
	Blackbutt Creek, through sports field, Cameron Street	Lack of involvement/apathy	Use local media to report on stormwater issues, including good news stories	NA	NA	2001
		Little publicity regarding stormwater management issues and practices	Encourage correct car washing practices, and disposal of garden wastes	NA	1500	2001
Lack of Planning						

ISSUE	LOCATIONS	CAUSE	OPTIONS	COST		TIMEFRAME
				Capital	Operating (pa)	
Planning Issues	Golf course	Lack of drainage infrastructure	Investigate opportunities for the improvement of infrastructure			
Lack of Regulatory documentations	Catchment wide	No LEP provisions	Council's planning and assessment processes should address potential stormwater issues with new development.			
		Limited policy Lack of Planning No trunk drainage strategies No maintenance strategies No Section 94 Plans	Review other factors, when Council's Management Plan is next reviewed	NA	NA	
		No DCP'S	Implementation of a DCP similar to Newcastle City Council's DCP 50, dealing with stormwater run-off from new development	10000		
Lack of Maintenance						
Maintenance	Catchment wide	Council operations and maintenance crews use incorrect procedures and do not clean up properly	Internal education programs within council regarding correct erosion control and clean up procedures		1000	ongoing
		Lack of maintenance due to funding constraints	Direct more funds towards stormwater issues and maintenance			

NOTE: Educational options are highlighted in the above table and these are presented in a separate table below.

EDUCATION PROGRAMS

By examining the above table it becomes clear that an education program in Port Macquarie would be very efficient in terms of stormwater management. Education is beneficial and educational to both, the community and Council staff. In addition, education programs do not need to be expensive and may involve a wide variety of tasks such as enforcement of littering laws, promoting Landcare activities and involving schools in water quality monitoring programs.

It should be remembered that part of the Port Macquarie population is immobile and thus education and awareness programs need to be target specific. Port Macquarie is also a major tourist area, with litter increasing during tourist seasons. Thus, the education program in terms of litter may seem pointless, however it should be remembered that stormwater management is being implemented in the whole of NSW and eventually will tie in throughout the state.

Below is a list of education components that were recommended for the Hastings area, outlining approximate costs. Suggested approaches for education programs can be found in later sections of this report.

Education programs are by no means fixed but evolve over time, depending on community needs and expectations and also on varying environmental conditions.

The following education program is designed to target the whole Hastings Shire to ensure a holistic approach to stormwater management.

In addition, education programs need to target the wide variety of community members and should thus be composed of various components.

Educational options	**Capital cost**	**Operating cost**
Rigorous enforcement of **littering laws**	15000	3000
Education programs such as **Yellow Fish Rd**., and targeting tourist activities.	15000	3000
Education of business owners/operators in terms of **chemical storage** and disposal, equipment washing, etc.	3000	500
Education program targeting **pet owners**.	NA	4500
Education regarding appropriate use **of fertilisers, car washing, and disposal of garden wastes.**	NA	4500
Council could introduce a **green waste collection** program either through supply of green waste bins, or periodic kerbside collections	15000	4500
Implement a tree **planting program** by planting of appropriate trees/shrubs along stormwater system/revegetation of denuded creek banks	20/tree	NA

Educational options	**Capital cost**	**Operating cost**
Education and Enforcement of **erosion** control procedures on building sites, home gardens, etc	NA	15000
Remove **noxious weeds** as education by doing	20000	5000
Promote and support the efforts of urban **Landcare** groups	NA	NA
Install **signage** warning of dangers of entering drains/structures.	30000	3000
Use local media to report on stormwater issues, including good news stories	NA	NA
Supply bins and **plastic bags** in popular dog walking areas for disposal of droppings.	15000	4500
Promote planing of **low maintenance ,native garden species**	**NA**	NA
Encourage onsite stormwater **detention storage and re-use**	**NA**	NA
Discourage **stock** access to river banks	NA	1500
Internal education programs within council regarding correct erosion control and clean up procedures	NA	3000
Discourage **hosing** down of shop fronts	NA	4500
Promote water sensitive urban design	NA	NA
TOTAL COST	**113,000**	**56,000**

EDUCATION EXAMPLES

Stormwater Management in Florida:

Public Education - The Stormwater/NPS Management Section staff give numerous slide presentations each year on the impacts of stormwater and the proper management of stormwater. These presentations are given to local elected officials, the general public, and civic groups. Staff also participate in several workshops each year on the design of effective stormwater treatment systems that are held by professional organizations, such as the Florida Chamber or the Florida Engineering Society. Staff also use the Enviroscape watershed landscape to give presentations to school children, helping them to learn some of the basic concepts of watershed management and how they can help to reduce pointless personal pollution in their communities.

Florida Erosion, Sediment, and Stormwater Control Inspector Training Program Using Section 319 grant funds, the Stormwater/NPS Management Section has developed and implemented a training program for public and private sector staff involved in the inspection of erosion, sediment, and stormwater controls. This program is designed to improve the construction and maintenance of BMPs during and after construction. It was developed to address the state stormwater program's biggest deficiency – inspections to assure proper long-term operation and maintenance of BMPs. The course materials consist of a curriculum notebook, 12 hours of instructional presentations on videotape, a half-day review class, and an instructor manual. The program is implemented cooperatively by DEP and local governments providing for statewide implementation of the program with delivery at the local level.

BMPs for Urban Development Florida's growth management and urban stormwater management programs rely on both nonstructural and structural BMPs for controlling nonpoint source pollution and protecting designated uses of water bodies from Florida's rapid urbanization. Nonstructural BMPs are those that can be used to prevent the generation of NPS pollutants or to limit their transport off-site. They also are called "source controls". Florida's growth management program requires the use of nonstructural BMPs such as land use management, preservation of wetlands and floodplains, minimizing impervious surfaces. In general, these BMPs help to promote "low impact development" or "conservation design". Other nonstructural BMPs that are widely used throughout Florida include street sweeping, proper use and disposal of fertilizers and pesticides, and public education programs. The Florida Yards & Neighborhoods program is an excellent example of a nonstructural program that is helping to minimize the use of pesticides, fertilizers, and irrigation water by educating citizens and builders about the use of native plants.

Technology-based structural BMPs also are required on all new developments and redevelopments to help mitigate the increased stormwater peak discharge rate, volume, and pollutant loading that accompanies urbanization. The most widely structural BMPs used in developing areas include retention or infiltration areas, wet detention ponds, constructed wetlands, sand filters, bioretention areas, vegetated buffer strips along streams, and swales. Florida's urban and construction BMPs, both nonstructural and structural, are described in detail in the Florida Development Manual: A Guide to Sound Land and Water Management

TABLE 7.2: COST BENEFIT ANALYSIS WITH TOTAL SCORES

The table below is an expansion of table 7.2 (a). This table contains the options that Council wishes to implement over a 5-year expenditure period. Each option was linked to stormwater issues and options and. This allowed for the calculation of a total score (also called the benefit of the option) to be calculated. The calculation was undertaken as follows: the scores of the issues (see table 6.4) were added up and multiplied with the scored of the objectives (see table 6.2). The impact on the community was stated for each option. This is usually positive but may be negative if, for example, safety issues are increased when addressing other issues.

PORT MACQUARIE

OPTIONS	COST		LINK TO ISSUES	LINK TO OBJECTIVES	TOTAL SCORE	IMPACT ON COMMUNITY	TIMEFRAME
	Capital	Operating (pa)					
1. Rigorous enforcement of littering laws	5000	1000	Water quality 15 Aesthetics 1 Awareness 5	Water quality 927 Aesthetics 99 Awareness 145	(15 + 1 + 5) x (927 + 99 + 145) =24591	positive	2001
2. Education programs such as Yellow Fish Rd., or targeting tourist activities.	5000	1000	Water quality 15 Aesthetics 1 Awareness 5	Water quality 927 Aesthetics 99 Awareness 145	24591	Positive	2002
3. Undertake regular audits of industrial premises as part of trade waste program	NA	2000 every 3-5 yrs	Water quality 15	Water quality 927	13905	Positive	2001/02
4. Supply bins and plastic bags in popular dog walking areas for disposal of droppings.	5000	1500	Water quality 15	Water quality 927	13905	Positive	2001/02
5. Education program targeting pet owners.	1500	1500	Water quality 15 Awareness 5	Water quality 927 Awareness 145	21440	Positive	2001/02
6. Investigate potential sites for installing silt traps	2000	NA	Water quality 15	Water quality 927	13905	Positive	2002/03-2006/07

OPTIONS	COST		LINK TO ISSUES	LINK TO OBJECTIVES	TOTAL SCORE	IMPACT ON COMMUNITY	TIMEFRAME
	Capital	Operating (pa)					
7. Education of builders/concrete industry	1000	1000	Water quality 15 awareness 5	Water quality 927 Awareness 145	21440	Positive	2001/02
8. Education regarding appropriate use of fertilisers, car washing, and disposal of garden wastes.	1000	1000	Water quality 15 Awareness 5	Water quality 927 Awareness 145	21440	positive	2001
9. Sealing of road shoulders to minimise erosion (kerb & gutter)	500000	5000	Water quality 15 Erosion 20	Water quality 927 Erosion 767	59290	Positive	2001/02 to 2006/07
10. Construct groynes/riffle zones	20000	1000	Erosion 20	Erosion 767	15340	Positive	2006/07
11. Investigate possibility of vegetating drains for visual amenity	5000		Aesthetics 1	Aesthetics 99	99	Positive	2004/05
12. Promote water Sensitive Urban Design on new developments	NA	NA	Water quality 15 Aesthetics 1 Awareness 5	Water quality 927 Aesthetics 99 Awareness 145	24591	Positive	2003/04
13. Encourage planting of native species in gardens	NA	NA	Habitats 3	Habitats 687	2061	Positive	
14. Reduce the number of stormwater discharges into important habitat areas such as the wetland behind the racecourse.	60000	2000	Habitats 3	Habitats 687	2061	Positive	2006/07 med/long term
15. Install pollution control devices	50000	3000	Habitats 3	Habitats 687	2061	Positive	2006/07 med/long term

OPTIONS	COST		LINK TO ISSUES	LINK TO OBJECTIVES	TOTAL SCORE	IMPACT ON COMMUNITY	TIMEFRAME
	Capital	Operating (pa)					
16. Fence off most dangerous areas Minimise the number of stormwater channels discharging onto the beaches in future	100000 NA	2000-03-23 maintenance NA	Health & safety 2	Health & safety 604	1208	Positive	2006/07
17. Increase water depth of detention ponds (this may increase the safety issue)	20000	10000	Health & safety 2	Health & safety 604	1208	May be negative if the safety issue is increased	1 area /yr ongoing
18. Discourage hosing down of shop fronts	NA	1500	Awareness 5	Awareness 145	725	positive	2001
19. Extend/augment drainage system to avoid inundation of reserve	300000	5000	Planning 10	Optimal infrast. 245	2450	Positive	2002/03
20. Investigate priorities for stormwater flow reduction through on-site detention, or construction of major detention/retention basins	2000	NA	Planning 10	Optimal infrast. 245	2450	Positive	2006 (maybe one or two per yr)
21. Education and Enforcement of erosion control procedures on building sites, home gardens, etc	1000	1000	Planning 10 Awareness 5	Awareness 145 Optimal infrast. 245	5840	Positive	Ongoing Every 3-5 yrs
22. Increase preparedness for potential accidents, spills by educating industries re: drainage networks	1000	2000	Planning 10	Optimal infrast. 245	2450	Positive	Ongoing Every 3 – 5 yrs
23. Develop LEP provisions, Amend Subdivision Code 94	20000	NA	Planning 10	Optimal infrast. 245	2450	Positive	2001/02

OPTIONS	COST		LINK TO ISSUES	LINK TO OBJECTIVES	TOTAL SCORE	IMPACT ON COMMUNITY	TIMEFRAME
	Capital	Operating (pa)					
24. Consider the findings of Flood Studies in planning and decision-making processes.	NA	NA	Planning 10	Optimal infrast. 245	2450	Positive	ongoing
25. Divert more rates towards stormwater maintenance strategy (this is a funding issue)	NA	200000	Planning 10	Optimal infrast. 245	2450	Positive	ongoing
26. Seek low cost/low maintenance solutions to stormwater issues	NA	NA	Planning 10	Optimal infrast. 245	2450	positive	ongoing

CAMDEN HAVEN

OPTIONS	COST		LINK TO ISSUES	LINK TO OBJECTIVES	TOTAL SCORE	IMPACT ON COMMUNITY	TIMEFRAME
	Capital	Operating (pa)					
27. Drainage to be constructed first at new development sites (ie amend codes & policies & erosion control)	NA	NA	Water quality 8	Water quality 1075	8600	positive	2001/02
28. Education and Enforcement of erosion control procedures on building sites, home gardens, etc	NA	5000	Water quality 8 Awareness 10	Water quality 1075 Awareness 930	8840	Positive	2001 ongoing & catchment wide
29. Supply bins and plastic bags in popular dog walking areas for disposal of droppings.	1000	1000	Water quality 8 Awareness 10	Water quality 1075 Awareness 930	8840	Positive	2001/02

OPTIONS	COST		LINK TO ISSUES	LINK TO OBJECTIVES	TOTAL SCORE	IMPACT ON COMMUNITY	TIMEFRAME
	Capital	Operating (pa)					
30. Education regarding appropriate use of fertilisers, car washing, and disposal of garden wastes.	1000	1000	Water quality 8 Awareness 10	Water quality 1075 Awareness 930	8840	Positive	2001
31. Rigorous enforcement of littering laws	5000	1000	Water quality 8 Awareness 10	Water quality 1075 Awareness 930	8840	Positive	2001
32. Education programs such as Yellow Fish Rd., or targeting tourist activities.	5000	1000	Water quality 8 Awareness 10	Water quality 1075 Awareness 930	8840	Positive	2002
33. Investigate potential for installation of silt traps	2000	NA	Water quality	Water quality 1075	8600	Positive	2002/03
34. Undertake weed control	20000	5000	Habitats 4	Habitats 930	3720	positive	2003/04
35. Promote Landcare groups and activities	NA	NA	Habitats 4 Awareness 10	Habitats 930	3720	Positive	2001
36. Replant areas with native vegetation	10000	1000	Habitats 4 Awareness 10	Habitats 930 Awareness 930	2604	Positive	2002/03
37. Use local media to report on stormwater issues, including good news stories	NA	NA	Awareness 10	Awareness 930	9300	Positive	2001/02
38. Encourage/enforce correct car washing practices, and disposal of garden wastes	NA	1500	Awareness 10	Awareness 930	9300	positive	2001/02

LAKE CATHIE/BONNY HILLS

OPTIONS	COST		LINK TO ISSUES	LINK TO OBJECTIVES	TOTAL SCORE	IMPACT ON COMMUNITY	TIMEFRAME
	Capital	**Operating (pa)**					
39. Promote low maintenance, native garden species	NA	NA	Water quality 8 Awareness 10	Water quality 860 Awareness 830	13520	Positive	2001/02
40. Education with regard to appropriate fertiliser use	1000	1000	Water quality 8 Awareness 10	Water quality 860 Awareness 830	13520	Positive	2001
41. Install GPT	30000	3000	Water quality 8	Water quality 860	8660	Positive	2001/02
42. Supply bins and plastic bags in popular dog walking areas for disposal of droppings	5000	1500	Water quality 8	Water quality 860	8660	Positive	2001/02
43. Rigorous enforcement of littering laws	5000	1000	Water quality 8 Awareness 10	Water quality 860 Awareness 830	13520	Positive	2001
44. Education programs such as Yellow Fish Rd., or targeting tourist activities.	5000	1000	Water quality 8 Awareness 10	Water quality 860 Awareness 830	13520	Positive	2002
45. Education and Enforcement of erosion control procedures on building sites, home gardens, etc	NA	5000	Water quality 8 Awareness 10	Water quality 860 Awareness 830	13520	Positive	2001
46. Investigate sealing of road shoulders to minimise erosion	20000	1000	Water quality 8	Water quality 860	8660-	Positive	2001/02
47. Investigate potential for installation of silt traps	2000	NA	Water quality 8	Water quality 860	8660	Positive	2002/03
48. Undertake weed control	20000	5000	Habitats 4	Habitats 965	3860	Positive	2003/04
49. Promote plating of native species	NA	NA	Habitats 4 Awareness 10	Habitats 965 Awareness 830	25130	Positive	2001/02
50. Investigate and seal high priority/high erosion road shoulders.	50000	1500	Erosion 5	Erosion 830	4150	Positive	2003/04

OPTIONS	COST		LINK TO ISSUES	LINK TO OBJECTIVES	TOTAL SCORE	IMPACT ON COMMUNITY	TIMEFRAME
	Capital	Operating (pa)					
39. Promote low maintenance, native garden species	NA	NA	Water quality 8 Awareness 10	Water quality 860 Awareness 830	13520	Positive	2001/02
40. Education with regard to appropriate fertiliser use	1000	1000	Water quality 8 Awareness 10	Water quality 860 Awareness 830	13520	Positive	2001
41. Install GPT	30000	3000	Water quality 8	Water quality 860	8660	Positive	2001/02
42. Supply bins and plastic bags in popular dog walking areas for disposal of droppings	5000	1500	Water quality 8	Water quality 860	8660	Positive	2001/02
43. Rigorous enforcement of littering laws	5000	1000	Water quality 8 Awareness 10	Water quality 860 Awareness 830	13520	Positive	2001
44. Education programs such as Yellow Fish Rd., or targeting tourist activities.	5000	1000	Water quality 8 Awareness 10	Water quality 860 Awareness 830	13520	Positive	2002
45. Education and Enforcement of erosion control procedures on building sites, home gardens, etc	NA	5000	Water quality 8 Awareness 10	Water quality 860 Awareness 830	13520	Positive	2001
46. Investigate sealing of road shoulders to minimise erosion	20000	1000	Water quality 8	Water quality 860	8660-	Positive	2001/02
47. Investigate potential for installation of silt traps	2000	NA	Water quality 8	Water quality 860	8660	Positive	2002/03
51. Regrade banks	10000	1000	Health & safety 4	Health & safety 740	2960	Positive	2002/03
52. Relocate playground equipment to another area of reserve.	5000	NA	Health & safety 4	Health & safety 740	2960	Positive	2004/05
53. Implement education programs such as streamwatch or Yellow Fish Road	5000	1000	Awareness 10	Awareness 830	8300	Positive	2002

OPTIONS	COST		LINK TO ISSUES	LINK TO OBJECTIVES	TOTAL SCORE	IMPACT ON COMMUNITY	TIMEFRAME
	Capital	Operating (pa)					
39. Promote low maintenance, native garden species	NA	NA	Water quality 8 Awareness 10	Water quality 860 Awareness 830	13520	Positive	2001/02
40. Education with regard to appropriate fertiliser use	1000	1000	Water quality 8 Awareness 10	Water quality 860 Awareness 830	13520	Positive	2001
41. Install GPT	30000	3000	Water quality 8	Water quality 860	8660	Positive	2001/02
42. Supply bins and plastic bags in popular dog walking areas for disposal of droppings	5000	1500	Water quality 8	Water quality 860	8660	Positive	2001/02
43. Rigorous enforcement of littering laws	5000	1000	Water quality 8 Awareness 10	Water quality 860 Awareness 830	13520	Positive	2001
44. Education programs such as Yellow Fish Rd., or targeting tourist activities.	5000	1000	Water quality 8 Awareness 10	Water quality 860 Awareness 830	13520	Positive	2002
45. Education and Enforcement of erosion control procedures on building sites, home gardens, etc	NA	5000	Water quality 8 Awareness 10	Water quality 860 Awareness 830	13520	Positive	2001
46. Investigate sealing of road shoulders to minimise erosion	20000	1000	Water quality 8	Water quality 860	8660-	Positive	2001/02
47. Investigate potential for installation of silt traps	2000	NA	Water quality 8	Water quality 860	8660	Positive	2002/03
54. Use local media to report on stormwater issues, including good news stories	NA	NA	Awareness 10	Awareness 830	8300	Positive	2001
55. Encourage/enforce correct car washing practices, and disposal of garden wastes	NA	1500	Awareness 10	Awareness 830	8300	Positive	2001/02
56. Discourage hosing down of shop fronts	NA	1500	Awareness 10	Awareness 830	8300	Positive	2001

WAUCHOPE

OPTIONS	COST		LINK TO ISSUES	LINK TO OBJECTIVES	TOTAL SCORE	IMPACT ON COMMUNITY	TIMEFRAME
	Capital	Operating (pa)					
57. Education regarding appropriate use of fertilisers, car washing, and disposal of garden wastes.	1000	1000	Water quality 8 Awareness 12	Water quality 460 Awareness 620	21600	Positive	2001
58. Supply bins and plastic bags in popular dog walking areas for disposal of droppings.	5000	1500	Water quality 8 Awareness 12	Water quality 460 Awareness 620	21600	Positive	2001/02
59. Education/enforcement of builders, home gardeners, erosion control practices	NA	5000	Water quality 8 Awareness 12	Water quality 460 Awareness 620	21600	Positive	2001
60. Investigate potential for installation of silt traps within catchments	2000	NA	Water quality 8	Water quality 460	3680	Positive	2002/03
61. Rigorous enforcement of littering laws	5000	1000	Water quality 8 Awareness 12	Water quality 460 Awareness 620	21600	Positive	2001
62. Education programs such as Yellow Fish Rd., or targeting tourist activities.	5000	1000	Water quality 8 Awareness 12	Water quality 460 Awareness 620	21600	Positive	2002
63. Education regarding car washing practices	NA	1500	Water quality 8 Awareness 12	Water quality 460 Awareness 620	21600	Positive	2001/02
64. Discourage "hosing down" of shop fronts	NA	1000	Water quality 8 Awareness 12	Water quality 460 Awareness 620	21600	Positive	2001/02

OPTIONS	COST		LINK TO ISSUES	LINK TO OBJECTIVES	TOTAL SCORE	IMPACT ON COMMUNITY	TIMEFRAME
	Capital	Operating (pa)					
65. Encourage onsite stormwater detention storage and re-use	500000	5000	Water quality 8 Awareness 12	Water quality 460 Awareness 620	21600	Positive	2006
66. Education programs regarding disposal of garden wastes	1000	1000	Habitats 6 Awareness 12	Habitats 620 Awareness 620	22320	Positive	2001
67. Encourage planting of native garden species.	NA	NA	Habitats 6 Awareness 12	Habitats 620 Awareness 620	7440	Positive	2001
68. Promote Landcare activities	NA	NA	Habitats 6 Awareness 12	Habitats 620 Awareness 620	2320	Positive	2001
69. Discourage stock access to river banks	NA	1500	Water quality 8 Awareness 12	Water quality 460 Awareness 620	21600	Positive	Ongoing Every 3 yrs
70. Install signs warning of dangers associated with flood waters	1000	500	Health & safety 4	Health & safety 650	2600	Positive	2002
71. Use local media to report on stormwater issues, including good news stories	NA	NA	Awareness 12	Awareness 620	7440	Positive	2001
72. Encourage correct car washing practices, and disposal of garden wastes	NA	1500	Awareness 12	Awareness 620	7440	Positive	2001
73. Internal education programs within council regarding correct erosion control and clean up procedures		1000	Awareness 12	Awareness 620	7440	Positive	ongoing

Options were tabulated into a 5-year expenditure program (see Appendix E) to compare expenditures for the next 5 years as shown in the graph below.

