PAT CONDINA & ASSOCIATES

Consultants in waterway, wetland and lake management,
Water quality monitoring and assessment,

STATEMENT OF EXPERT EVIDENCE

CITY OF GREATER GEELONG

AMENDMENT C259 HORSESHOE BEND PRECINCT STRUCTURE PLAN

PROPOSED SPARROVALE WETLAND SUSTAINABILITY AND RISK MANAGEMENT

For City of Greater Geelong

23 May 2014

Aspromonte Enviro Pty Ltd (ABN 31 074 579 936), Trading as Pat Condina & Associates
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1 NAME AND ADDRESS

Pat Condina, 17 Olive Road, Devon Meadows, Victoria 3977

2 QUALIFICATIONS AND EXPERIENCE

1. Master of Environmental Science (Monash University 1983)
2. Graduate Diploma of Water Science (Caulfield Institute of Technology 1978)
3. Diploma of Applied Chemistry (Caulfield Institute of Technology 1974)

After 19 years professional employment with the former Dandenong Valley Authority and Melbourne Water I commenced private practice as a waterway management consultant in 1996 and have worked continuously in this role since then. I am a recognised expert in the field of urban and rural waterway management, water quality monitoring and assessment, environmental assessment of aquatic ecosystems, and stormwater quality control measures. I have advised on such issues on numerous projects in rural, semi-urban and urban areas throughout Victoria and in other states. A Statement of Qualifications and Experience is attached as Appendix A.

3 INSTRUCTIONS

According to the letter of engagement and instructions from the city of Greater Geelong on 7th May 2014 the tasks to be undertaken "will include a review of all relevant submissions, preparation of an expert evidence statement, meetings with Council officers and the legal team to discuss key issues and presentation of the expert evidence statement at the panel".

Earlier instructions had requested the preparation of a stormwater monitoring program for existing and future development in the Armstrong Creek Precincts (Horseshoe Bend Precinct and Armstrong Creek East Precinct) to ensure that suitable water quality objectives are achieved in the proposed Sparrovale wetland and in the downstream Hospital Swamps. An assessment of sustainability of the proposed Sparrovale wetlands and identification of potential risks and risk management measures was also required, as was a review of the costs shown in DCP Project DI DR13 - Sparrovale Wetland – Management Plan and Implementation Works.

4 INFORMATION USED AND RELIED UPON

To prepare this statement I have relied primarily on the sustainability and risk assessment report jointly prepared with my associate Neil Craigie, dated 20 May 2014 and titled "*An Assessment of the sustainability of the proposed Sparrovale wetlands and assessment of the associated social, economic and environmental risks*", (hereafter referred to as the Sparrovale wetlands report), attached as Appendix B.

I adopt the findings and conclusions of that report.

I have read all submissions received by Council relating to surface water management and respond to these in Section 6.

5 SUMMARY OF SPARROVALE REPORT

The following section summarises the Sparrovale wetlands report. While costs are dealt with in the Sparrovale wetlands report, the overall issue of costs as identified in the Development Contributions Plan will be dealt with by my associate Mr. Neil Craigie in his Expert Evidence Statement.

The Sparrovale wetlands report was primarily prepared to ensure that the proposal for a major wetland area was sustainable in both the long and the short term, and did not pose any unacceptable risks to the City of Greater Geelong.

Proposed Wetland Sustainability and Design

The sustainability of any aquatic system is basically its capacity to satisfy its intended beneficial uses and environmental values over its lifetime without intractable water quality problems occurring, and without resort to excessive management intervention.

Appropriate initial wetland design is a key factor in ensuring future sustainability.

There are several factors and influences which can guide a decision as to the optimal design intent for the Sparrovale wetland:

- The source, volume and quality of flow to the wetland.
- The present need to utilise and treat stormwater from upstream development and minimise impact to higher environmental value downstream receiving environments.
- The range and type of beneficial uses envisaged.
- The existing physical characteristics of the area.
- Present and future saltwater influences including saline groundwater intrusion and saline intrusion as a result of sea level rise.
- The range of aquatic environments established in the Lower Barwon Wetlands area.
- The type of ecosystem that existed on the land prior to agricultural use.
- The costs associated with any large scale construction or earth moving, including the costs associated with dealing with currently unidentified site contamination issues.