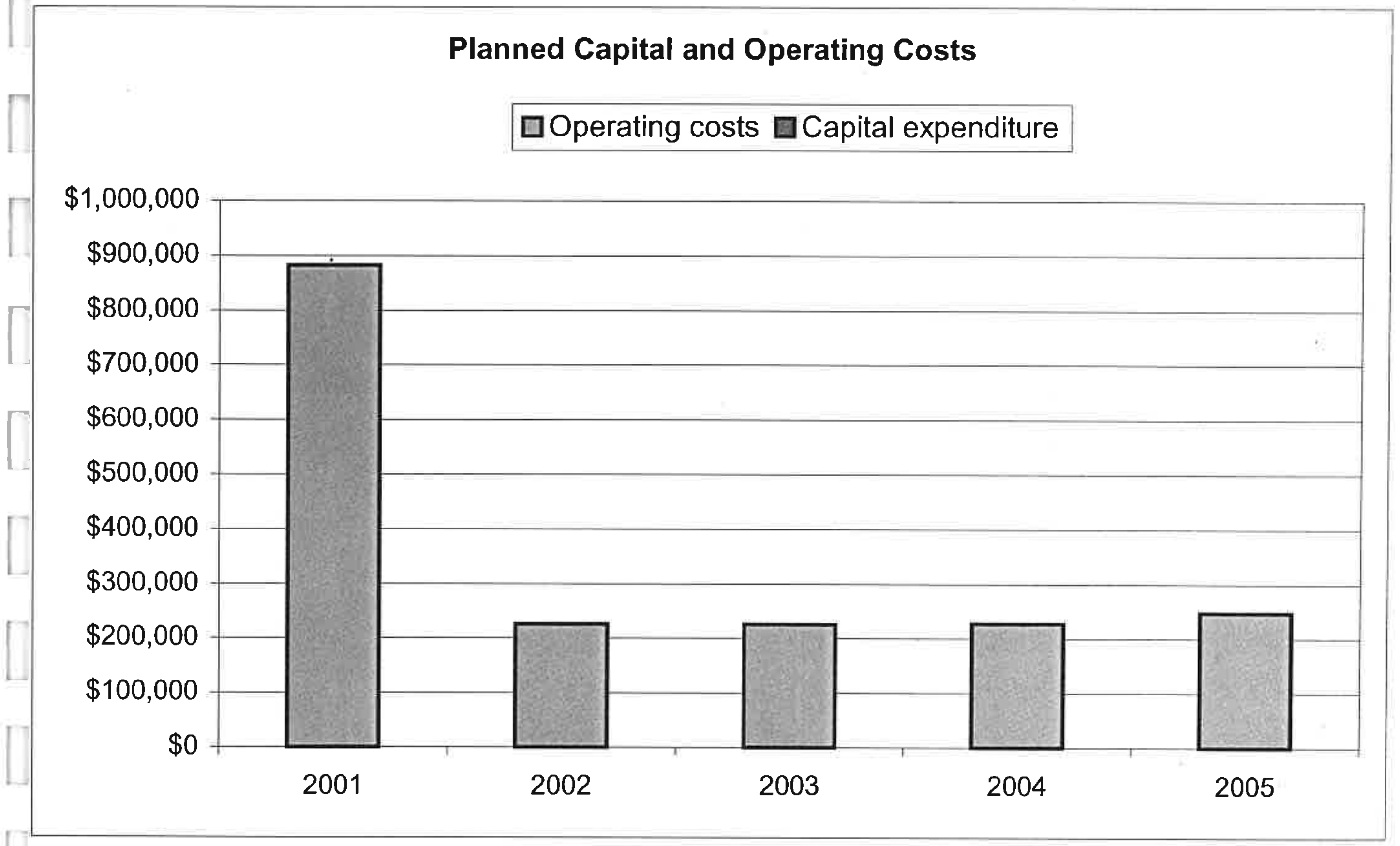


TABLE 7.3: COST-BENEFIT MATRIX

KEY: The option to the matching numbers can be found in Table 7.2.

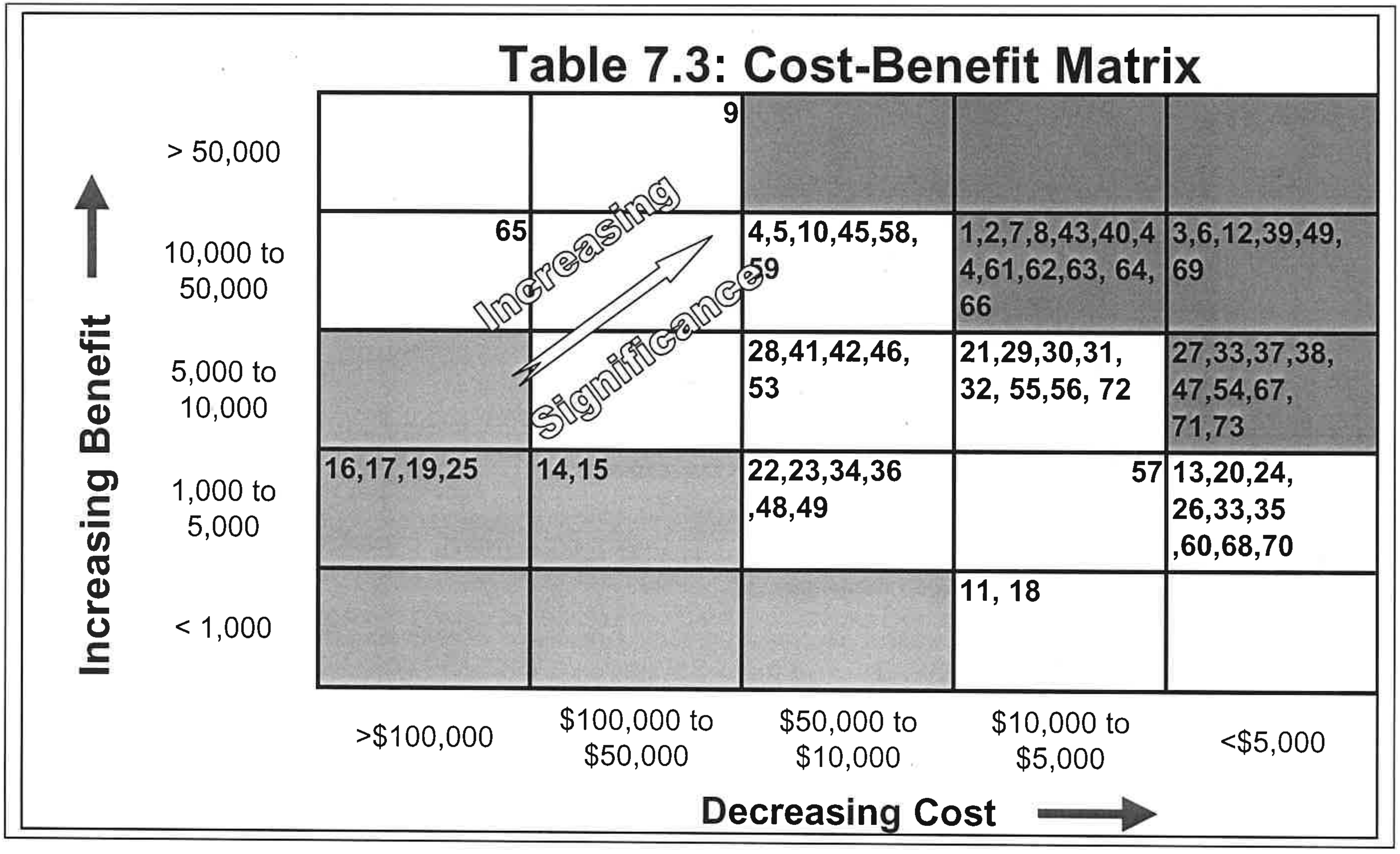


Table 7.3: Cost-Benefit Matrix

> 50,000		9			
10,000 to 50,000	65		4,5,10,45,58,59	1,2,7,8,43,40,44,61,62,63, 64, 66	3,6,12,39,49, 69
5,000 to 10,000			28,41,42,46, 53	21,29,30,31, 32, 55,56, 72	27,33,37,38, 47,54,67, 71,73
1,000 to 5,000	16,17,19,25	14,15	22,23,34,36,48,49	57	13,20,24, 26,33,35,60,68,70
< 1,000				11, 18	
	>$100,000	$100,000 to $50,000	$50,000 to $10,000	$10,000 to $5,000	<$5,000

8.0 IMPLEMENTATION STRATEGIES

The following strategies have been developed from the management options in section 8.0 and these focus on source control, practicality and cost-effectiveness. The strategies take into account stormwater values and objectives described in Sections 4.0 and 5.0. After evaluation of options (section 8.0), these options were translated into actions with accordance to budget, responsibility and timeframe, as outlined below.

Table 8.1: Stormwater Management Actions

PORT MACQUARIE

OPTIONS	COST		TIMEFRAME AND RESPONSIBILITY
	Capital	Operating (pa)	
1. Rigorous enforcement of littering laws	5000	1000	Council to enforce littering laws starting in the year 2001
2. Education programs such as Yellow Fish Rd., or targeting tourist activities.	5000	1000	Council in conjunction with DLWC to implement an education program, implementing programs such as the Yellow Fish Road by 2002
3. Undertake regular audits of industrial premises as part of trade waste program	NA	2000 every 3-5 yrs	Council to audit industrial premises by 2001/02
4. Supply bins and plastic bags in popular dog walking areas for disposal of droppings.	5000	1500	Council to supply bins and plastic bags in popular dog walking areas by 2001/02
5. Education program targeting pet owners.	1500	1500	Council to educate pet owners as part of the educational program by 2001/02
6. Investigate potential sites for installing silt traps (Hastings River and Kooloonbung Creek)	2000	NA	Council to investigate feasibility of installing silt traps by 2002/03-2006/07
7. Education of builders/concrete industry	1000	1000	Council to educate builders as part of the education program by 2001/02
8. Education regarding appropriate use of fertilisers, car washing, and disposal of garden wastes.	1000	1000	Council to implement an education program by 2001
9. Sealing of road shoulders to minimise erosion (kerb & gutter) in Ocean Drive, Lake Rd, Koala Rd	500000	5000	Council to seal road shoulders in problem areas from 2001/02 to 2006/07
10. Construct groynes/riffle zones in the rainforest reserve in Lighthouse Beach	20000	1000	Council to construct groynes/riffle zones by 2006/07
11. Investigate possibility of vegetating drains for visual amenity under the wharf near the Fisherman's Co-op and along Kooloonbung Creek	5000		Council to investigate the possibility of vegetating drains by 2004/05

OPTIONS	COST		TIMEFRAME AND RESPONSIBILITY
	Capital	Operating (pa)	
12. Promote Water Sensitive Urban Design on new developments	NA	NA	Council to promote Water Sensitive Urban Design by 2003/04
13. Encourage planting of native species in gardens	NA	NA	Council to encourage planting of native trees as part of the education program by 2001.
14. Reduce the number of stormwater discharges into important habitat areas such as the wetland behind the racecourse.	60000	2000	Council to reduce the number of stormwater discharges into important habitats by 2006/07
15. Install pollution control devices behind the race-course	50000	3000	Council to install pollution control devices by 2006/07
16. Fence off most dangerous areas and minimise the number of stormwater channels discharging onto the beaches in future	100000 NA	2000-03-23 maintenance NA	Council to fence off most dangerous areas by 2006/07
17. Increase water depth of detention ponds on the playground (this may increase the safety issue)	20000	10000	Council to increase the water depth of detention ponds (1 area /yr, Ongoing)
18. Discourage hosing down of shop fronts	NA	1500	Council to discourage hosing down of shop fronts as part of the education program by 2001
19. Extend/augment drainage system to avoid inundation of reserve	300000	5000	Council to extend/augment drainage system by 2002/03
20. Investigate priorities for stormwater flow reduction through on-site detention, or construction of major detention/retention basins	2000	NA	Council t investigate stormwater flow reduction by 2006 (maybe one or two per yr)
21. Education and Enforcement of erosion control procedures on building sites, home gardens, etc	1000	1000	Council to enforce erosion control procedures as part of an education program (Every 3-5 yrs)
22. Increase preparedness for potential accidents, spills by educating industries re: drainage networks	1000	2000	Council to increase preparedness for potential accidents, spills (Ongoing, every 3 – 5 yrs)
23. Develop LEP provisions, Amend Subdivision Code 94	20000	NA	Council to develop LEP provisions and Amend Subdivision Code 94 by 2001/02
24. Consider the findings of Flood Studies in planning and decision-making processes.	NA	NA	Council to consider findings of Flood Studies (ongoing)
25. Divert more rates towards stormwater maintenance strategy (this is a funding issue)	NA	200000	Council to divert more rates towards stormwater maintenance (Ongoing)
26. Seek low cost/low maintenance solutions to stormwater issues	NA	NA	Council to seek low cost/low maintenance solutions (ongoing)

CAMDEN HAVEN

OPTIONS	COST		TIMEFRAME
	Capital	Operating (pa)	
27. Drainage to be constructed first at new development sites (ie amend codes & policies & erosion control)	NA	NA	Council to ensure that stormwater drains are constructed early at new development sites by 2001/02
28. Education and Enforcement of erosion control procedures on building sites, home gardens, etc	NA	5000	Council to enforce erosion control procedures as part of an education program by 2001 (ongoing & catchment wide)
29. Supply bins and plastic bags in popular dog walking areas for disposal of droppings.	1000	1000	Council to supply bins in popular dog walking areas by 2001/02
30. Education regarding appropriate use of fertilisers, car washing, and disposal of garden wastes.	1000	1000	Council to implement an education program by 2001
31. Rigorous enforcement of littering laws	5000	1000	Council to enforce littering laws as part of an education program by 2001
32. Education programs such as Yellow Fish Rd., or targeting tourist activities.	5000	1000	Council in conjunction with DLWC to implement education programs such as the Yellow Fish Road by 2002
33. Investigate potential for installation of silt traps in Watson Taylor Lake and Googly's Lagoon	2000	NA	Council to investigate potential for installing a silt trap by 2002/03
34. Undertake weed control in David Cambell Drive, North Haven	20000	5000	Council and local environmental groups to undertake weed control by 2003/04 (this may be part of an education program)
35. Promote Landcare groups and activities	NA	NA	Council to promote Landcare groups and activities by 2001
36. Replant areas with native vegetation in David Cambell Drive, North Haven	10000	1000	Council and local environmental groups to undertake weed control by 2002/03 (this may be part of an education program)
37. Use local media to report on stormwater issues, including good news stories	NA	NA	Council to use the local media to report on stormwater issues by 2001/02
38. Encourage/enforce correct car washing practices, and disposal of garden wastes	NA	1500	Council to enforce correct practices as part of an education program by 2001/02

LAKE CATHIE/BONNY HILLS

OPTIONS	COST		TIMEFRAME
	Capital	Operating (pa)	
39. Promote low maintenance, native garden species	NA	NA	Council to promote planting of suitable trees as part of an education program by 2001/02

40. Education with regard to appropriate fertiliser use	1000	1000	Council to implement an education program by 2001
41. Install GPT immediately downstream of Ocean Drive (stinky corner)	30000	3000	Council to install a GPT by 2001/02
42. Supply bins and plastic bags in popular dog walking areas for disposal of droppings	5000	1500	Council to supply bins and plastic bags in popular dog walking areas by 2001/02
43. Rigorous enforcement of littering laws	5000	1000	Council to enforce littering laws as part of an education program by 2001
44. Education programs such as Yellow Fish Rd., or targeting tourist activities.	5000	1000	Council in conjunction with DLWC to implement education programs such as the Yellow Fish Road by 2002
45. Education and Enforcement of erosion control procedures on building sites, home gardens, etc	NA	5000	Council to enforce erosion control as part of an education program by 2001
46. Investigate sealing of road shoulders to minimise erosion in Vinegar Creek, Bonny Hills	20000	1000	Council to investigate sealing of road shoulders to minimise erosion by 2001/02
47. Investigate potential for installation of silt traps in Vinegar Creek, Bonny Hills	2000	NA	Council to investigate potential of installing a silt trap by 2002/03
48. Undertake weed control in Lake Cathie, Panorama Drive, Fiona Cres	20000	5000	Council with local environmental groups to undertake weed control by 2003/04 (this may be part of an education program)
49. Promote plating of native species in Lake Cathie, Panorama Drive, Fiona Cres	NA	NA	Council to promote planting of suitable garden species by 2001/02
50. Investigate and seal high priority/high erosion road shoulders.	50000	1500	Council to investigate the sealing of high priority road shoulders by 2003/04
51. Regrade banks	10000	1000	Council to regrade banks by 2002/03
52. Relocate playground equipment to another area of reserve.	5000	NA	Council to relocate the playground by 2004/05
53. Implement education programs such as streamwatch or Yellow Fish Road	5000	1000	Council in conjunction with DLWC to implement education programs such as the Yellow Fish Road by 2002
54. Use local media to report on stormwater issues, including good news stories	NA	NA	Council to use local media to report on stormwater issues by 2001
55. Encourage/enforce correct car washing practices, and disposal of garden wastes	NA	1500	Council to enforce correct practices as part of an education program by 2001/02
56. Discourage hosing down of shop fronts	NA	1500	Council to discourage hosing down of shop fronts by 2001

WAUCHOPE

OPTIONS	COST		TIMEFRAME
	Capital	Operating (pa)	
57. Education regarding appropriate use of fertilisers, car washing, and disposal of garden wastes.	1000	1000	Council to implement an education program by 2001
58. Supply bins and plastic bags in popular dog walking areas for disposal of droppings.	5000	1500	Council to supply bins and plastic bags in popular dog areas by 2001/02
59. Education/enforcement of builders, home gardeners, erosion control practices	NA	5000	Council to implement an education program about correct erosion control procedures by 2001
60. Investigate potential for installation of silt traps within Yippin Creek, Hastings River and Blackbutt Ck.	2000	NA	Council to investigate the potential for installing silt traps by 2002/03
61. Rigorous enforcement of littering laws	5000	1000	Council to enforce littering laws as part of an education program by 2001
62. Education programs such as Yellow Fish Rd., or targeting tourist activities.	5000	1000	Council in conjunction with DLWC to implement an education program such as the Yellow Fish Road by 2002
63. Education regarding car washing practices	NA	1500	Council to educate the community about correct practices by 2001/02
64. Discourage “hosing down” of shop fronts	NA	1000	Council to discourage hosing down of shop fronts as part of and education program by 2001/02
65. Encourage onsite stormwater detention storage and re-use	500000	5000	Council to encourage onsite detention storage and reuse by 2006
66. Education programs regarding disposal of garden wastes	1000	1000	Council to implement education programs such as education about disposal of garden waste by 2001
67. Encourage planting of native garden species.	NA	NA	Council to encourage planting of appropriate trees by 2001
68. Promote Landcare activities	NA	NA	Council to promote Landcare activities by 2001
69. Discourage stock access to river banks	NA	1500	Council to discourage stock access to river banks (Ongoing)
70. Install signs warning of dangers associated with flood waters	1000	500	Council to install stormwater signage by 2002
71. Use local media to report on stormwater issues, including good news stories	NA	NA	Council to use the local media to report on stormwater issues as part of an education program by 2001
72. Encourage correct car washing practices, and disposal of garden wastes	NA	1500	Council to encourage correct practices by 2001

OPTIONS	COST		TIMEFRAME
	Capital	Operating (pa)	
73. Internal education programs within council regarding correct erosion control and clean up procedures	NA	1000	Council to undertake some internal education (ongoing)

SUMMARY OUTCOMES OF THE COST-BENEFIT ANALYSIS:

- Through the cost-benefit analysis it became apparent that not all options area feasible for the stormwater management in the Hastings area. The implementation strategy thus filtered out the most significant options.
- Options were widely spread in the cost-benefit matrix which allows Council to choose the most feasible and beneficial options
- For the Port Macquarie area the most significant options ie. Those that were highly recommended were: education, auditing the industrial area, installing a silt trap and promoting water sensitive urban design on new developments.
- For Camden Haven, the most highly recommended options were to construct stormwater drains early during the new development stages, investigation of installing a silt trap and education.
- Similarly for Lake Cathie/Bonny Hills the most significant options were education and investigating the possibility of installing a silt trap.
- Education was highly recommended for Wauchope.
- In summary, the most highly recommended option for all areas was the implementation of an education program. This program consists of various components described both in the table above and in the following section of this report.

Below is a summary of options, which are common for all areas and the link to the issues they address are also shown.

GENERIC OPTIONS (COMMON TO ALL AREAS)

ISSUE	OPTIONS
WATER QUALITY EROSION AESTHETICS AWARENESS PLANNING HABITATS SAFETY	Education programs such as Yellow Fish Rd., tree planting programs, or targeting tourist activities, littering laws, business owners, pet owners, fertiliser usage, erosion control on building sites, install waring signs, tree planting, use local media to report on stormwater issues, educate industries about drainage network, promote Landcare, promote low maintenance, native garden species, discourage "hosing down" of shop fronts
WATER QUALITY	Install devices to trap litter before it reaches receiving waters (Nettech litter socks, or Stormwater Systems Pratten Traps on outlets, or proprietary devices such as CDS units.
PLANNING	Implementation of a DCP similar to Newcastle City Council's DCP 50, dealing with stormwater runoff from new developments

ISSUE	OPTIONS
WATER QUALITY AESTHETICS PLANNING MAINTENANCE FLOODING	Increase frequency of maintenance of the stormwater system (eg. GPT, street sweeping)
WATER QUALITY	Supply bins and plastic bags in popular dog walking areas for disposal of droppings.
WATER QUALITY	Investigate potential for construction of silt traps

IMPLEMENTATION

Effective stormwater management should aim at an innovative, site-specific approach. An integrated approach is required to ensure effective implementation to maximise pollutant removal, minimise cost and reduce maintenance burdens.

Both deficiencies in current stormwater management practices and a guideline for future management and improvement of the stormwater system have been addressed in the implementation strategy.

All stormwater work should be carried out in accordance with Water Sensitive Urban Design. It refers to minimising the impact of development on the water cycle, and maximising the multiple use benefits of a stormwater system. The following info is from an EPA handbook:

All structural options have taken into consideration the principle of water sensitive urban design.

WATER SENSITIVE URBAN DESIGN

This principle is based on minimising the impact of development on the total water cycle and maximising the multiple use benefits of a stormwater system.

The overall goals of water sensitive urban design are:

- preservation of existing topographic and natural features, including watercourses and wetlands
- protection of surface water and groundwater resources
- integration of public open space with stormwater drainage corridors, maximising public access, passive recreational activities and visual amenity.

The broader principles of water sensitive urban design include:

- minimising impervious areas
- minimising use of formal drainage system (eg. pipes)
- encouraging infiltration (where appropriate)
- encouraging stormwater reuse

Water sensitive urban design principles can be adopted at a range of development scales, including:

- the overall extent of proposed development areas
- the road and block layout within a development
- development forms on individual blocks

Potential water sensitive design techniques include:

- Inclusion of natural habitats (eg.watercourse) within the development area, primarily within open space areas. This includes the provision of buffer zones adjacent to watercourses and other waterbodies
- Integration of major (above ground) stormwater systems as positive features within the urban design rather than purely functional elements to be 'hidden' (eg. avoiding back fences adjacent to drainage reserves)
- Adoption of water sensitive road development standards. These can include reduced pavement widths and the use of grass swales in place of kerb and gutter and piped stormwater drains
- Use of compact development forms. For example, reducing individual block sizes and increasing communal open space (and stormwater drainage) areas to achieve the same density as a standard residential development
- Water sensitive car park design. This can include substitutes for impervious surfaces such as pavers or reinforces grass, particularly in infrequent used parking areas. Runoff can also be managed by grass swales instead of kerb and gutter and piped drainage systems, and the infiltration of runoff can also be considered.
- (Source: Managing Urban Stormwater: Source Control)

The focus of the actions should be in the following hierarchy: to retain/restore valuable features of the water environment, to control pollution at its source and to implement "end of pipe" solutions. This should also include both structural and non-structural solutions.

This Stormwater Management Plan is designed to be implemented in conjunction with other plans such as the Estuary Management Plan, Kooloonbung Creek catchment Management Action Plan, SOE Report, etc. and it should work closely with existing local projects.

It is advised that this SMP is reviewed and revised on an on-going forum to ensure that actions are implemented and that actions do indeed improve stormwater management to the satisfaction of both the Council and the community. Regular meetings will aid, as does the involvement of other groups such as Total Catchment Committees, Estuary Committees, etc.

8.2 MANAGEMENT STRATEGY

The implementation plan aims at identifying areas of approval and the establishment of a monitoring and review phase. It will enable the Hastings Council to outline a financial program, identifying major capital investment time and cost. From the cost-benefit analysis it became evident that the management strategy should focus on the mitigation of identified high priority issues.

Hastings Council may also gain increased community support and participation through the establishment of a public information framework relating to stormwater issues and concerns within Hastings's urban stormwater catchment.

The following section is an expansion or explanation of some of the options mentioned earlier and will outline details of some of the possible non-structural options for Council to follow.

Non-Structural Measures

8.2.1 Street Sweeping

Roads, carparks and footpaths make up approximately 70% of urban impervious surfaces, and are a major area of pollutant accumulation (VSC, draft 1998). Street sweeping is widely adopted in Newcastle to prevent street borne pollutants entering the stormwater system. However, there is an opportunity to enhance the effectiveness of street sweeping by specifically targeting 'hot spots' and/or increasing the frequency of sweeping operations.

It is considered that for street sweeping to prevent gross pollutants from entering the stormwater system, the sweeping needs to occur before each rainfall event. Given that rainfall in Port Macquarie occurs regularly, street sweeping would need to occur on a daily basis to be effective.

Commercial areas are considered to generate the highest amount of street litter. Therefore, these areas should be swept as a priority over other areas.

Council is undertaking street sweeping at present which is a fairly cost effective method of reducing pollutants. However, various methods of control may be required in conjunction.

Could street sweeping be the simple solution to all stormwater problems? Of course not, since the solution to this complicated problem involves more than just water quality. However, for our urban waterways that receive a large dose of pollutant runoff, this may be the most effective pollution reduction technique ever conceived. So much discussion and regulatory effort is devoted to controlling pollution from new developments. But even in a rapidly growing area new development represents only a small portion of the area that drains to our streams. What do we do about improving the situation in areas already extensively developed? High-efficiency sweeping may be one important part of the solution. Hence, this issue is devoted to new developments in sweeping, which professionals who are involved in this subject are calling high-efficiency sweeping.

Using a street sweeper to clean a street is the preferred over flushing. However, only one type of street sweeper will actually get the street clean. That type of sweeper has been referred to as a "high efficiency sweeper" since by definition it is highly efficient in picking up a large portion of the very fine particulate material found accumulated on street surfaces.

This material commonly referred to as "street dirt" is highly contaminated with all of the pollutants found in stormwater runoff. As such, the street dirt that accumulates on impervious areas such as streets, driveways and parking lots that are directly connected to the urban waterways via a storm sewer system, have been identified over and over again as the primary source of urban nonpoint pollutants entering the waterways of the nation.

The ability of a street sweeping operation to reduce the overall pollutant washoff loads depends on several things. First is the street sweeper's innate ability, when operated properly, to remove accumulated sediment. Another is the environmental dynamics of sediment accumulation and resuspension, and of sediment washoff during storm events plus suspended sediment removal by downstream water quality controls (source; http://www.mrse.org?stormwater).

8.2.2 Creek Rehabilitation

Rehabilitation of actively eroding creek banks will stop on-going supplies of sediment to the stormwater system. Works required to rehabilitate creek banks would include reshaping of the banks to a gentler slope, and stabilisation of these banks with native grasses and shrubs. Removal of weeds from within and around these waterways would also minimise organic loads entering the stormwater system.

8.2.3 Implement A Public Education Program

A proportion of pollution that occurs in urban areas is directly attributable to community ignorance. Many people do not understand that stormwater runoff drains to the surrounding waters with little or no treatment prior to discharge. It is a common misconception that stormwater runoff goes to a sewage treatment plant, as is in many overseas countries where 'combined' systems are used. Also, the local community does not generally understand the impacts that litter, sediment, detergents and fertilisers can have on the quality and amenity of receiving waters.

Public education campaigns, which may include public displays, advertisements, letter drops and brochures, are an effective method for increasing public awareness, and as such, could be incorporated into an overall pollution control strategy.

Some common measures adopted for raising public awareness regarding stormwater include:

- Advertising in local papers, ie mayoral messages
- Leaflets sent out with rates notices
- Interpretive signage near existing and future structural measures (eg GPT's)

- Encourage litter collection facilities in private business localities

School students could also be used to continue the study of gross pollutants in the creek, with follow up audits, cleaning of mangrove areas, and displays at local shopping centres.

Public education is an important part in stormwater management. This action provides ownership to the community by informing the community about values of a healthy, well-maintained stormwater system. Public interest will be encouraged through education and ensured community involvement in the stormwater process. Community education is now acknowledged at state and local level as an essential tool in achieving local environmental protection objectives. Environmental education promotes increased community knowledge and skills to effect change, by promoting ownership and participation (Tulau and Powell, 1999). Studies in the US have also demonstrated that broad-based education in focused areas is effective to reduce non-point source pollution.

The following are issues that should be addressed;

(a) Appropriate car washing:
  - washing cars on lawns and not on roadsides or driveways
  - prevent excess waste water from entering stormwater drains

(b) Appropriate litter disposal
  - educate community about effects and consequences of inappropriate litter disposal
  - outline correct litter disposal behaviour

(c) Appropriate waste oil and other chemical disposal
  - ensure the community is awareness of correct disposal for waste such as oil and other chemicals such as herbicides
  - provide oil disposal facilities at service stations
  - promote Hunter Water's free domestic chemical collection service

(d) Appropriate disposal of domestic animal droppings
  - encourage dog walkers to implement correct disposal of dog droppings
  - encourage appropriate disposal methods for households (compost bins, garbage bins, sewer)

(e) Appropriate garden and lawn maintenance
  - correct levels of fertiliser use in gardens
  - encourage use of low maintenance, native plant species
  - discourage hosing lawn clippings from entering the stormwater gutters

(f) Safety awareness
  - prevent contact with high velocity stormwater flows

8.2.4 Encourage Public Involvement Stormwater Management

Community involvement will provide a sense of ownership to the community and will aid the management of the urban stormwater system. The value of the stormwater system will be increased with the community's desire to maintain a healthy stormwater system. Public involvement should be encouraged during all stages of the stormwater process, including planning, implementation and review stages.

Various programs such as Streamwatch and Landcare groups, School syllabus and community groups can be used to promote awareness and involvement of the community in managing and monitoring particular sections of the stormwater system.

8.2.5 Increase Number and Locations of Rubbish Bins

Additional rubbish bins at key locations within the catchment may reduce the amount of litter that enters the stormwater system at these sites. Key locations would include bus stops, railway stations, commercial areas, parks and reserves (ie any location where the public tend to congregate).

Some Councils, however, have taken steps in the opposite direction by removing all rubbish bins from the streets. These Councils consider that rubbish bins, even in public localities, actually attract household rubbish. The design of any future rubbish bins must prevent the disposal of large items and deter residents from dumping household rubbish nearby.

8.2.6 Sediment Erosion Control on Building Sites

Building sites are often targeted as significant sources of sediment within urban catchments. Given that most building sites are devoid of ground cover vegetation and contain stockpiles of erodable material, this focus can be considered warranted. Control of erosion on building sites is essential to ensuring that sediment loads entering the waterways are minimised.

Numerous publications outline ways in which sediment erosion can be controlled on building sites, and Council requires that erosion controls are implemented as a condition of all development consents. Developments, which do not controlling sediment erosion, are in breach of the conditions of DA approval, and should be fined or penalised accordingly.

8.2.7 Labelling Of Stormwater Pits with Slogans

An effective and economic method of increasing community awareness about stormwater management involves painting slogans or motifs on the concrete lintels at each kerb inlet pit throughout the catchment. Some Councils stencil the name of the receiving water of that drain, while others stencil images, such as platypuses, birds and fish.

It is believed that residents are less likely to discard pollutants to the stormwater system if they are aware of the consequences of their actions.

Stencilling labels near the stormwater pits with slogans such as

"Only rain down this drain"

The introduction of similar programs may encourage public awareness and decrease impacts of gross pollutants, grease and oils, nutrients and bacterial contamination. Local school, scouts and community groups may carry out the labelling with Hastings Council supplying the road marking spray paint.

Stencilling could be carried out on a voluntary basis by community groups or even school students. The figure below shows an example of a drain stencil, which has been successfully adopted, by the city of Portland, Oregon, USA.

The installation of storm drain plaques has proven to be an effective means of providing a pollution prevention message to citizens.
Plaque Installation SOP

Materials

- Plaques.

- Wire brush (or steel wool).
- Cloth (or whisk broom).
- Paper towels/disposable rags.
- Adhesive (Liquid Nails) or waterproof silicone adhesive.

Procedure

- Determine location(s)

Criteria:

- On top or face of a storm drain curb inlet.
- Populated area or an area where dumping is suspected.
- Flat concrete surface.
- Clearly visible.
- Dry surface and warm temperatures.
- Once location has been determined, use the wire brush to clean the surface and wipe any debris away using a cloth or broom. Do not use water or cleaning agents.
- Apply adhesive to the plaque (do not apply directly on the concrete surface). Start from the outside edge and work inward to the centre.
- Place plaque on the cleaned and dusted concrete surface.
- Slowly step on top of the plaque being careful not to slide it around on the curb inlet. This will help secure the plaque to the concrete surface.
- Wipe away any excess adhesive with paper towels, if necessary.

Time

Typically, it takes approximately 5 minutes to install a plaque.

Precautions When Using Adhesives

- Before using any adhesive, read and follow all instructions on the tube.
- Eye protection and gloves are suggested. If gloves are not used, clean hands thoroughly after using adhesive.
- Adhesives release solvents when used, so use only in well-ventilated areas.
- Vapours released from adhesives are flammable, do not smoke while using the Liquid Nails.

Recheck

On occasion, check the placement location to make sure that the plaque has not been damaged or stolen.

Other Considerations

- Overuse of the plaques in one area will not only cause an area to look "tacky," but will cause people to grow accustomed to the plaques' presence and not pay attention to them.

- Use only on public right of way (street curb areas). Do not place plaques on private property.
- Respect a citizen's request to not install a plaque in front of their home.
- Wear a high visibility safety vest and do not stand or work in the street while installing plaques. Remember safety first - it's dangerous out there!

On Ozone Action Days, restrict plaque installations to the afternoon or wait until another day. (http://ci.fort-worth.tx.us/dem/fishsign.htm)

Example of Drain Stencilling

Rather than stencilling new drains, Brisbane City Council (BCC) has taken the initiative to have all new drains imprinted with the slogan ‘DUMP NO WASTE – DRAINS TO CREEK’ during manufacturing. This way, on-going resources to paint and periodically re-paint stencils on individual drains are not required.

8.2.8 Yellow Fish Road

A program such as the Stormwater Industry Association (SIA) endorsed “Yellow Fish Road” Program could also be considered. This program, involving corporate sponsorship, combines drain stencilling activities with distinctive yellow fish shaped flyers for letter box drops. The program was first used in Canada and has been trialed and promoted by the SIA and Pittwater Council in Sydney.

Using the outline of a silver bream, a common fish species in Australia, the outline will be stencilled on drains and used to shape a brochure, which will be letter-boxed to every home in the district. The shape of the bream will soon become synonymous with the clean drain program and hopefully stop the dumping of harmful waste into stormwater drains.

The aim of the Yellow Fish Road program is to remind people that it is marine life that ultimately bears the impact of what is washed down into the drains.

This program has been proven successful in Canada, and has really raised the awareness of the community to pollution discharging to receiving waters via stormwater drains. This program does work by reaching all age groups, reducing pollution loads, especially litter, waste oils and garden chemicals and fertilisers being washed into creeks, rivers, lakes and the sea.

The outcomes usually include most people becoming aware that stormwater from private properties and from roads and footpaths carries litter, oil, detergents, animal faeces and grass clippings through street drains directly to our beaches and waterways.

The Stormwater Industry Association or SIA (Local Government) is interested to receive submissions from Local Government and associated community groups who would like to join the Yellow Fish Road program. Organisations must be able to demonstrate that they can co-ordinate the campaign within their catchment or municipality and make the program part of their environmental education awareness approach to their community. Submissions should be made written to SIA and may be made at any time. Successful applicants will receive a sponsored Yellow Fish Road Kit. **(Waterfall Journal, Autumn 1999)**

Sponsor Package

Each Sponsor will be asked to pay for the following package.

- 5000 fish fliers
- 250 posters
- 500 bumper stickers

Each sponsor is asked to have an active involvement in the launch of the program in each district / catchment, and SIA and Local Government and community group would try and maximise the media publicity to reach local schools and residents.

HAVE YOU SEEN THIS FISH?

Volunteers are doing something fishy on your street!

The Yellow Fish Road

Stormwater Drain Marking Program

They are painting yellow fish symbols next to stormwater drains. These remind you that unwanted litter and household products should not be dumped down stormwater drains. Do not dump litter, motor oil, paint thinner, pesticides, car cleaning products, pool chemicals, garden fertilisers and chemicals or other wastes into stormwater drains. Sweep up leaves and organic garden waste for your compost bin. Do not permit sand, soil or gravel to wash sediments down the drain.

Collect dog and cat litter and dispose in Council's waste collection, or bury in your garden or dispose of down the toilet. Wash your car on the grass – not on the driveway.

Only rainwater must enter stormwater drains

The Yellow Fish Road Stormwater Drain Marking Program is a Volunteer effort by people who care about their environment.