Guidance as to the optimal design intent for Sparrovale can also be obtained by reference to existing environmental studies of the aquatic ecosystems of the Lower Barwon region. Prior to development of this area, ephemeral reed swamps and marshes would have been common on the Lower Barwon. Due to water regulation practices these ephemeral marsh characteristics have diminished in the existing wetland complex. Sparrovale presents an opportunity to restore an ephemeral marsh ecosystem with considerable stormwater treatment capability.

In such an ephemeral marsh system, shallow water would persist over the wetland in wet winters, shrinking quickly over late spring and summer/autumn. The wetland would be essentially dry by the end of summer apart from any deeper refuges specifically constructed to allow aquatic organisms to persist. It would fill again in any Winter/Spring flood. A return to this hydrological pattern could be somewhat approximated, not by increased flows from the Barwon River, but rather by accepting developmental flows from the upstream catchment in the Horseshoe Bend Precinct. The inclusion of deeper refuge areas would allow storage of stormwater inflows from upstream development over the summer/autumn period (rather than allow spreading over the flat wetland floor) and so maintain an annual drying cycle over the greater part of the wetland.

Apart from creating significant new habitat the Sparrovale wetland would ensure protection of important downstream ecosystems. As well as water quality improvement there would be significant evaporation and infiltration of the incoming stormwater over the summer season so that downstream ecosystems are protected from increased or unnatural stormwater flows.

Providing significant stormwater treatment in Sparrovale wetlands will reduce land take within the developed catchment area for stormwater treatment and will assist in making the Sparrovale project truly multipurpose and economically viable. Stormwater quality treatment in the HBP can therefore be limited to removal of gross pollutants, and medium to coarse sediments, commensurate with ancillary peak flow management needs within the HBP development area.

The Sparrovale wetlands report outlines key design responses aimed at ensuring the environmental sustainability of the wetland. Such key design responses include:

- Design a shallow ephemeral freshwater wetland system.
- Provide large area for evaporation/infiltration of additional stormwater volumes.
- Implement and refine water quality monitoring program.
- Maximize range of habitat types.
- Encourage natural regeneration rather than planting, through strategic use of inundation and weed control techniques.
- Plant aquatic species, with terrestrial groundcover, middle storey and upper storey plants as necessary above wetland water levels.
- Institute and maintain effective aquatic and terrestrial weed management.
- Complete freshwater inundation of the wetland at least on an annual basis to levels of 0.95 m or higher.
- Provide small areas of greater depth to provide aquatic flora and fauna refuge and increase range and diversity of habitat types.

Risks Associated with the Sparrovale Wetlands

Each of the key environmental social and economic issues relevant to wetland operation and use will have a level of risk associated with them. The potential risks were assessed based on the Likelihood and Consequences of occurrences and hazards as outlined in Australian Standards for Risk Management (AS/NZS, 2000, 2004). The level of risk normally determines the type and extent of mitigation measures that will be required on a site. Where a high risk to the environment and/or human health has been identified, mitigation measures should be introduced to reduce the risk to an acceptable level wherever practicable. Factors with a medium or low risk should also have practicable management measures implemented if these can further reduce risk at a reasonable cost.

Table 7 of the Sparrovale wetlands report lists the potential risks associated with the proposed Sparrovale wetlands Among the risks considered are potential contamination by metals hydrocarbons and other pollutants in stormwater inputs; occurrence of blue green algal blooms; proliferation of pest species; occurrence of high populations of mosquitoes carrying diseases; growth of pest plants; human contact problems including risk of dermatitis and drowning; generation of smells or other poor aesthetic wetland condition and site contamination due to prior land use activities

Table 7 also gives estimates of risk rating and potential responses to mitigate such risk. More importantly, it also proposes a range of measures to reduce the likelihood of a risk occurring.

Review of the DCP_DI_DR_13 project cost estimates

With regard to wetland management and implementation costs, the report concluded that the quantities, rates and costs listed in the DI_DR_13 summary table prepared by the City of Greater Geelong are considered generally appropriate. However it is suggested that some changes are needed for Items 2.2, 2.3, 3.3, and 5.1, 5.2 and 5.3. These cost issues are further considered by my associate Mr Neil Craigie in his Statement of Expert Evidence.

The clear nexus between the need for the Sparrovale project and the development of HBP in full is accepted, and funding of the purchase of the land by HBP is supported, together with the various investigations, reviews and Management Plans required to facilitate conversion of the land to wetland uses. It is also apparent that the project has potentially very high future social and environmental values which extend well beyond the HBP.