CSR Humes
Humecepter removes
Pollution that counts

Sponsored by
Stormwater

Promoted by
Pittwater Council

If you would like to assist with the program please contact the
Coastal Environment Centre,
PO Box 522 Narrabeen, NSW 2101.
Phone (02) 9970 6905

8.2.9 Streamwatch

Streamwatch is a dynamic environmental action network, educating and empowering communities to work together for healthy catchments.

Streamwatch is (quite simply) the world's most remarkable school and community water quality monitoring and action program.

Streamwatch is supported by Department of Land and Water Conservation, Hawkesbury Nepean Catchment Trust, Hunter Catchment Management Trust, Sydney Water, Upper Parramatta River Catchment Management Trust, and Waterwatch Australia. In NSW Streamwatch operates under the umbrella of NSW WaterWatch.

Streamwatch is a fabulous opportunity for schools and community groups to help improve the environment of their local area. Using state-of-the-art field testing kits, groups can carry out a range of scientific tests including phosphorus, dissolved oxygen, faecal coliform and lots more. The results are collated into a powerful database of water quality information.

Water bugs, frogs, algae and habitat are also monitored, providing groups with information on how healthy and productive their waterways are.

With a good understanding of the problems in their local rivers and creeks and the possible causes, Streamwatch groups can then spring into action.

Community awareness campaigns, creek clean-ups, drain stencilling; building artificial wetlands, and educating industry have all been popular and highly successful actions by Streamwatch groups.

Activities

In addition to the water quality testing programs, Streamwatch has some exciting new ways to act for the environment and have fun at the same time -

The Water Bug Survey
It's bug fever as thousands of schools and groups scan their waterways for those elusive bugs that reveal the health of streams. In 1997 over 20,000 people searched high and low for insects, crustaceans, molluscs, and worms. The survey is fun, and the results form an important snapshot of stream health across NSW.

Murder Under the Microscope

Murder Under the Microscope is a leading-edge technological eco-game played annually by hundreds of schools across Australia and even overseas. It's go, go, go and school against school as teams of eco-detectives uncover the evidence and probe the minds of a panel of environmental experts at 'Catchment Headquarters' to be the first to crack the environmental mystery.

Streamwatch 5-8

This is a three-part eco-adventure for school years 5-8. Part A is an eco-game: The Case of the Contaminated Catchment. Part B is a catchment role-play. Part C is a water testing activity using the special Streamwatch 5-8 testing kits. Training and support is offered to teachers as part of the program. (http://www.streamwatch.org.au).

8.2.10 Educational Games

"Splash"
Desdemona's "Splash" is a game about water quality and the environment. A free demo is available for download from http://www.epa.gov/OWOW/NPS/kids/splash/webpage2/

or the CD-ROM is available for purchase from the same site.

The game works by identifying actions that will pollute the stormwater in the city, neighbourhood or farm.

8.2.11 Posters/Brochures

Available from the EPA – relevant posters include
- Don't put plastics in the sea
- Everything we do…urban catchment management
- Know where it all goes

Brochures, leaflets and educational materials are also available (PH 131555)

8.2.12 Promotion of Public Access to the Stormwater System

Promoting public access to the stormwater system may develop a sense of ownership and an increased concern. If the community is involved in the process of stormwater management, they will feel responsible for the identification of potential problems and concerns.

8.2.13 Continue to Hold Workshops Involving all Relevant Stakeholders to Discuss the Process and Issues of the Stormwater System.

The ongoing consultation will ensure that all stakeholders are aware of their responsibilities and an active approach to ongoing stormwater management will be encouraged.

8.2.14 Continue To Hold Workshops Involving All Relevant Stakeholders To Discuss The Process And Issues Of The Stormwater System.

The ongoing consultation will ensure that all stakeholders are aware of their responsibilities and an active approach to ongoing stormwater management will be encouraged.

In conclusion, it is important to integrate both structural and non-structural option for best practice. For example, education alone is probably not significantly improving stormwater management but in correlation with other solutions it will. Port Macquarie's population mainly consists of housebound people; therefore the education needs to be target specific. The current community involvement should also be mentioned, ie. There is relatively little litter in town

8.2.15 Separate stormwater rate

Hastings Council explored the possibility for the charging of a special rate for drainage. The following needs to be considered:

To assess the options available it needs to be established whether the special rate for drainage will be levied on existing, or for an infrastructure, which is yet to be constructed.

Should the drainage special rate be intended to finance (or go towards financing) borrowings associated with plan or design works for a proposed drainage it would only be permissible to make and levy the rate via Section 495.

If this section were used for the making and raising of the rate Council would be required to form a certain "opinion" as to the land which will benefit from, contribute to the need for, or have access to the particular works which will be the subject of the rate.

In the resolution that makes a special rate, council must also state whether the special rate is to be levied on all rateable land in the area or only part of that land. Where the rate applies to only a part of the area, Council must also specify in the resolution the land to which the rate is to apply. This requirement is mandatory so as to affect the validity of the rate.

Section 501of the Act provides that Council is empowered to make and levy an "annual charge" for a number of different services which include, drainage services. It is generally held that these types of charges are relevant to situations where infrastructures relevant to the service has not yet been constructed.

As Section 501 charges are subject to rate pegging, it would be necessary to obtain Ministerial approval for a special variation for the raising of the additional charge.

Under Section 552(4) of the Local Government Act, 1993 a special rate or charge relating to drainage may be levied on rateable land that is within the basin served by the drainage works. It is noted from the Council Rating and Revenue Raising Manual that it is considered that the charge would only be able to be levied if the infrastructure to which the special rate (or charge) is already in place.

Prior to the initial charge being made and levied it would be necessary to identify all affected lands and publish an appropriate notice in the Government Gazette. Notice regarding any extensions of the drain, which may occur, would also need to be published in the Government Gazette prior to the levying of the special rate.

It would appear that funding from the environmental levy has already allocated. Accordingly it may be contended that Council is "double dipping" by charging ratepayers in urban areas twice for drainage works. A copy of the report is attached for your information.

Further, as a condition of development approval for new subdivisions Section 64 or 94 contributions for stormwater management may be sought. It could therefore be argued that these properties should not be subject to the special rate for drainage as they have already discharged any obligation for stormwater management.

There are a number of implications in respect of this matter. These include;

- Receiving approval from the Minister for Local Government for a special variation to permit the making and levying of the drainage rate.

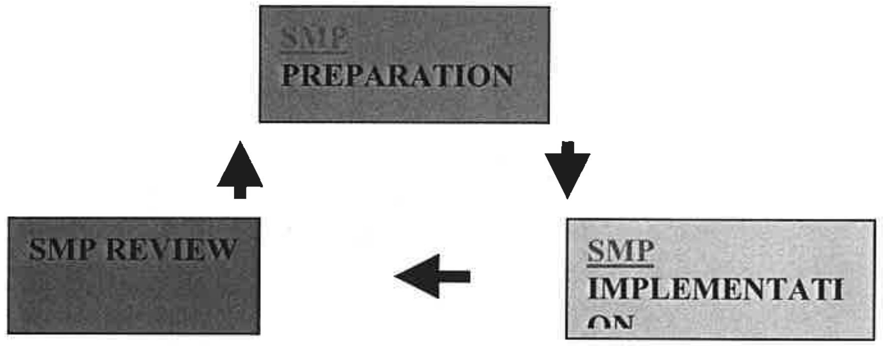
- Receiving approval from the Minister for Local Government to increase the current level of the Environmental Levy above the normal allowable level by way of a special variation.

9.0 MONITORING AND REPORTING

Revision of the Stormwater Management Plan is a crucial part in stormwater management plan to ensure its effectiveness in years to come. Environmental conditions and uses of the catchment will change over time and this SMP should be flexible to evolve with these changes. A typical stormwater management loop is illustrated in Figure 9.1.

The three components of a monitoring program are sampling, testing, and reporting. None of them are overly complex, but since every Structural Stormwater BMP is unique, there may be some variability in the physical testing configuration. In order to compare testing results from different technologies, there needs to be a common testing procedure.

Figure 9.1: Stormwater Management Loop.



The stormwater management loop shows how the preparation of the SMP, the implementation as per implementation strategy and the monitoring and review of the implementation measures all form part of stormwater management. This loop is continuous and needs to be updated on a regular basis.

9.1 MONITORING

Monitoring is an important tool in assessing the success of the Stormwater Management Plan. In constructing the catchment descriptions, it was found that quite a few data gaps existed. Monitoring can also help to fill these gaps and provide a base line data set. Monitoring should include water quality monitoring and should generally be undertaken in accordance with the principles outlined in the EPA's *Managing Urban Stormwater: Council Handbook* document.

Monitoring is a part of the urban stormwater management responsibilities to determine if actions and strategies are effective. The overall objectives should include minimisation of environmental impacts in accordance with the principles of Ecologically Sustainable Development and Total Catchment Management.

Monitoring programs should be specific to the project and may be undertaken in conjunction with neighbouring Councils. Council should incorporate stormwater monitoring in its "Works Improvement Program" or Council may with to publicise results in their SOE report. Monitoring programs should aim to be efficient and cost effective. Cost effectiveness can be ensured by involving the community and through observational monitoring.

Lack of monitoring and maintenance results in overgrown vegetation, accumulated sediment and debris, and deteriorated stormwater structures can greatly reduce effectiveness. Without maintenance on a regular basis, stormwater structures may not store, treat or convey stormwater according to design and purpose, and may require frequent repair or even replacement. Regular maintenance will allow structures to operate as designed for their maximum lifetime, enabling optimum flood control and water quality treatment as well as demonstrating to the community that stormwater capital investments are being protected in a systematic, responsible and cost-effective way.

The catchment health should be assessed and reviewed with the assistance of relevant community groups and government agencies. For example, Streamwatch and Landcare groups could be involved in observational water quality assessment, which is an effective tool in establishing the success of the Stormwater Management Plan. It is necessary to establish base line data and information on stormwater issues in Port Macquarie including photographic and water quality information.

The performance evaluation and reporting of the performance of the Urban Stormwater Management Plan will provide a review of recommendations and stormwater strategies so they remain valid and effective over time.

The review progress should be conducted on a regular basis against available base line data and against each objective.

Other catchment management responsibilities may include:

1) Carrying out of surveys every two years to assess the health of the catchment, pollution sources and to identify problems (erosion, weeds, litter, etc)
2) To monitor and report publicly on the performance of this Stormwater Management Plan every two years.
3) Provision of regular briefing to Council on progress against the plan and to develop more comprehensive objectives and targets for the plan when significant monitoring has been completed.

Council may wish to form a Stormwater Management Committee, which could include the following representatives:

- Director Environment & Planing Services
- Director Engineering Services
- Manager Works
- Manager Strategic Planning
- Manager Engineering & Infrastructure
- RTA Representative
- Community Members

- DLWC Representative

This committee could meet every 6 months to establish wether works are proceeding in accordance with the Implementation Strategy, schedule and budget.

Monitoring can be achieved through the following:

☐ observation based monitoring,
☐ ambient water quality monitoring,
☐ biological monitoring and recording progress of plan implementation.

Some of these do not require special training and the community/schools could be part of this. Reporting on the following may be achieved in this way:

- Litter, oil, algae, odour, water clarity, organic matter, aquatic plants, condition of riparian vegetation, fish abundance, bank erosion and sedimentation.
-

The survey form should include the following information:

- Location
- Date
- Time
- Weather Conditions
- Flow Conditions/Depth

10.1.1 Example of a Water Quality Monitoring Program

The more water samples are collected, the better chance we have of understanding the status of the water quality, and thus leading to better ways to manage the water at a high quality level for residents.

Why do we monitor water quality?

Water-monitoring programs provide valuable data on the water quality of the catchment, establishes a bank of knowledge and understanding on the natural quality of water. By increasing the amount of reliable data, more accurate assumptions on the natural water quality can be made. In addition, the community will show that they are proactive in the management of the catchment and its natural resources. It also provides the community with an understanding of how different soils, or management practices can influence the quality of water.

A water quality sampling recording sheet might look like the following table.

Location	Colour	Turbidity (NTU)	pH	Total Phosphorus (mg/l)	Nitrogen (mg/l)
Upstream of the urban catchment					
Near major outlets into the river					
Downstream of the					

urban area					
Any other locations of concern					

Note: Downstream of one town is upstream of another town and impacts on water quality in one town may therefore effect towns further downstream.

Addition sampling may be done for:
- Faecal Coliforms
- Chlorophyll-a
- Conductivity
- Dissolved oxygen
- Temperature

Before commencing water quality sampling, the following need to be established:
- Baseline water quality conditions (eg. ANZECC Guidelines)
- Determine how to link monitoring and looking at the performance of the existing stormwater management practices (ie. Does the education program improve water quality?)

With time, Council should consider wether there are catchment wide changes in water quality as a result of structural and non-structural measures implemented as part of the SMP.

10.1.2 Biological Monitoring

Biological monitoring will help in the understanding of the health of waterbodies and involves the collection of marine and freshwater biota from the waterbodies. The aim is to build a picture of the waterbodies over time so that when changes occur, the type, magnitude and frequency of that change can be easily monitored and possibly linked to a specific cause or causes.

9.2 REPORTING

The process of the implementation of the SMP and monitoring results of stormwater quality may be included in the Council's State of the Environment Report and it should be used as a valuable input into future improvements of stormwater management. The effectiveness of pollution control devices need to be highlighted to pinpoint any weaknesses of these and aid in improving its effectiveness as stormwater management is a long term process and requires a process of continuous improvement. Hence, the preparation of this SMP is only the first phase in the stormwater management process.

9.3 REVISION

This Plan should be reviewed in 3 years. The revision process will involve the assessment of the effectiveness of stormwater management options, ie. Do options satisfy the stormwater management objectives? The implementation strategy will aid Hastings Council in their management planning process in the future.

Revision can be undertaken in two different ways and timeframes:
(a) revise/re-issue the implementation strategies
(b) review/revise the SMP document

9.3.1 Revise/Re-issue Council Implementation Strategy

The Implementation Strategy is the basis for Council's and the RTA's stormwater management program and addressed each stormwater issue within the catchment in a cost-effective and community-beneficial manner.

The implementation strategy is dynamic and should evolve as stormwater works have been completed (and as issues have been addressed). New issues may arise and new strategies may need to be developed. The implementation strategies should be reviewed on an annual basis to identify progress and gaps in the program.

The review of the implementation strategy should consider:

- Results of any monitoring programs, ie. Water quality monitoring
- Any additional stormwater management option to be included in the plan

9.3.1 Review/Revise the SMP Document

Just as the implementation strategy is dynamic, objectives and issues are dynamic as well. The revision of the SMP is important to ensure that these are relevant and provide the necessary information for the Council's works program.

The revision/reviewing should take place as required with the exception of the implementation strategy, which should be revised more frequently. The review of the plan should involve:

- Results from any monitoring programs eg. water quality monitoring
- The effectiveness and efficiency of options implementation
- Document what objectives and issues have been addressed
- The effectiveness of satisfying the community's values
- Newly arising issues and objectives
- Improve the local understanding of issues within the catchment
- Identify if additional options need to be developed or if present options need to be modified

9.4 CONCLUSIONS

The preparation of this SMP was achieved through catchment inspections with Council, consultation and of the community, relevant agencies and the Council. This plan could not have been developed without the valuable local input from the stakeholders and the greatly appreciated cooperation of Council. Effort has been put into this plan to ensure that community values and concerns have been included and supported by stormwater managers.

This Stormwater Management Plan for the Hastings urban catchment provides an integrated scheme for the ecologically sustainable and cost-effective management of stormwater within the catchment that will both satisfy community's expectations and address environmental issues. The major part of this plan is the implementation strategy, which defined actions to be implemented by Hastings Council to address stormwater issues and objectives. The implementation strategy also prioritises work in terms of its cost and benefit to the community

Addressing stormwater within the catchment requires a long-term commitment by Council and cooperation of the community. It should be noted that stormwater management is an integral part of catchment management, as the activities of one town directly impact on (for example) water quality of the town downstream.

10.0 APPENDICES

APPENDIX A:
REFERENCES

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WA EPA (1994) **Planning and Management Guidelines for Water Sensitive Urban (residential) Design** Consultants Report, prepared by Whelans and Halpern Glick Maunsell

APPENDIX B:
PHOTOGRAPHIC RECORD

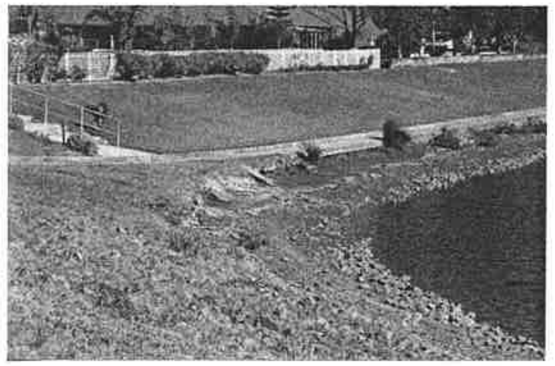
Note: The location of these photos can be found on the maps in Appendix ***

Port Macquarie

1. Erosion due to construction works

2. Mangroves - vegetation

3. Shopping trolley



4. Visual impact - erosion

5. Stormwater outlet in caravan park

6. Oxley beach Stormwater outlet – visual amenity, erosion

7. Oxley beach Stormwater outlet – visual amenity, erosion

8. Shelly Beach outfall

9. Siltation in stormwater channel

10. Erosion control on creek banks

11. Detention basin

12. Detention basin

13. The 2 branches of Wright's Creek meet – algae, siltation

14. Algae, silt, litter and accumulation of tree branches in stormwater channel.

15. Exotic plants on creek bank

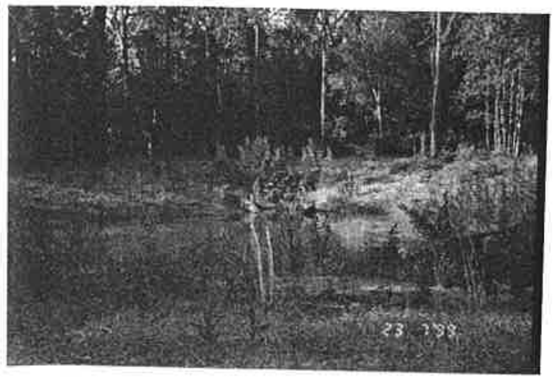
16. Cumbungi in creek

17. Creek with riparian vegetation

Lake Cathie

18. Tallong Rd – unsealed driveway, erosion

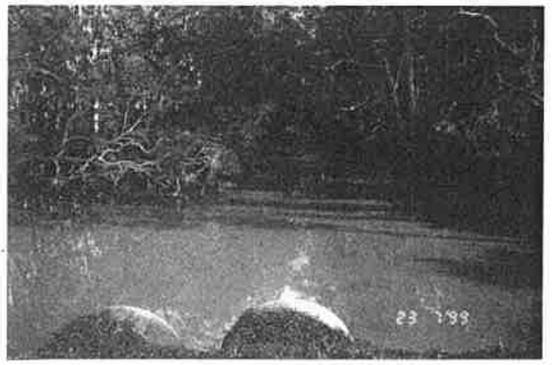
19. Detention Basin in new development – Lakeside Way



20. Detention Basin at end of Fisherman's Way

21. Stockpile with no silt fence, washing into stormwater pit

22. Erosion control on outlet, Lakeside Woods Estate



23. Bank erosion, Lakeside Woods Estate

24. Aqua Crescent – closed GPT

25. Outlet from GPT

26. Aqua Crescent – CDS Unit

27. No erosion control on new development – Abel Tasman Drive

Bonny Hills

28. Beach Street – natural stream, reeds, riparian vegetation

29. Culvert under Beach Street

30. Erosion of Beach Street

31. Garden Debris, Panorama Drive

32. Grass clippings, Panorama Drive

33.Weeds on creek banks – Hill Street/Gordon Avenue

34. Outfall onto beach

35. Pipes under Ocean Drive – silt

36. Other side of pipe of 35 silt, erosion, algae, bricks in creek from nearby pile

Wauchope

37. Stormwater channel – corner of Clareville Avenue and Bain Street – siltation, introduced species

38. Same as previous

39. Grass swale leading into stormwater channel and runs through to where the above 2 photos were taken – accumulation of litter.

40. Stormwater creek – bank erosion

41. Same as previous

42. Stormwater channel runs into underground drain – erosion and weeds are issues here

43. Same as previous

44. Same as previous but on the other side of the road, underground drain with grass swale on top

45. Stormwater channel with gabion to stabilise banks, a little bit of erosion where gabions end

46. INDUSTRIAL AREA – reeds in channel

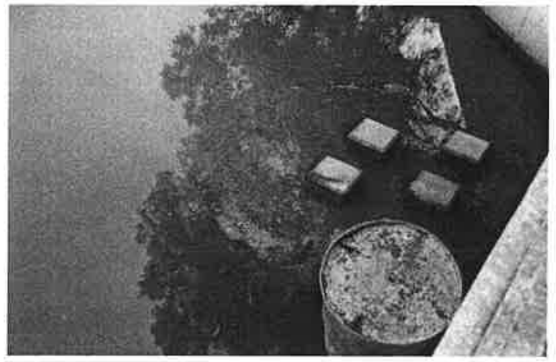
Camden Haven

47. Stormwater channel – siltation, bank erosion

48. Stormwater channel with wetland

49. Stormwater channel upstream from previous photo on the other side of the road

50. Small silt trap and trash rack behind Laurieton RSL Club



51. Same as previous – silt, leaf litter and a metal barrel in trap

52. Stormwater channel – erosion, introduced species

53. Siltation due to bank erosion, litter

54. Erosion control fence in creek

55. Stormwater outlet into river, Wauchope

Stormwater outlet into reserve, Wauchope
(Note the pristine conditions on this side of the stormwater outlet)

Stormwater outlet into Reserve, Wauchope
(Note the pollution on this side of the Stormwater Channel)

APPENDIX C:
ATTENDANCE LIST FOR WORKSHOPS

Wauchope

NAME	COMPANY/ORGANISATION	CONTACT NUMBER
Bruce Petersen	Hunter Water Corporation	(02) 49799593
Sandra Otto	HWC	(02) 49799709
Heath Carney	HWC	(02) 49799415
Kris Mitchell	Hastings Council	(02) 65818649
Cliff Toms	Hastings Council	(02) 65818560
Rudi Schmierer	Local resident	(02) 65852436
Bill Russel	Local Resident	(02) 65851336
Kim Steckelbruck	Local resident	(02) 65851224
Patrick McEntee	PMCS, HCHCMC	(02) 65876125 0412404923

Lake Cathie/Bonny Hills &Camden Haven

NAME	COMPANY/ORGANISATION	CONTACT NUMBER
Bruce Petersen	Hunter Water Corporation	(02) 49799593
Sandra Otto	HWC	(02) 49799709
Heath Carney	HWC	(02) 49799415
Kris Mitchell	Hastings Council	(02) 65818649
Cliff Toms	Hastings Council	(02) 65818560
Kerry Simmonds	Camden Haven Oyster QAP	(02) 65595912
Tony Troup	C.H Oyster QAP, CHEMC	(02) 65596678 (02) 65599821
Mavis Barnes	Local Resident	(02) 65594339
Sue Baker	Camden Haven Protection Society	(02) 65597134
Syd Murphy	Local Resident	(02) 65599102
Marie Murphy	Local Resident	(02) 65599102
Richard Ghamraoui	NPWS	(02) 65842203
Geoff Armstrong	Lake Cathie Progress Association	(02) 65854412
Don Hindson	Local Resident	(02) 65854083
Henry Williams	CHPS – Est.Mgt. Com.	(02) 65599973
Garry Fajks	CHSES	(02) 65594277
Jonathan Brickwood	Lake Cathie EMC	(02) 65871201
Murray Dalton	Murray Dalton & Associates	(02) 65599795
Kim Poole	Chairman Laurieton Fish co-op	(02) 65598070
Daphne Johnston	Lake Cathie EMC	(02) 65599940
Isabelle Lee	National Parks Association NSW	(02) 65598114

Port Macquarie

NAME	COMPANY/ORGANISATION	CONTACT NUMBER
Bruce Petersen	Hunter Water Corporation	(02) 49799593
Sandra Otto	HWC	(02) 49799709
Heath Carney	HWC	(02) 49799415
Kris Mitchell	Hastings Council	(02) 65818649
Cliff Toms	Hastings Council	(02) 65818560
Joan Wilson	Lake Cathie EMC	(02) 65832196
Gordon Dick	North Shore Progress Association	(02) 65850564
Stephen Skinner	Port Macquarie Landcare	0413665655
Maree Moore	Port Macquarie Oyster Farmer	(02) 65839040
Robert Herbert	Co-ordinator Hastings River Shellfish QAP	(02) 65832330
Roya; Pullen	Friends of Kooloonbung	(02) 65821669
Jim Newton	Hastings Construction Industry Association	(02)
Tony Nash	Hastings Council	(02)
Syd Hopkins	Hopkins Consultants	(02) 65836722
Paul Rowlandson	King & Campbell Pty. Ltd	(02) 65832666
Peter Jenkins	Hastings Council	(02) 65818592
Tony Green	Luke & Company	(02) 65832677
Geoff Metcalfe	Hastings Council	(02) 65818653
Frank Roberts	North Side Progress Association	(02) 65834385
Patrick McEntee	PMCS, HCHCMC	(02) 65876125 0412404923

APPENDIX D:

RESOURCES FOR IMPLEMENTATION AND LINK TO OTHER PLANNING DOCUMENTATIONS

To assists Council further in the implementation of the Stormwater Management Plans, a number of resource documents are available. These resources provide a guide into areas of stormwater management including source control techniques, construction activities, water sensitive urban design and treatment structures.

NSW Department of Housing (1998) Managing Urban Stormwater: Soils and Construction (3rd Edition)

The above document outline techniques for erosion and sediment control and protection of waterways, primarily during construction and new urban development. The documents include guidelines for on-site erosion control, and site rehabilitation after construction has been finalised.

NSW Environmental Protection Authority (1996) Managing Urban Stormwater: Treatment Techniques

This document outlines various structural treatment practices such as pollutant traps, wetlands and detention basins. The benefits and limitations of each technique are described along with other factors such as site constraints, to be considered in the selection of appropriate practices.

NSW Environmental Protection Authority (1998) Managing Urban Stormwater: Source Control (DRAFT)

Provides a guide to stormwater managers on a range of source control techniques that can be utilised to minimise the impacts on the stormwater environment. It provides guidance on choosing source controls, community education, Council activities such as maintenance and depot operations, urban land capability assessment and water sensitive urban design (WSUD) techniques.

NSW Environmental Protection Authority (1996) Solutions to Pollution: A Teaching and Learning Unit on Stormwater Issues (English Years 7-10)

NSW Environmental Protection Authority (1996) Solutions to Pollution: A Teaching and Learning Unit on Stormwater Issues (Science Years 9-12)

These educational units are targeted at high school students and aim to increase students' knowledge and understanding of the stormwater system and its link with water quality in local waterways, and to lead students to adopt appropriate habits to protect water quality. The units outline classroom activities for Science and English students, such as the identification of sustainable and unsustainable catchment management practices and ways to keep waterways clean. A number of other educational materials are available from the EPA, and are listed on the Internet site - http://www.epa.nsw.gov.au/pubslist.htm#water along with information about the EPA's "The drain is just for rain" education campaign http://www.epa.nsw.gov.au/drain_rain

Allison, R.A, Chiew, F.H.S & McMahon T.A (1998) A Decision Support System for Determining Effective Trapping Strategies for Gross Pollutants. CRC for Catchment Hydrology Report 98/3

This is one of three reports that describe a gross pollutant research study undertaken by the CRC for Catchment Hydrology. The study aimed to provide an understanding of the quantities and characteristics of gross pollutants and to assess various trapping techniques. The decision support system provides a method for comparing different approaches for trapping gross pollutants. A computer model for the assessment of trapping techniques is provided with the report.

Other resources from the CRC's web-site are available at:
http://www.catchment.crc.org.au

APPENDIX E
EROSION CONTROL AT NEW DEVELOPMENT SITES

The following information was taken from the EPA Stormwater website on erosion control:

Soil erosion on building sites can be a major source of sediment pollution in our waterways. In fact, a single building block can lose four truckloads of soil in one storm. Washed from the sites into stormwater drains this sediment is eventually deposited in creeks, rivers and lakes in the area. Although a single block of land may seem a small part of the river catchment, the cumulative effect of polluted runoff from a number of building sites can have a dramatic impact on water quality.

Who's responsible?

The owner and the builder are responsible for controlling soil erosion and preventing sediment from the building site from being washed into stormwater drains.

Under section 16 of the Clean Waters Act heavy fines, including a $600 on-the-spot fine, may be imposed if a person allows soil, earth, mud, clay, concrete washings or similar material to be washed, or placed in a position from where it is likely to be washed, into stormwater drains.

The following information applies to owner-builders or single building block construction sites.

The effect on the environment

There are a number of environmental problems directly associated with pollution from building sites.

•Water-carrying pollutants like soil and soil nutrients, as well as building materials such as concrete residues, runs off building sites and enters stormwater drains with subsequent pollution of natural watercourses. The changes to natural land surfaces and drainage patterns, which accompany urban development, can result in natural watercourses becoming turbid, silted, littered and undesirably enriched with nutrients. This nutrient-rich water often develops algal blooms. •When turbid water restricts sunlight filtration, photosynthesis is reduced and productivity of the aquatic ecosystem suffers. •Watercourses are subject to increased flooding and an increase in cross-sectional area where catchments have been cleared of vegetation. Subsequent flooding and erosion contribute to siltation problems downstream.

Controlling erosion

Management strategies to control site erosion and the water quality of runoff are determined by the following factors:

•Soil type •slope of site •site erosion hazard rating •surface rock •extent and duration of site disturbance •proximity of watercourses and drainage lines •sensitivity of receiving waters.

When the erosion hazard rating for the site is high or moderate, local councils often require a soil erosion and sediment control plan. Guidelines can be obtained from the Department of Land and Water Conservation. If the site has a low erosion hazard rating then general protection measures are required. These include preventative measures as well as appropriately placed and maintained sediment controls such as sediment traps and barriers, and silt fences and straw bales below fill batters or highly disturbed areas.

Pollution prevention measures

All building sites should adopt the following measures to prevent pollution:

•Restrict vehicle access to one stable entry and exit point •Preserve grassed areas and retain the maximum cover of natural vegetation by minimising the amount of land disturbed by shaping. Mulch or revegetate disturbed areas as soon as possible •Ensure that stockpiles of sand, gravel, soil and similar materials are located so that material :
- Does not spill onto the road or pavement
- Is not placed in drainage lines, depressions or watercourses
- Cannot be washed into roadways, drainage lines, depressions or watercourses

•Remove accidental spills of soil or other materials onto the roadway or gutter prior to completion of the day's work •Excess materials and water from cleaning tools and equipment should not be washed down stormwater drains •Locate houses and buildings on the site so that cut and fill operations are minimised and ensure that access driveways are no steeper than necessary •Minimise on-site vehicle activity during wet weather or when the site is muddy

More Information

For further information contact:

Environment Protection Authority (Pollution Line)
Phone: 131 555 (local call cost)
Fax: (02) 9325 5572

Department of Land and Water Conservation:
Phone: (02) 9228 6111
Fax: (02) 9228 6140

30 June 1998
FEEDBACK

APPENDIX F: 5-YEAR EXPENDITURE PROGRAM

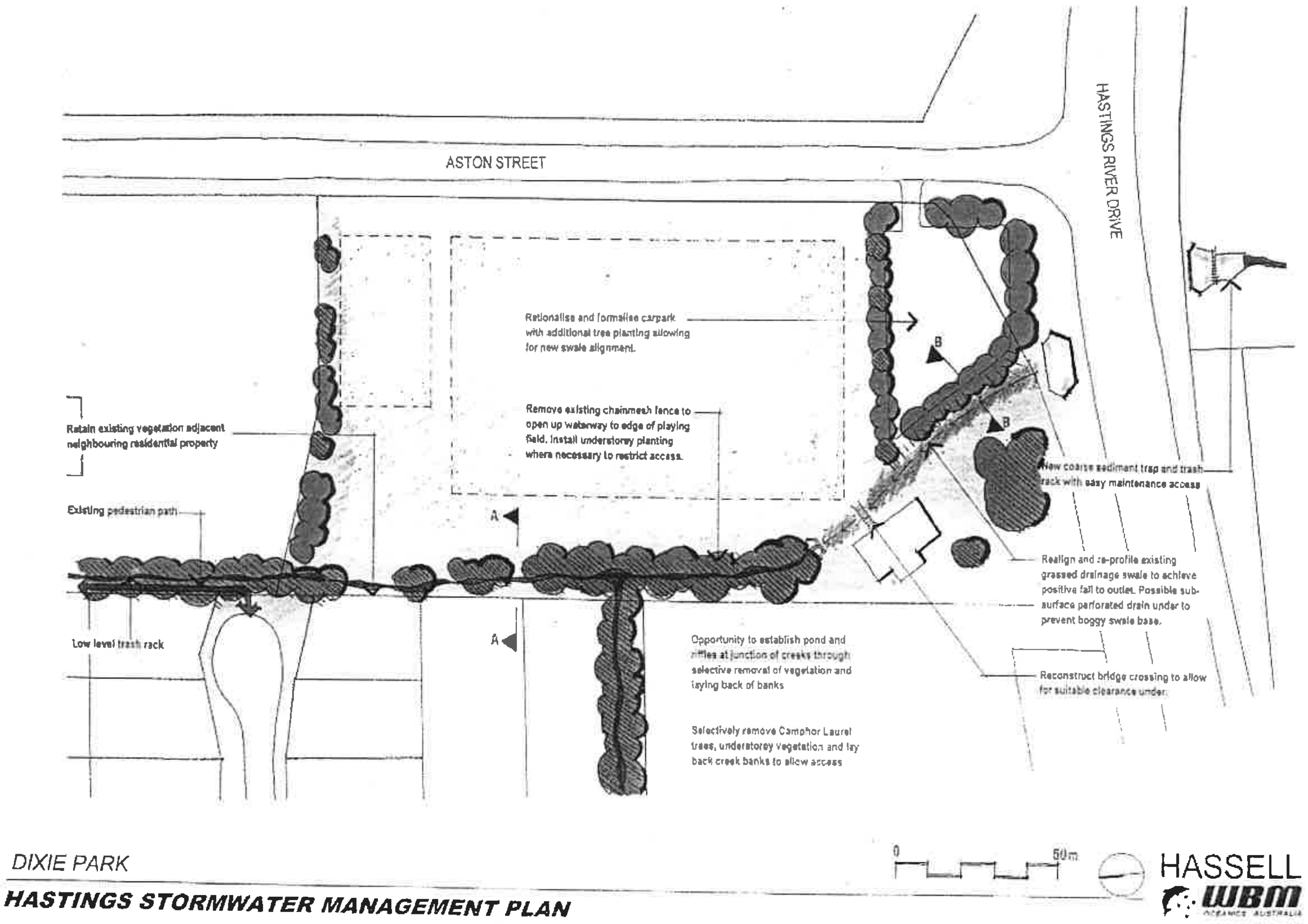
5 YEAR EXPENDITURE PROFILE

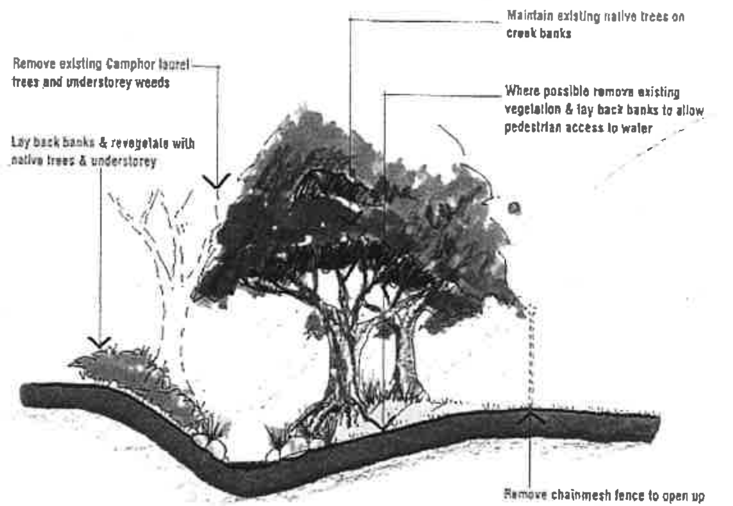
Job	Total exp.	Total exp	2001	2002	2003	2004	2005
1 - PM	10000	Capital	5000				
		Operating	1000	1000	1000	1000	1000
2	9000	Capital	5000				
		Operating		1000	1000	1000	1000
3	4000	Capital	NA				
		Operating	2000			2000	
4	12500	Capital	5000				
		Operating	1500	1500	1500	1500	1500
5	9000	Capital	1500				
		Operating	1500	1500	1500	1500	1500
6	2000	Capital	2000				
		Operating	NA				
7	6000	Capital	1000				
		Operating	1000	1000	1000	1000	1000
8	6000	Capital	1000				
		Operating	1000	1000	1000	1000	1000
9	55000	Capital	50000				
		Operating					5000
10	21000	Capital	20000				
		Operating					1000
11	5000	Capital	5000				
		Operating	NA				
12	0	Capital	NA				
		Operating	NA				
13	0	Capital	NA				
		Operating	NA				
14	62000	Capital	60000				
		Operating					2000
15	53000	Capital	50000				
		Operating					3000
16	102000	Capital	100000				
		Operating					2000
17	30000	Capital	20000				
		Operating					10000
18	7500	Capital	NA				
		Operating	1500	1500	1500	1500	1500
19	320000	Capital	300000				
		Operating		5000	5000	5000	5000
20	2000	Capital	2000				
		Operating		NA			
21	6000	Capital	1000				
		Operating	1000	1000	1000	1000	1000
22	11000	Capital	1000				
		Operating	2000	2000	2000	2000	2000
23	20000	Capital	20000				
		Operating	NA				
24	0	Capital	NA				

		Operating	NA				
25	1000000	Capital	NA				
		Operating	200000	200000	200000	200000	200000
26	0	Capital	NA				
		Operating	NA				
27 - CH	0	Capital	NA				
		Operating	NA				
28	25000	Capital	NA				
		Operating	5000	5000	5000	5000	5000
29	6000	Capital	1000				
		Operating	1000	1000	1000	1000	1000
30	6000	Capital	1000				
		Operating	1000	1000	1000	1000	1000
31	10000	Capital	5000				
		Operating	1000	1000	1000	1000	1000
32	9000	Capital	5000				
		Operating		1000	1000	1000	1000
33	2000	Capital	2000				
		Operating		NA			
34	35000	Capital	20000				
		Operating			5000	5000	5000
35	0	Capital	NA				
		Operating	NA				
36	14000	Capital	10000				
		Operating		1000	1000	1000	1000
37	0	Capital	NA				
		Operating	NA				
38	7500	Capital	NA				
		Operating	1500	1500	1500	1500	1500
39-LC/BH	0	Capital	NA				
		Operating	NA				
40	6000	Capital	1000				
		Operating	1000	1000	1000	1000	1000
41	45000	Capital	30000				
		Operating	3000	3000	3000	3000	3000
42	12500	Capital	5000				
		Operating	1500	1500	1500	1500	1500
43	10000	Capital	5000				
		Operating	1000	1000	1000	1000	1000
44	9000	Capital	5000				
		Operating		1000	1000	1000	1000
45	25000	Capital	NA				
		Operating	5000	5000	5000	5000	5000
46	25000	Capital	20000				
		Operating	1000	1000	1000	1000	1000
47	2000	Capital	2000				
		Operating		NA			
48	35000	Capital	20000				
		Operating			5000	5000	5000
49	0	Capital	NA				
		Operating	NA				
50	54500	Capital	50000				
		Operating			1500	1500	1500