6 THE SUBMISSIONS

This statement considers submissions to *Greater Geelong Planning Scheme –Amendment C259 Horseshoe Bend Precinct Structure Plan* and responds to issues raised in those submissions. Only issues relevant to wetland sustainability or risks posed by the wetlands are considered in this statement.

Perusal of the submissions showed very few comments regarding the Sparrovale wetlands, and where such comment did occur it was generally with respect to the costs of constructing, establishing and managing these wetlands. In this respect I am satisfied that the costs proposed are reasonable and not dissimilar to the costs of treatment wetlands throughout the Melbourne region in which I have had involvement.

Submission 37c by DEPI notes that "The implementation of the Sparrovale wetland is important in protecting the Ramsar listed Hospital swamp from inappropriate storm water quality and volume". This statement is fully supported and the Sparrovale wetland would in the future have the capacity to provide such protection. Furthermore the potentially very high future social, economic and environmental benefits of such a wetland should also be recognized. Over time significant habitat and ecosystem values will develop which could rival existing ecosystems.

7 DECLARATION

In preparing this statement I have made all the enquiries that I believe to be desirable and appropriate, and no matters of significance which I regard as relevant have to my knowledge been withheld from the Panel.

Pat Condina

M. Env. Sc., Grad. Dip. Water Sc., Dip. App. Chem.

23 May 2014

Appendix A - Statement of Qualifications and Experience and CV

Name: Pat Condina

Address: 17 Olive Road, Devon Meadows, Vic., 3977

Business Phone/Fax: 5998 2034 Email: patcondina@bigpond.com

Current Occupation:Environmental Consultant, trading as Pat Condina & Associates

Professional Qualifications:

- Master of Environmental Science (Monash University, 1983):
- Graduate Diploma in Water Science (Chisholm Institute of Technology 1978):
- Diploma of Applied Chemistry (Caulfield Institute of Technology, 1974).

Experience:

My professional experience of 40 years has largely been in waterway, wetland, drainage, and water quality management, including environmental assessment, pollution control, water quality monitoring and management, and lake, wetland and waterway condition assessment and restoration. My early professional experience was with the Dandenong Valley Authority, and later with Melbourne Water, where I advised on drainage and catchment issues including waterway management, stormwater management, pollution and catchment co-ordination.

In July 1996 I left MW to start my own consultancy. Since then I have worked as the lead or sub-consultant on a wide range of projects in the fields of lake, wetland and waterway design and management. I have also been involved in the preparation of a number of Stormwater Management Plans and frequently provide advice to councils on methods of mitigation and treatment of stormwater runoff.

My field of expertise is in surface water quality management, waterway management, waterway condition assessment and stormwater quality and quantity control measures. I have advised on surface water management, water quality protection and waterway condition issues in Melbourne and throughout Victoria and elsewhere. I have prepared a number of Environmental Management Plans for residential, and commercial developments.

In recent years, in conjunction with my associate Mr Neil Craigie, I have advised on waterway management, water quality issues, and wetland and lake design on many of the major residential developments in the Melbourne region for several developments that incorporate extensive areas of waterways, wetlands and lakes

In conjunction with Neil Craigie I have also completed a large number of waterway management studies throughout Victoria and Queensland. For the last 15 years I have also been the assessor for Melbourne Waters Stream Frontage Management Program in the Westernport Catchment

CV - PAT CONDINA

PERSONAL DETAILS

Address: 17 Olive Road, Devon Meadows, Vic., 3977

Business Phone/Fax: 5998 2034 Email: patcondina@bigpond.com

Current Occupation: Environmental Consultant, Aspromonte Enviro Pty Ltd,

Key Expertise: **Waterway, Wetland and Lake Management,**
Water quality monitoring and assessment
Waterway assessment and improvement strategies

QUALIFICATIONS SUMMARY

4. Master of Environmental Science (Monash University 1983)
5. Graduate Diploma of Water Science (Caulfield Institute of Technology 1978)
6. Diploma of Applied Chemistry (Caulfield Institute of Technology 1974)

SUMMARY OF PROFESSIONAL BACKGROUND

July 1996 -present	**Environmental Consultant,** Pat Condina and Associates
1991 - 1996	**Manager, Catchment Co-ordination**, and **Manager, Catchment Strategy**, Melbourne Water
1987 - 1991	**Senior Environmental Scientist**, and **Western Port Co-ordinator**, Dandenong Valley &Western Port Authority
1983 - 1987	**Environmental Chemist** - Dandenong Valley Authority (DVA)
1977 - 1983	**Scientific Officer/Laboratory Manager** - DVA
1971 -1977	**Development Chemist** and **Plant Chemist** – United Packages

PROFESSIONAL AND COMMUNITY AFFILIATIONS

- Member of the Royal Australian Chemical Institute
- Member of the Australian Society for Limnology
- Member of the River Basin Management Society

PROFESSIONAL SKILLS AND KNOWLEDGE

Professional Qualifications

- **Master of Environmental Science:** By course work and including a major multidisciplinary study entitled "Water Management and the Development of Upper Beaconsfield".
- **Graduate Diploma in Water Science:** Subjects included "Pollution Ecology", "Water Management", "Marine and Estuarine Systems", and "Aquatic Biology".
- **Diploma of Applied Chemistry:** Acquired strong grounding in mathematics, physics, chemistry, experimental methodology, and industrial processes.

Acquired Knowledge and Skills

- **Recognised expert in fields of regional drainage, and river and catchment management**. Currently MW assessor for Stream Frontage Management Program. Completed large number of **Waterway Management Plans.**
- Experience with the all environmental aspects of **Development, Design**, **Management and Monitoring of Urban Lakes, Tidal Canals, Wetlands,** and other aquatic resources including **Design of Stormwater Treatment Wetlands**
- Practical and theoretical knowledge of **urban and rural runoff** and pollution and sediment generation, including assessment of effects on receiving waters, **mitigation** and **treatment** aspects and **Water Sensitive Urban Design**. Recognised with Urban Development Institute of Australia awards for excellence in Water Sensitive Urban Design in 2000, 2002, 2003, 2004, 2005 and 2007.
- Conduct of stream **pollution assessment** and conduct of **water quality monitoring** and assessment programs
- Conduct of **environmental assessments and environmental overviews** on aquatic ecosystems
- **Presentation Skills:** 25 years experience in delivering talks and lectures on environmental issues, water quality management, and catchment management.
- **Community Consultation Skills:** basically through preparation of publicity and issues documents for the community, organisation and conduct of public meetings.

EMPLOYMENT AND EXPERIENCE

July 1996-Present Environmental Consultant (Trading as Pat Condina & Associates)

Since setting up a private consultancy business has worked as the lead or sub-consultant on a wide range of projects of which the following are representative:

- Westernport Catchment stormwater quality modelling for DSE Victoria
- Assessment of Impact of Grounwater Discharges to Condamine River for Origin Energy
- Ecological Impact Assessment of Yarra Valley Quarry Licensed Discharge – for YVQ
- Preparation of Stormwater Quality Management Plans for Cities of Kingston, Monash, Casey, Moreland Darebin and Yarra
- Draft Chinamans Creek Catchment Strategy-for Mornington Peninsula Shire
- Mornington Peninsula Waterways and Drainage Due Diligence Investigation -for MPS
- Shire of Moira Urban Drainage Strategy-Overview of Water Quality issues - for SKM
- Wannon River Assessment Project - for Glenelg CALP Board
- Environmental Impact of future STP flows to Yallock Creek -for South East Water
- Chambers Flora and Fauna Reserve Draft Management Plan-for Shire of Cardinia
- City Link Project -Assessment of effects of site discharges on Yarra River - for TOJV
- Rosebud Foreshore Review - Community Consultation Program -for Parks Victoria
- Lake Coranderrk Water Quality Investigation - for Healesville Sanctuary Trust
- Berwick Springs Lake Quality and Recreational Use Assessment - for Watsons P/L
- Westernport Stream Frontages Program, Management and Assessment - for MWC
- Victoria Harbour, Overview of Water Quality Issues - for Lawson and Treloar
- Assessment of causes of Vegetation Die-back at Yellingbo Reserve - for Parks Victoria
- Upper Yarra Waterway Management Plan - for Melbourne Water
- Woori Yallock Catchment Waterways Activity Plan - for Melbourne Water
- Williamstown Range Estate, Review of Lake Conditions - for the ULC
- Wimmera catchment, Waterway Strategy - for Wimmera Catchment Authority
- Upper Maribyrnong and Werribee Catchments Waterway Management Plan - for CALPB
- Stormwater Treatment Wetland System For Township Of Moriac - for Surf Coast Shire
- Albert Park Lake, Review of Impacts of Seasonal Recharging with non-potable Water Sources - and follow-up water quality assessment - for Parks Victoria
- Patterson Lakes, Quiet Lakes – Review of Water Quality/ Lake management for MWC
- Investigation of Sediment sources to Kananook Ck. – for Melbourne Water
- Mary River Basin Water resource Plan – Water Quality – For Queensland Government
- Tootgarook Swamp Rosebud, Literature Review and Directions Report - for MWC.
- Submission Environment and Natural Resources Committee – Inquiry on Rural Drainage.
- Dalmore Drain Flooding Study – prepared for District Landowners.