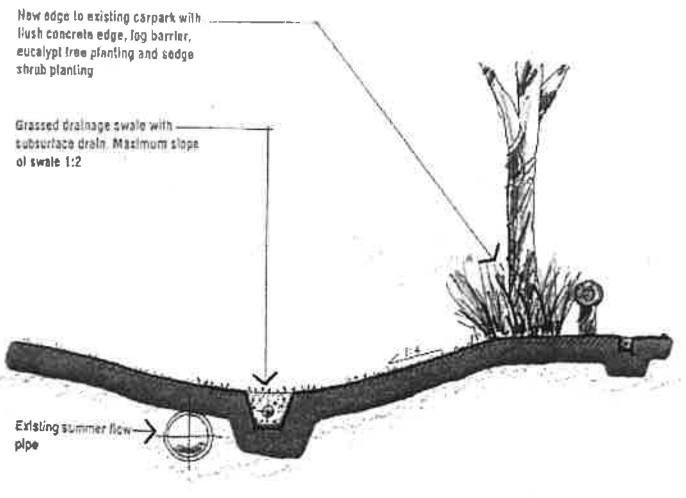
51	14000	Capital	10000				
		Operating		1000	1000	1000	1000
52	5000	Capital	5000				
		Operating			NA		
53	9000	Capital	5000				
		Operating		1000	1000	1000	1000
54	0	Capital	NA				
		Operating	NA				
55	7500	Capital	NA				
		Operating	1500	1500	1500	1500	1500
56	7500	Capital	NA				
		Operating	1500	1500	1500	1500	1500
57 - W	6000	Capital	1000				
		Operating	1000	1000	1000	1000	1000
58	12500	Capital	5000				
		Operating	1500	1500	1500	1500	1500
59	20000	Capital	NA				
		Operating	5000	5000	5000	5000	
60	2000	Capital	2000				
		Operating		NA			
61	10000	Capital	5000				
		Operating	1000	1000	1000	1000	1000
62	9000	Capital	5000				
		Operating		1000	1000	1000	1000
63	7500	Capital	NA				
		Operating	1500	1500	1500	1500	1500
64	5000	Capital	NA				
		Operating	1000	1000	1000	1000	1000
65	505000	Capital	500000				
		Operating					5000
66	6000	Capital	1000				
		Operating	1000	1000	1000	1000	1000
67	0	Capital	NA				
		Operating	NA				
68	0	Capital	NA				
		Operating	NA				
69	3000	Capital	NA				
		Operating	1500			1500	
70	3000	Capital	1000				
		Operating		500	500	500	500
71	0	Capital	NA				
		Operating	NA				
72	7500	Capital	NA				
		Operating	1500	1500	1500	1500	1500
73	5000	Capital	NA				
		Operating	1000	1000	1000	1000	1000
		Total expenditure	882000	225500	225500	227500	248500