1991-1996 Manager, Catchment Co-ordination, and **Manager, Catchment Strategy**,

These positions with Melbourne Water involved a range of strategic tasks including advice to Melbourne Water on catchment management, community consultation, environmental issues, responses to media and the protection of the drainage business. Achievements include:

- Review of extension of drainage services to the Mornington Peninsula
- Negotiation of asset transfers including transfer of responsibility for 63 timber bridges from MW to the Shire of Cardinia at a cost of $2 Million.
- Initiated "Rural Waterways Community Revegetation Program"

1987-1991 Senior Environmental Scientist and **Western Port Co-ordinater**, Dandenong Valley &Western Port Authority

Highest level of environmental advice to the Authority and others. The position included supervision of a number of technical specialists. Major achievements in this period included:

- Joint conduct of a major study, the *"Western Port Rivers Management Study "which* developed of a 15 year activity plan and works program for the Western Port catchment
- Consultation and negotiation to facilitate the eventual formation of the new Dandenong Valley & Western Port Authority on the 1st of November 1990.
- Preparation of advice to Authority on environmental, water quality and waterway issues.
- Joint development of a "Stream Conditions Assessment Program"(SCAP)

1977 - 1987 Scientific Officer/Laboratory Manager, and from 1983, **Environmental Chemist** with the Dandenong Valley Authority in the Pollution Control Branch.

- Sampling and analysis of industrial and treatment plant effluent for compliance with EPA licences. Appearances in court as Authorised Analyst and expert witness.
- Planning and implementation of ambient monitoring runs on the streams, lakes, tidal canals and estuaries within the DVA catchment area.
- Implementation of research projects including project on use of wetlands and macrophytes for wastewater treatment.

1971 - 1977 Trainee Chemist, **Development Chemist,** and **Plant Chemist** with United Packages Victoria.The position of Development Chemist involved research into new products in the fields of packaging, insulating materials and adhesives. The position of Plant Chemist involved general overseeing of an alkali silicate plant and resolving technical problems.

Appendix B The Sparrovale Wetland Report

PAT CONDINA & ASSOCIATES

Consultants in waterway, wetland and lake management
Water quality monitoring and assessment
Community consultation and education

An assessment of the sustainability of the proposed Sparrovale wetlands and assessment of the associated social, economic and environmental risks

Pat Condina and Neil Craigie

20 May 2014

Report prepared for City of Greater Geelong

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An assessment of the sustainability of the proposed Sparrovale wetlands and assessment of the associated social, economic and environmental risks.

1. Wetland Sustainability and Characteristics

The sustainability of any aquatic system is basically its capacity to satisfy its intended beneficial uses and environmental values over its lifetime without intractable water quality problems occurring, and without resort to excessive management intervention. The issues effecting sustainability of the Sparrovale wetlands are numerous, however from a water quality viewpoint nutrient levels and water salinity are the key determinants of wetland condition and biological status.

From a physical viewpoint the most important determinants of the type of ecosystems and plant and animal communities that are established on Sparrovale is the volume and frequency of stormwater inflow; and the depth of water in the wetland and the seasonal depth regime.

Wetland inflow, depth regime and to a somewhat lesser extent salinity and nutrient levels are amenable to management and these will predominantly determine how the wetland functions, the organisms it supports, how it serves its intended functions and uses, its aesthetic and landscape values, and ultimately, its long term sustainability.

2. Factors to be considered for Sparrovale Wetlands Design

Before setting management parameters for the proposed Sparrovale wetland a statement of intent needs to be formulated describing the ecosystem that should be established in both the short term and in the longer term. For example is the intent to create deep freshwater wetlands and pondages; or ephemeral wetlands of variable seasonal salinity; or freshwater meadows; or an area with saltmarsh characteristics; or combinations of these given the large area available?