APPENDIX G: SCHEMATIC DRAWINGS OF SPECIFIC OPTION





Section A

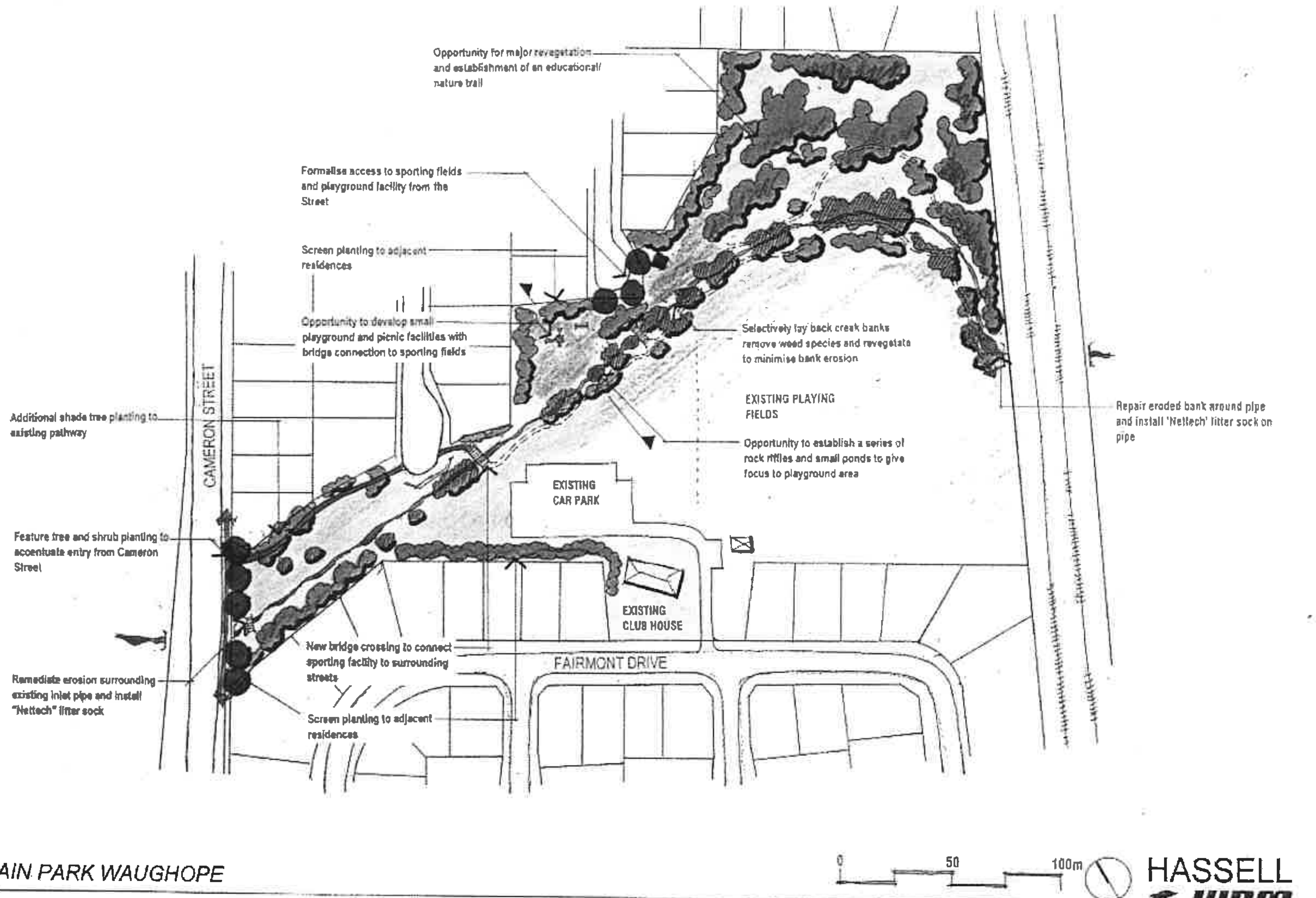


Section B

DIXIE PARK

HASTINGS STORMWATER MANAGEMENT PLAN

HASSELL
WBM OCEANICS AUSTRALIA

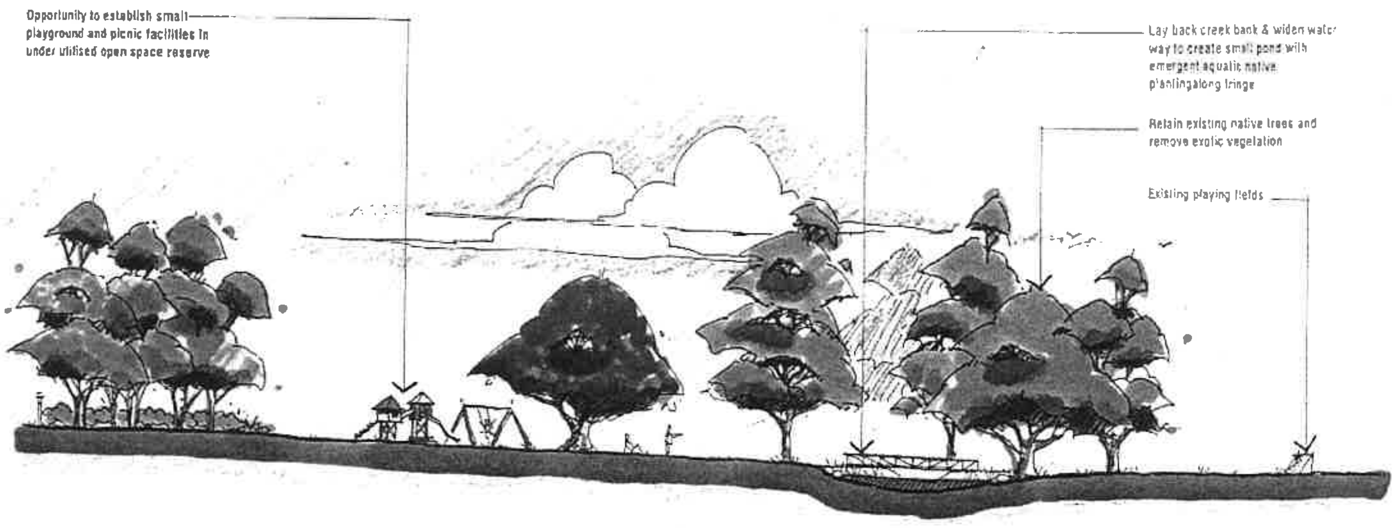


BAIN PARK WAUGHOPE

HASTINGS STORMWATER MANAGEMENT PLAN

HASSELL

WBM OCEANICS AUSTRALIA



SECTION

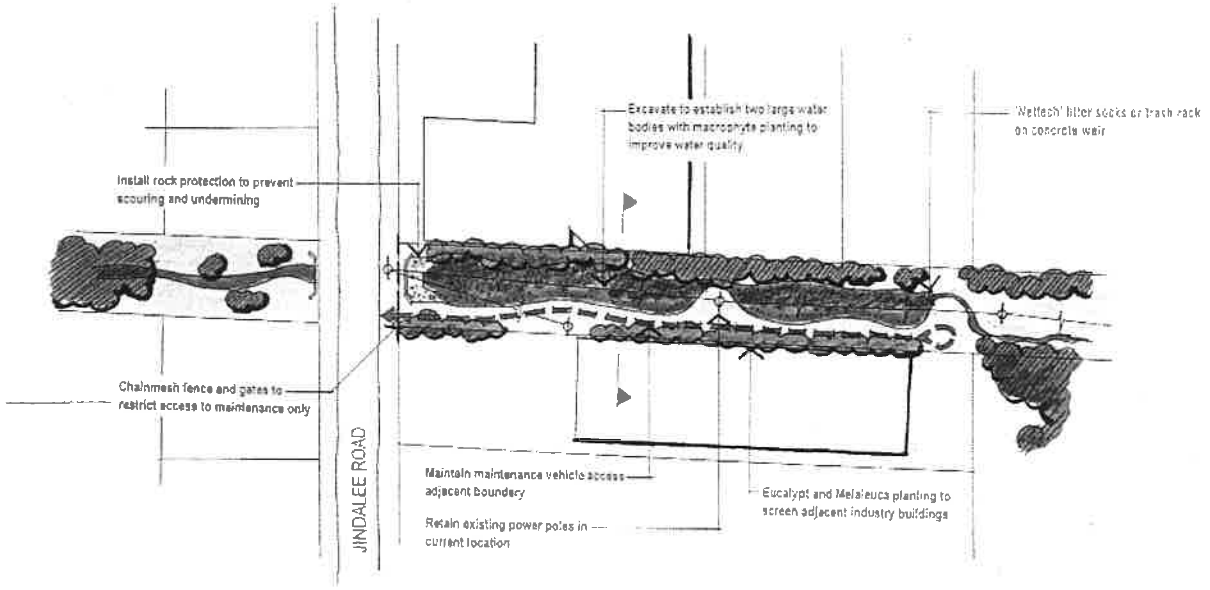
BAIN PARK WAUCHOPE

HASTINGS STORMWATER MANAGEMENT PLAN

0 50 100 150 200 m

HASSELL

WBM OCEANICS AUSTRALIA



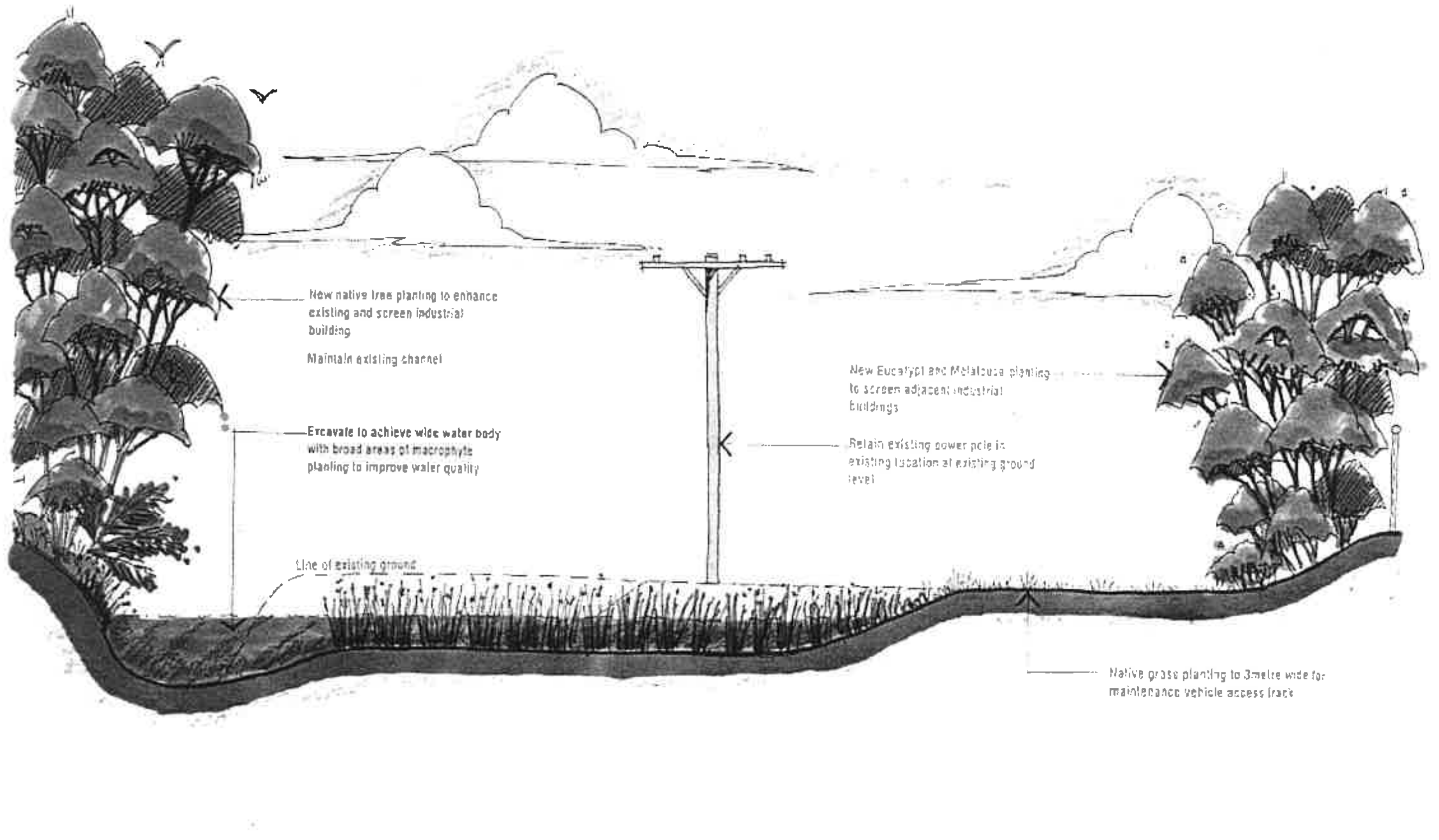
PORT MACQUARIE INDUSTRIAL AREA - SITE A

HASTINGS STORMWATER MANAGEMENT PLAN

0 50m

HASSELL

WBM OCEANICS AUSTRALIA

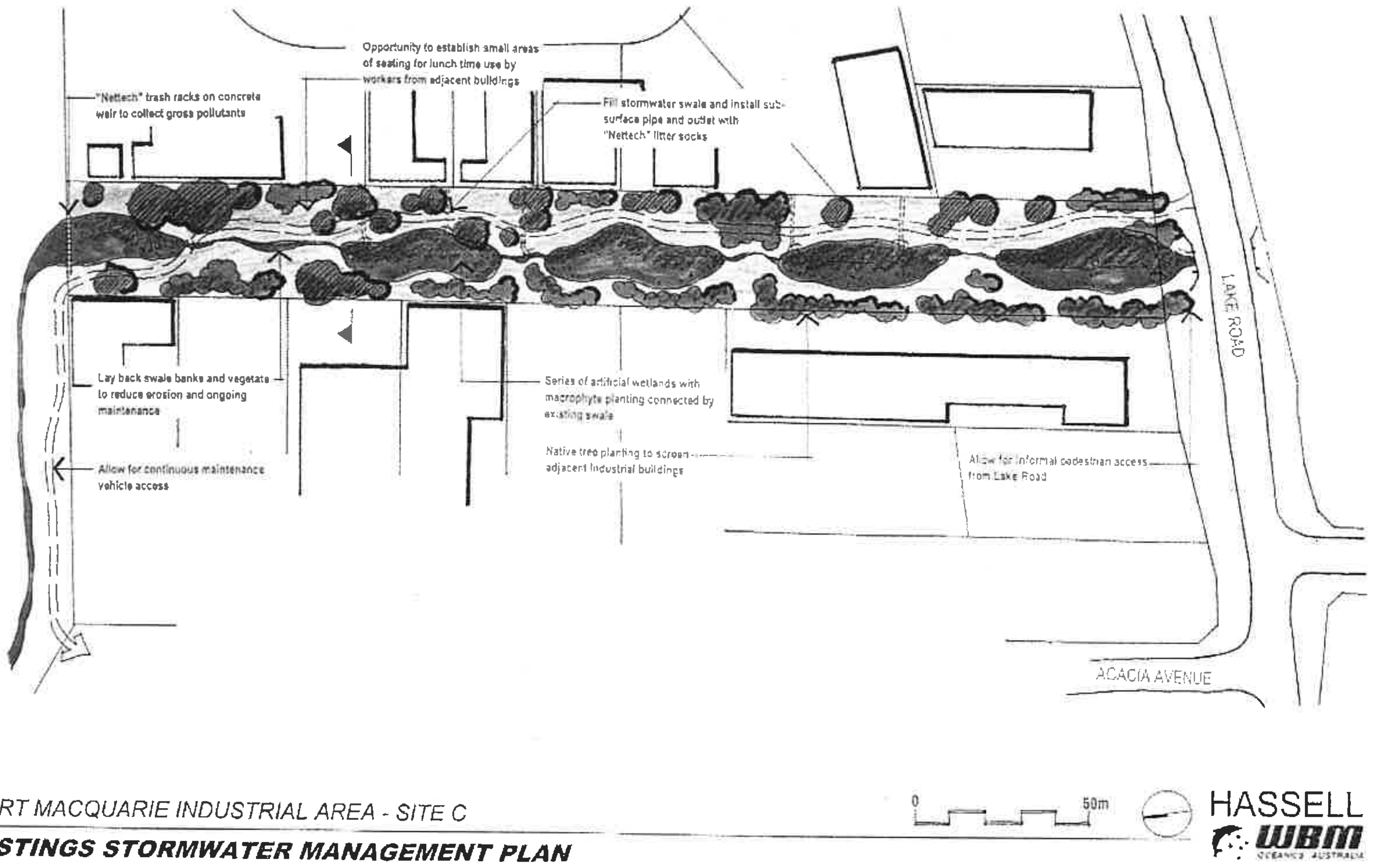


PORT MACQUARIE INDUSTRIAL AREA - SITE A

HASTINGS STORMWATER MANAGEMENT PLAN

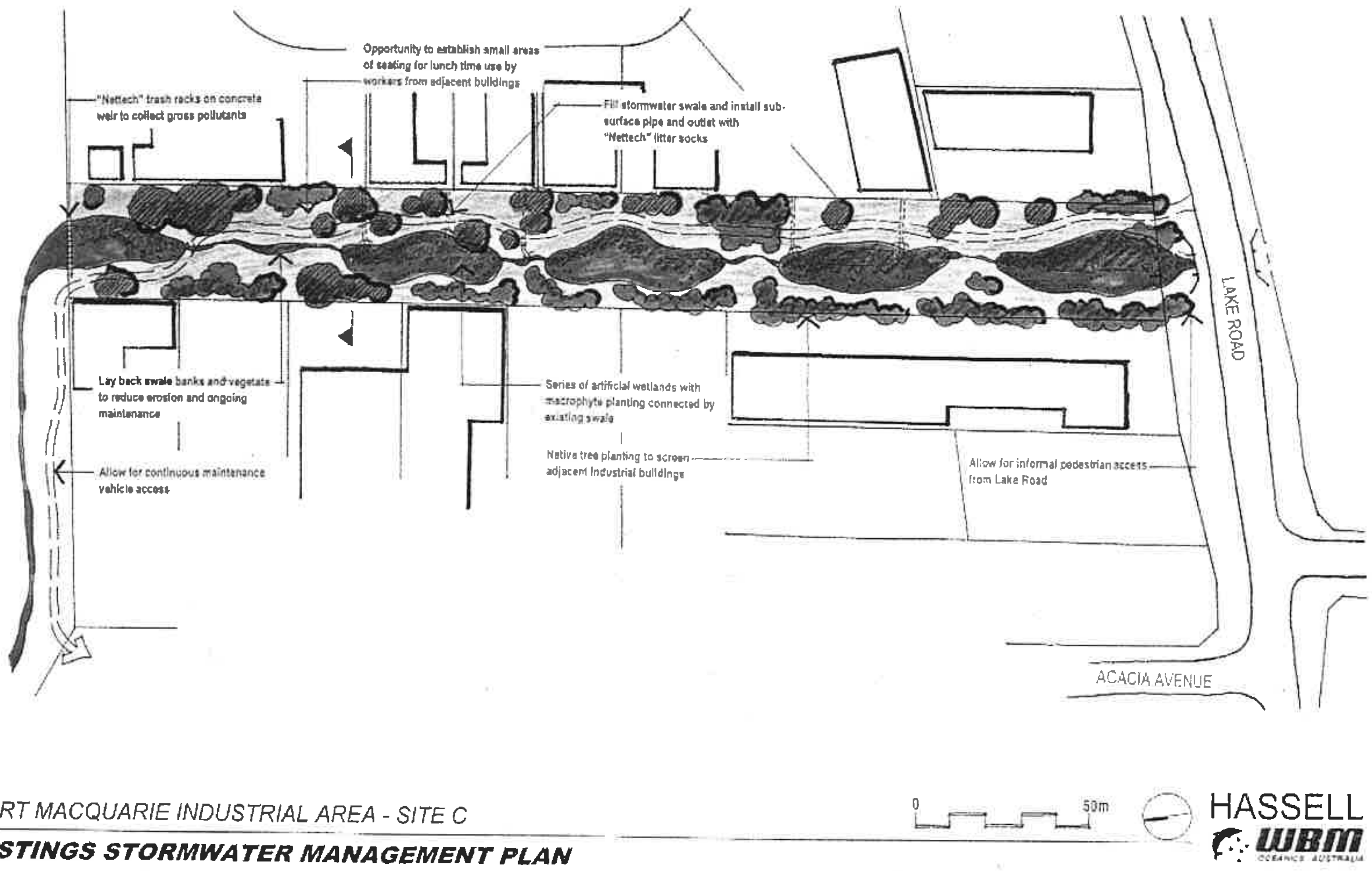
HASSELL

WBM
OCEANICS AUSTRALIA



PORT MACQUARIE INDUSTRIAL AREA - SITE C

HASTINGS STORMWATER MANAGEMENT PLAN

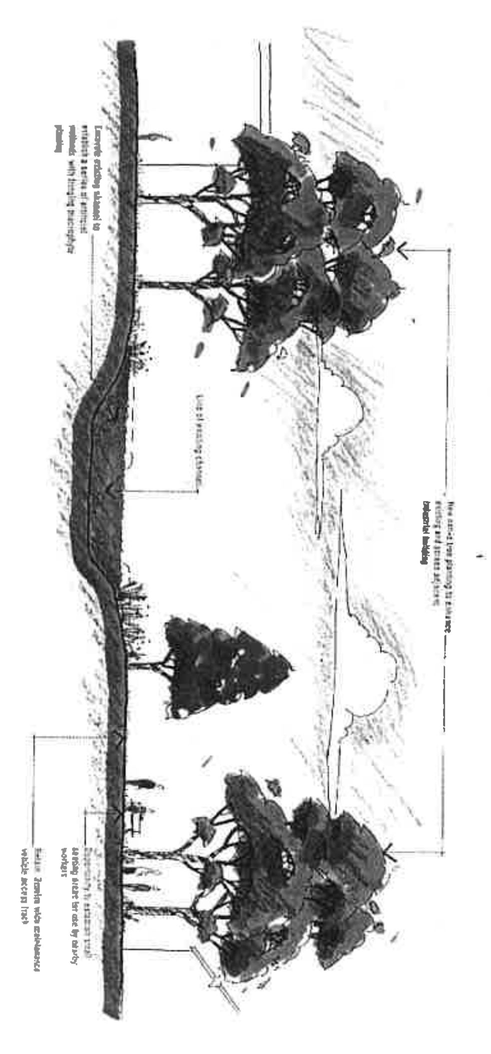


PORT MACQUARIE INDUSTRIAL AREA - SITE C

HASTINGS STORMWATER MANAGEMENT PLAN

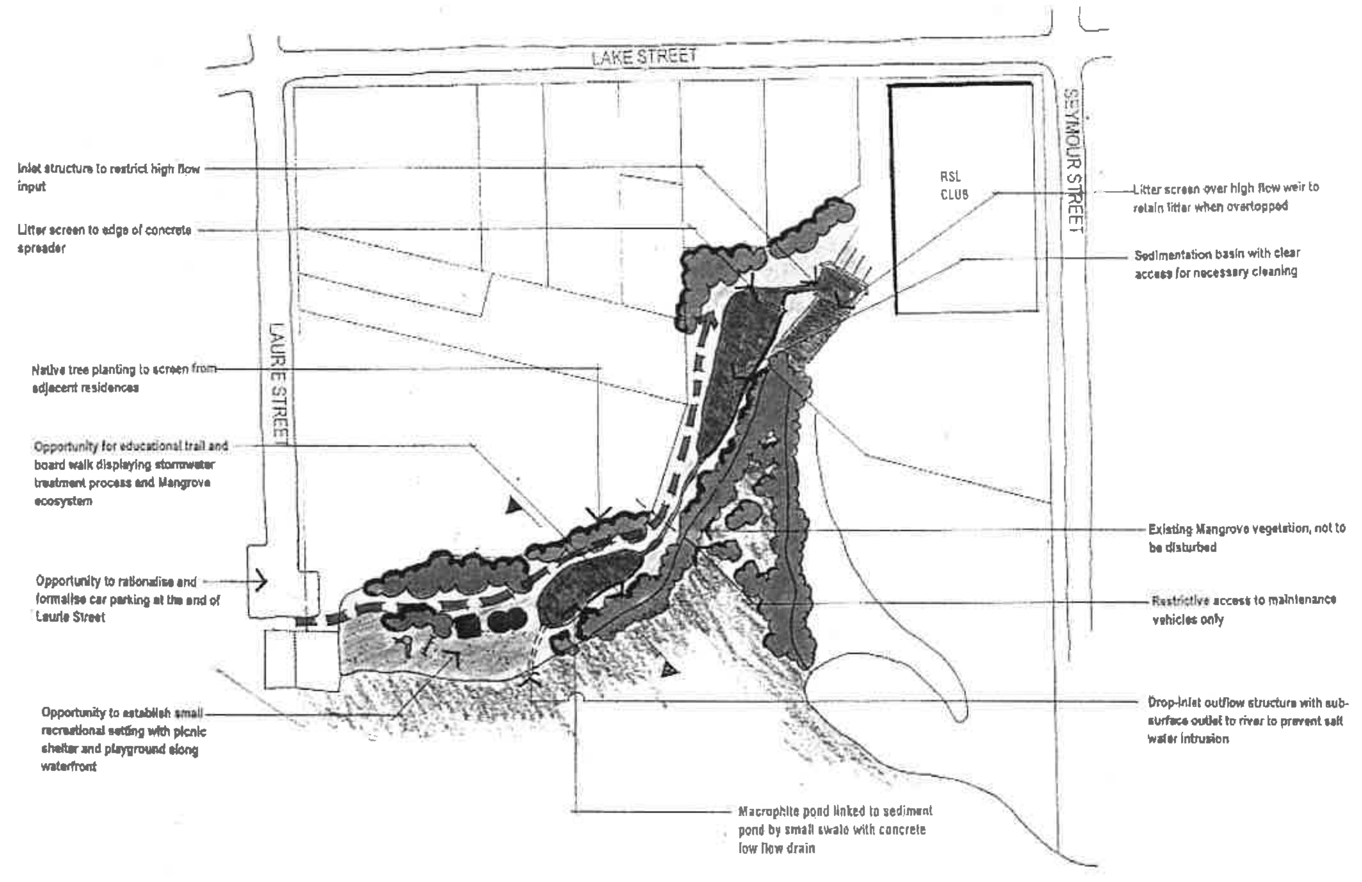
PORT MACQUARIE INDUSTRIAL AREA - SITE C

HASTINGS STORMWATER MANAGEMENT PLAN



HASSELL

WBM

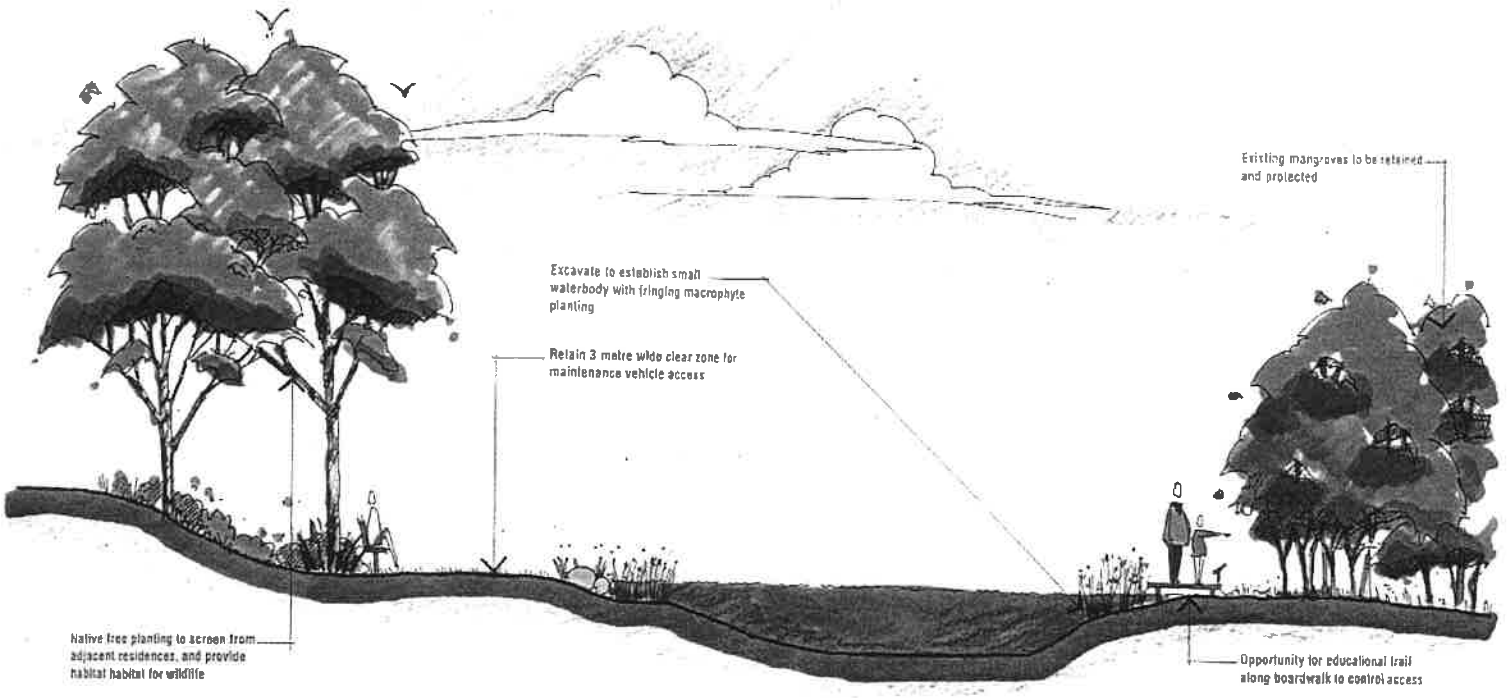


LAURIETON RSL

HASTINGS STORMWATER MANAGEMENT PLAN

0 50m

HASSELL
WBM
OCEANICS AUSTRALIA



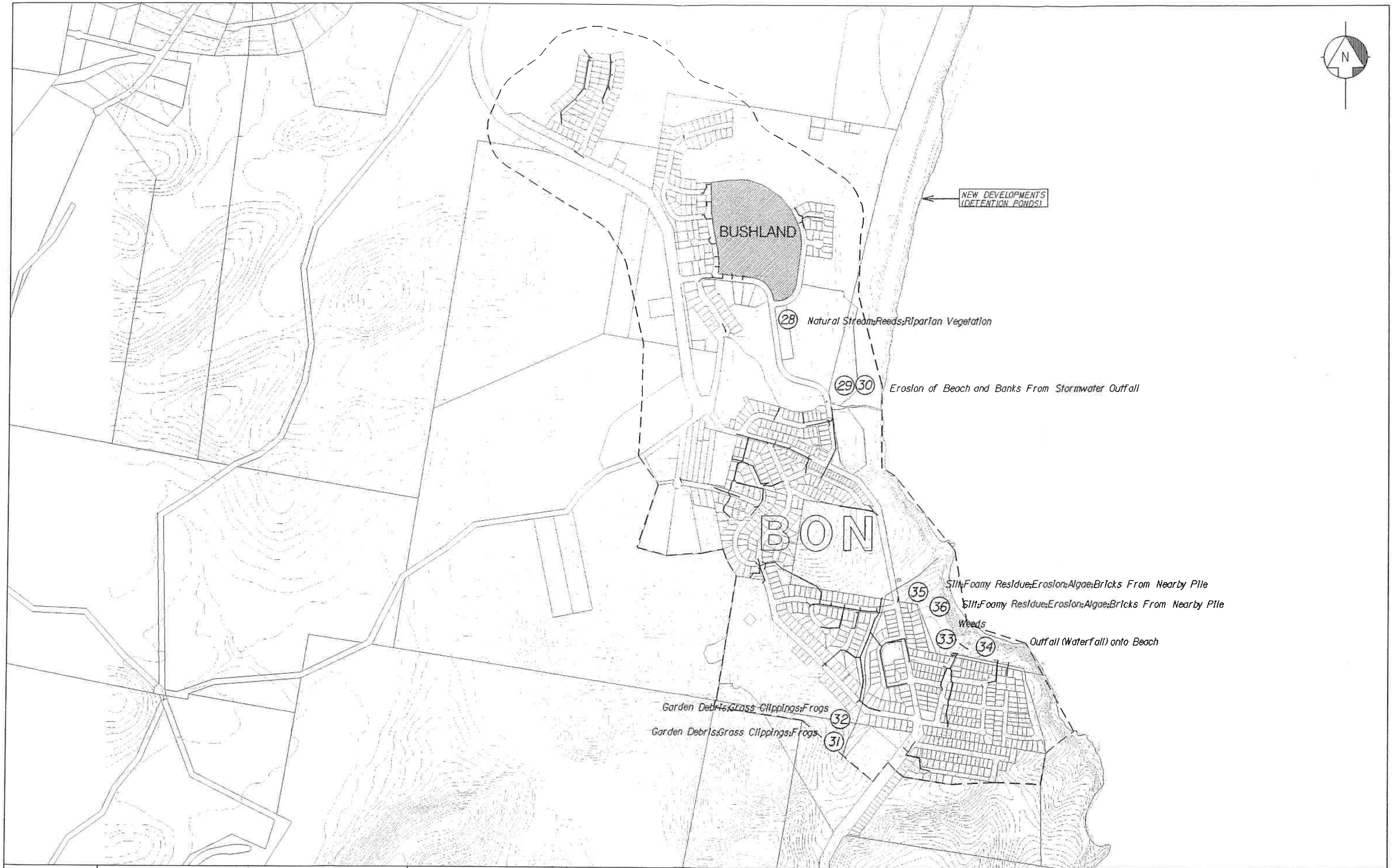
LAURETON RSL

HASTINGS STORMWATER MANAGEMENT PLAN

0 1 2 3 4 5m

HASSELL

WBM OCEANICS AUSTRALIA



A3

LEGEND

- ㉘ PHOTOMARKER
- STORMWATER PIPES
- WATERWAY
- CATCHMENT
- RIPARIAN VEGETATION
- COUNCIL OWNED/CONTROLLED RESERVES

SCALE 1:12000

metres 0 50 100 200 300 400 500m 1 Kilometre

Filename:
v:\environmental_services\portmacquarie\es6009_bh.dgn

Scale:
12000.000000:1.000000

Pentable:
z:\pentables\es6009_bonnyhills.pen

Date:
30-NOV-1999

Username:
palmierida

© CADASTRAL/CONTOUR DATA
SURVEYOR-GENERAL'S
DEPARTMENT (1998)

© SEWER/WATER UTILITY DATA
HUNTER WATER CORPORATION

HUNTER WATER AUSTRALIA

HASTINGS COUNCIL
STORMWATER ASSET MANAGEMENT PROJECT
BONNYHILLS

SWIMS GROUP

A Division of Survey Information Management
Providing Sewer & Water Information
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P.O. Box 5007 Newcastle West NSW 2302
Ph: (02)49799692 Fax: (02)49264984
Manager: Allan Large

Quality
Endorsed
Company
ISO 9001 Lic QEC11612
Standards Australia

A3

MK

LEGEND

- ㉘ PHOTOMARKER
- ▨ BUSHLAND
- ― STORMWATER PIPES
- ― WATERWAY
- — — CATCHMENT
- ▨ RIPARIAN VEGETATION
- ☐ COUNCIL OWNED/CONTROLLED RESERVES

metres 0 25 50 250m 500 metres
SCALE 1:12000

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Scale:
12000.000000:1.000000

Pentable:
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Date:
30-NOV-1999

Username:
palmierida

Ⓒ CADASTRAL/CONTOUR DATA
SURVEYOR-GENERAL'S
DEPARTMENT (1998)

Ⓒ SEWER/WATER UTILITY DATA
HUNTER WATER CORPORATION

HUNTER WATER AUSTRALIA

HASTINGS COUNCIL
STORMWATER ASSET MANAGEMENT PROJECT
LAKE CATHIE AREA

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Company
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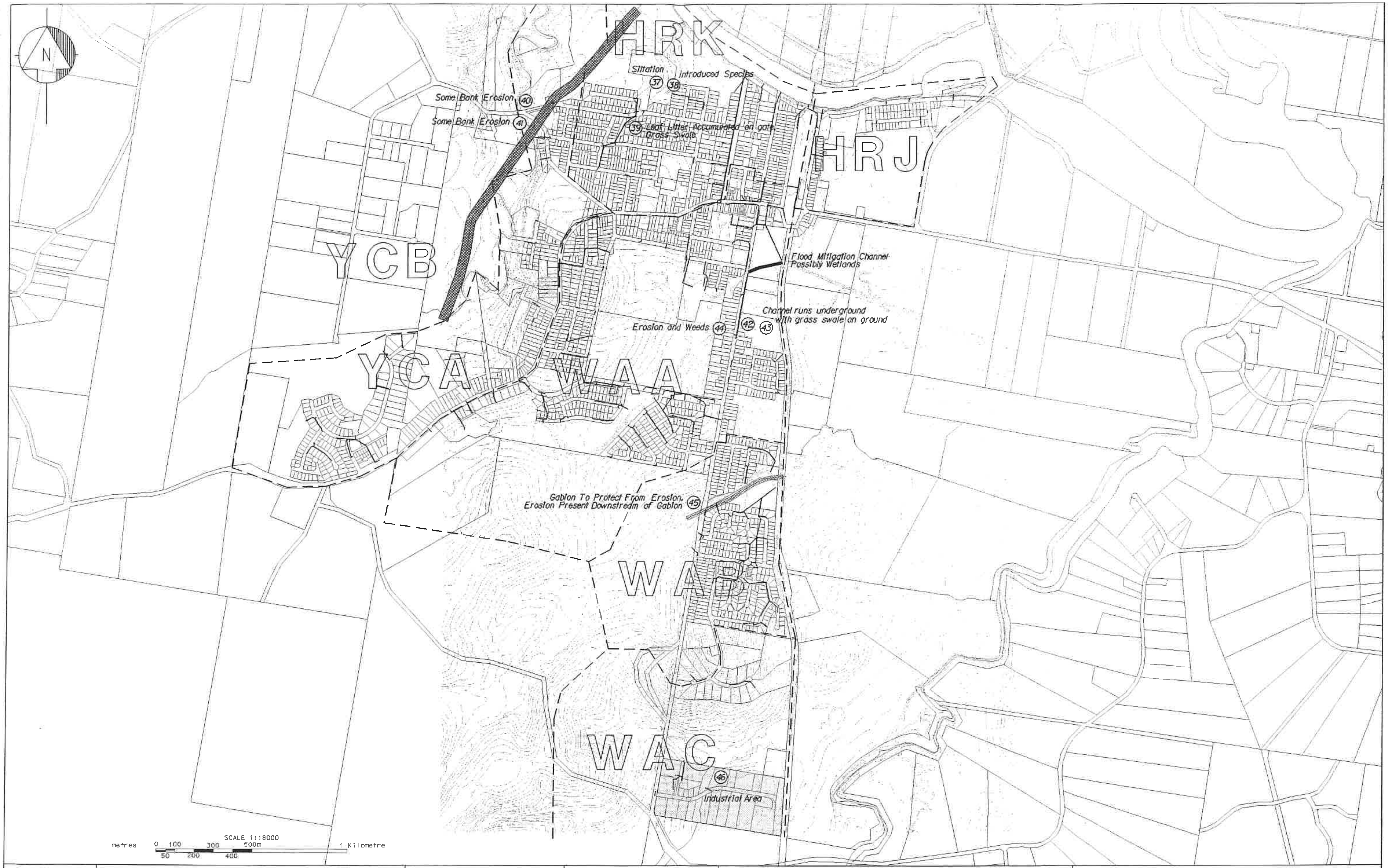

A3

LEGEND

㉘ PHOTOMARKER
STORMWATER PIPES
WATERWAY
CATCHMENT
RIPARIAN VEGETATION
COUNCIL OWNED/CONTROLLED RESERVES

HRJ HASTINGS RIVER
WAA WAUCHOPE AREA
YCA YIPPIN CREEK

Filename:
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Scale:
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Date:
30-NOV-1999

Username:
palmierida

Ⓒ CADASTRAL/CONTOUR DATA
SURVEYOR-GENERAL'S
DEPARTMENT (1998)

Ⓒ SEWER/WATER UTILITY DATA
HUNTER WATER CORPORATION

HUNTER WATER AUSTRALIA

HASTINGS COUNCIL ZONE No.2
STORMWATER ASSET MANAGEMENT PROJECT
WAUCHOPE

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Standards Australia

A3

LEGEND

(28)	PHOTOMARKER
●	DETENTION BASIN
───	STORMWATER PIPES
───	WATERWAY
— —	CATCHMENT
▨	RIPARIAN VEGETATION
☐	COUNCIL OWNED/CONTROLLED RESERVES

metres 0 50 100 500m 1 Kilometre
SCALE 1:24000

Filename:
V:\environmental_services\PortMacquarie\es6009_camdenhavendgn.dgn

Scale:
24000.000000:1.000000

Pentable:
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Date:
30-NOV-1999

Username:
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CADASTRAL/CONTOUR DATA
© SURVEYOR-GENERAL'S
DEPARTMENT (1998)

© SEWER/WATER UTILITY DATA
HUNTER WATER CORPORATION

HUNTER WATER AUSTRALIA

HASTINGS COUNCIL
STORMWATER ASSET MANAGEMENT PROJECT
CAMDEN HAVEN AREA

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Quality
Endorsed
Company
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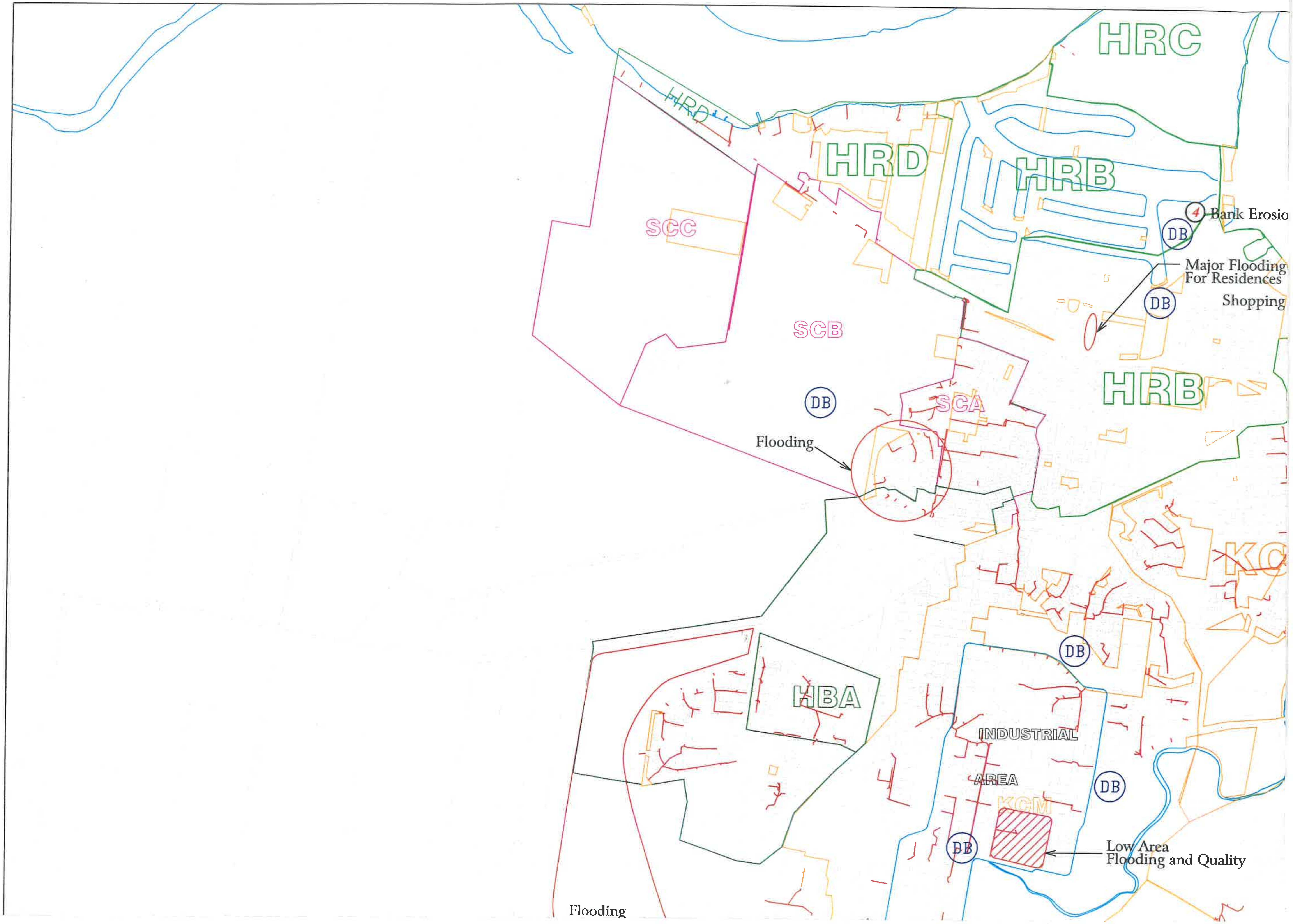
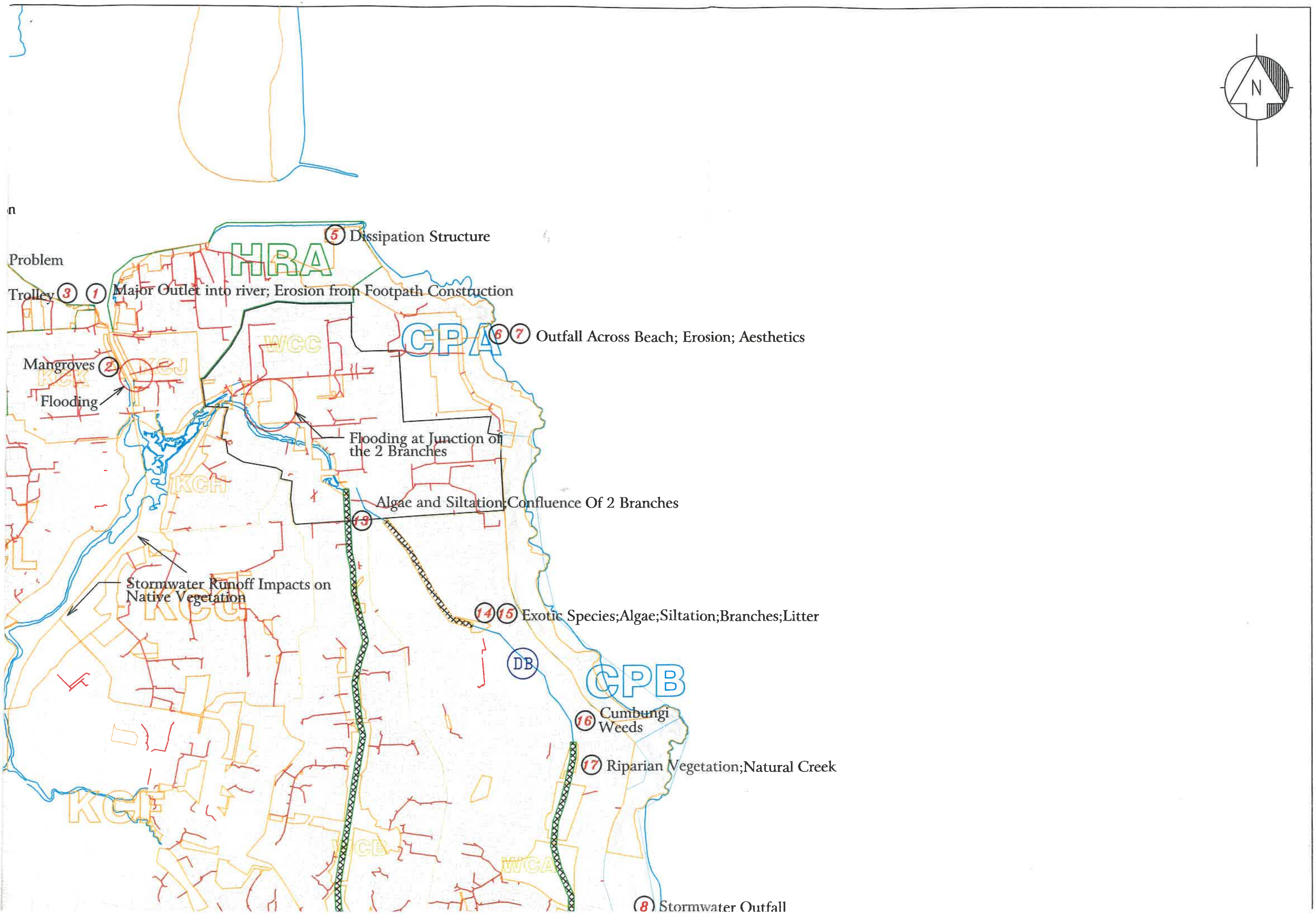
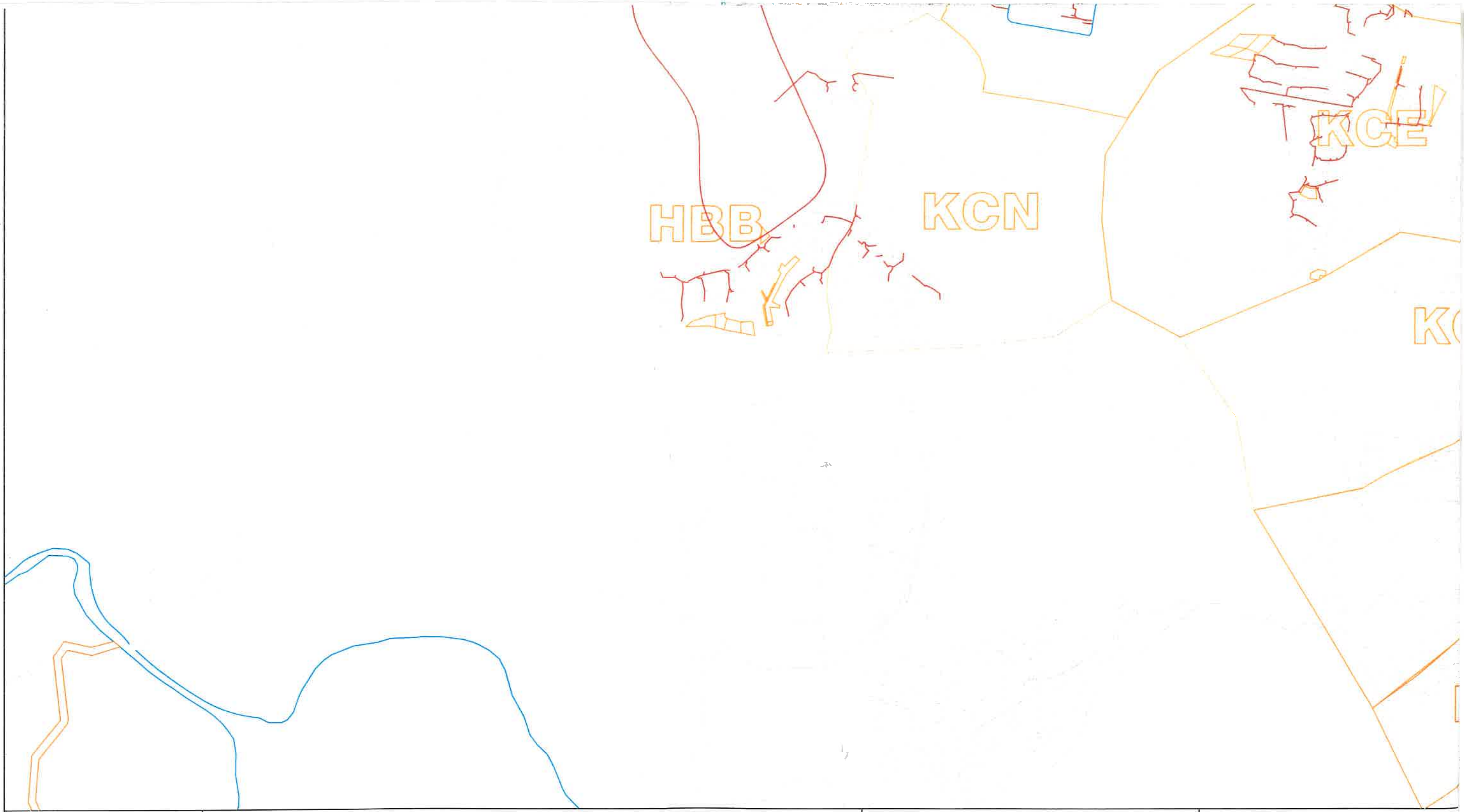
Standards Australia


HRC
HRD
HRD
HRB
SCC
4
Bank Erosio
DB
Major Flooding
For Residences
DB
Shopping
SCB
HRB
DB
SCA
Flooding
KC
HBA
DB
INDUSTRIAL
AREA
DB
KCM
DB
Low Area
Flooding and Quality
Flooding


N
n
Problem
Trolley ③
① Major Outlet into river; Erosion from Footpath Construction
⑤ Dissipation Structure
HRA
WCC
CPA
⑥ ⑦ Outfall Across Beach; Erosion; Aesthetics
Mangroves ②
KCJ
KCK
Flooding
Flooding at Junction of the 2 Branches
KCH
Algae and Siltation;Confluence Of 2 Branches
⑬
Stormwater Runoff Impacts on Native Vegetation
L
KCG
⑭ ⑮ Exotic Species;Algae;Siltation;Branches;Litter
DB
CPB
⑯ Cumbungi Weeds
⑰ Riparian Vegetation;Natural Creek
KCF
WCB
WCA
⑧ Stormwater Outfall



A1

LEGEND

28 PHOTOMARKER
STORMWATER PIPES
WATERWAY
CATCHMENT
RIPARIAN VEGETATION
COUNCIL OWNED/CONTROLLED RESERVES
DENSE BUSH
DB DETENTION BASIN

CPC	COASTAL AREA PORT MACQUARIE
KCA	KOOLOONBUNG CREEK
WCA	WRIGHTS CREEK
HRA	HASTINGS RIVER
SCA	SALTWATER CREEK
HBA	HIBBARD CREEK

SCALE 1:15000

metres 0 50 100 200 300 400 500m 1 Kilometre

Filename:
$$dgnspec$$

Scale:
$$scale$$

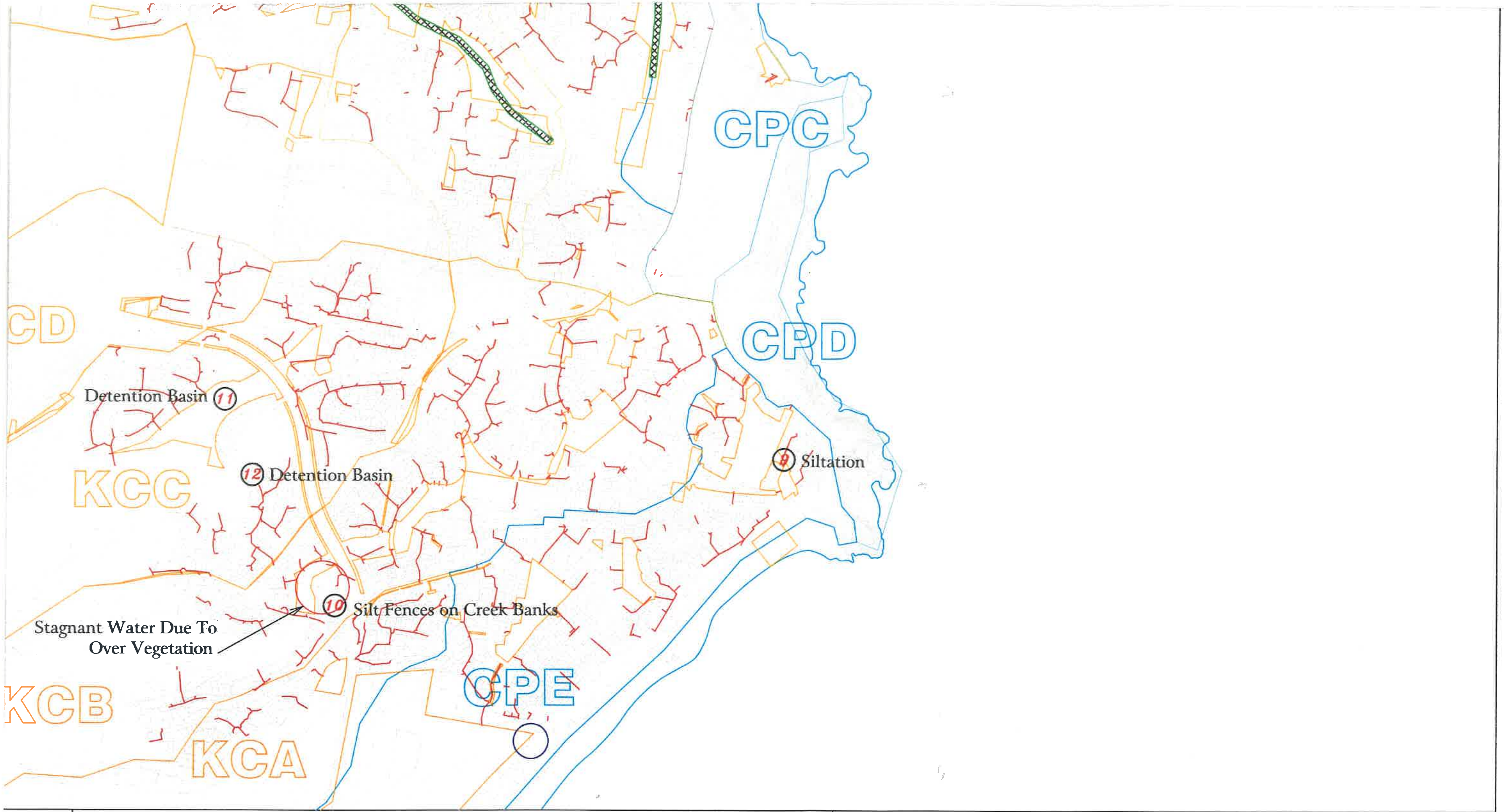
Pentable:
$$pentable$$

Date:
$$date$$

Username:
$$username$$

Ⓒ CADASTRAL/CONTOUR DATA
SURVEYOR-GENERAL'S
DEPARTMENT (1998)

Ⓒ SEWER/WATER UTILITY DATA
HUNTER WATER CORPORATIO



HUNTER WATER AUSTRALIA

ZONE 1
HASTINGS COUNCIL
STORMWATER ASSET MANAGEMENT PROJECT

Hunter Water Australia

SWIMS GROUP

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Quality System

Quality
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Standards Australia