There are several factors and influences which can guide such a decision as to the optimal design intent for the Sparrovale wetland:

- The source, volume and quality of flow to the wetland.
- The present need to utilise and treat stormwater from upstream development and in doing so, to prevent or minimise impact to higher environmental value downstream receiving environments.
- The range and type of beneficial uses envisaged.
- The existing physical characteristics of the area.
- Present and future saltwater influences including saline groundwater intrusion and saline intrusion as a result of sea level rise.

- The range of aquatic environments already established in the Lower Barwon Wetlands area.
- The type of ecosystem that existed on the land prior to agricultural use.
- The costs associated with any large scale construction or earth moving, including the costs associated with dealing with any currently unidentified site contamination issues (such as imported fill).

Table 1 discusses these factors in greater detail.

Guidance as to the optimal design intent for Sparrovale can also be obtained by reference to existing environmental studies of the aquatic ecosystems of the Lower Barwon region. These studies describe the characteristics of a range of freshwater to saline aquatic ecosystems, both as they were in the past and as they exist today, following any past hydrological modification.

An ecological study of the Lake Connewarre wetlands complex (Billows and Gwyther (2007) notes that Lake Connewarre, a shallow estuarine lagoon of the Barwon River, is the central feature of the wetlands system, and that a cluster of fresh and saline wetlands surround the lake, each governed by its own unique hydrological characteristics. These include Reedy Lake, Hospital Swamps, Salt Swamp and Lake Murtnaghurt . The extent of tidal penetration is limited along the Barwon River by a breakwater nearly two kilometres upstream of where the river flows into Lake Connewarre. The report also noted the evident relationships between plant communities and prevailing environmental conditions within the wetlands complex. The variety and variability of the array of abiotic factors within the complex contributes to the wetland system's floristic diversity, both spatially and temporally. Put simply, increased physical habitat diversity leads to increased biological diversity.

The complex was in 1983 declared as a wetland of International significance under the Ramsar Convention. All of the waterbodies in the wetlands complex have lake, swamp or marsh characteristics and they have varying water depth and salinity. Lakes are generally distinguished from wetlands by their deeper water which usually persists all year round. A marsh is a type of wetland where water covers the ground for long periods of the year and plant life is dominated by grasses and herbaceous plants (unlike swamps which are dominated by tree species such as Melaleuca sp).

Lake Connewarree for example is a saline tidal estuarine lake influenced by the daily tidal regime in the Barwon River estuary.

By contrast Reedy Lake is a brackish freshwater lake and is almost completely covered by aquatic submerged and emergent vegetation. It could also be correctly referred to as a deep marsh wetland. With an area of 550 Ha it is the largest natural freshwater wetland in central Victoria. It has a small local catchment of 2700 Ha but is flooded almost entirely from the Barwon River. Prior to European settlement, Reedy Lake was an ephemeral wetland that received minor inflows from the local catchment and major flows from peaks in the Barwon River. The river was originally estuarine upstream of the lake and the lake would have received a combination of saline and freshwater inflows, depending on the contribution of high tides and high river flows (Lloyd Environment Pty Ltd, 2010).The inlet and outlet hydraulic structures to Reedy Lake create deeper, more permanent water and are now

essential to provision of a favourable water regime. In the absence of these structures it is estimated that at a capacity of 4000 ML (1m depth) the lake would dry up within a year under average climatic conditions (PPK, 2000)

Hospital Swamps comprises five basins which receive water from both the Barwon River and from local runoff. The wetland is isolated from the estuary by a bund. Water is diverted from the Barwon River via a regulated channel through Sparrovale Farm, which has an invert of 0.3 m AHD (Lloyd Environment Pty Ltd, 2010). Prior to these 1983 works the Swamp would only hold water temporarily after heavy winter rain or when flooded by the Barwon River. The swamp vegetation communities are dominated by submerged and emergent macrophytes.

A number of reports have examined the hydrological and flow requirements of wetlands within the wetlands complex including Lloyd Environment Pty Ltd (2006 and 2011), PPK (2000), and Water Technology (2010). Detailed prescriptions for water management have been formulated so as to achieve environmental and beneficial use objectives for each wetland system. It is apparent however that there have been so many past hydrological modifications and resultant physico-chemical modifications to these systems, that to suggest that any current or proposed regime is the optimal environmental arrangement, has little basis in fact. Wetlands are in any case not static ecosystems, and even in the absence of man induced changes they can change very rapidly (particularly after extreme flood events) from the viewpoint of depth, sediment build-up, area and type of flora and fauna communities found. It is therefore legitimate to prescribe a management regime which achieves maximum environmental, social and economic benefit in accordance with current scientific and community values and objectives.

In implementing the Sparrovale wetland project, regional environmental benefit would also result if the wetland replicated an aquatic ecosystem and habitat that existed on the site in the past and may be uncommon now. It can be seen from the above discussion that prior to development of this area ephemeral reed swamps and marshes would have been more common on the Lower Barwon. Due to water regulation practices these ephemeral marsh characteristics have diminished in the existing wetland complex and Sparrovale presents an opportunity to restore an ephemeral marsh ecosystem.

Site inspections of the Sparrovale site show a very flat area that, because flood protection levees have been constructed in the past, is now only infrequently flooded by overtopping from the Barwon River and so can be grazed at most times. Craigie (2013) notes that Sparrovale Farm is, and has historically been, subject to extensive inundation from both its local catchment and the Barwon River. Prior to construction of the Sparrovale levee the site would have received overbank flows from the Barwon River whenever the natural river verges were overtopped in flood events. This pattern of overbank river flow onto an essentially flat basin would have created the characteristics of a freshwater ephemeral marsh. There may have been considerable variation in salinity due to saline groundwater inputs but the wetland would still essentially have retained freshwater characteristics.

In such an ephemeral marsh system, shallow water would persist over the wetland in wet winters, shrinking quickly over late spring and summer/autumn. The wetland would be essentially dry by the end of summer apart from any deeper refuges constructed to allow aquatic organisms to persist. It would fill again in any Winter/Spring flood. A return to this

hydrological pattern could be somewhat approximated, not by increased flows from the Barwon River, but rather by accepting developmental flows from the upstream catchment in the Horseshoe Bend Precinct. The inclusion of deeper refuge areas would allow storage of stormwater inflows from upstream development over the summer/autumn period (rather than allow spreading over the flat wetland floor) and so maintain an annual drying cycle over the greater part of the wetland. If Sparrovale Farm was transferred into public ownership then the area currently subject to prolonged inundation would be able to be converted to a freshwater wetland system, with the existing Barwon River levee retained. The Normal Top Water Level (NTWL) of the wetland would be set at 0.95m AHD and the area of land inundated at this level would be 220 Ha (Craigie, 2013).

Apart from creating significant new habitat the Sparrovale wetland would ensure complete protection of important downstream ecosystems. As well as water quality improvement there would be significant evaporation and infiltration of the incoming stormwater over the summer season so that downstream ecosystems are protected from increased or unnatural stormwater flows.

3. Proposed Wetlands Design

Reflecting the discussion in Section 2, the key design responses proposed for Sparrovale are listed in Table 1 for each of the listed factors.

Table 2 then summarises the design intent and ecosystem objectives for Sparrovale in the short, medium and long term. These will be fully realised via implementation of the DCP programs.

Table 1 Factors influencing characteristics of proposed Sparrovale wetlands		
Factor/Influence	**Discussion**	**Key Design Response/Outcome for Sparrovale**
The source, volume and quality of flow to the wetland	• Prior to upstream residential development, inflow from the upstream natural catchment only occurs in larger storm events. • With development there will be far more frequent inflows and larger annual inflow volumes. • The quality of stormwater may be degraded compared to pre-development quality depending on upstream treatment. • At times there may be insufficient supply of freshwater from the HBP areas alone to sustain wetlands as large as those which can be created in Sparrovale.	• Provide large area for evaporation/infiltration of additional stormwater volumes. • Reinstate northern outlet from Sparrovale to the Lower Barwon River. • Design this same structure to enable transfer of water from the lower Barwon pondage back into the wetlands if deemed necessary for environmental reasons (e.g., soil and vegetation management). • Provide initial sedimentation area and large area of shallow marsh to filter stormwater. • Implement and refine water quality monitoring program.
The present need to utilise and treat stormwater from upstream development and in doing so to prevent or minimise impact to higher environmental value downstream receiving environments.	• Providing significant stormwater treatment in Sparrovale wetlands will reduce land take within the developed catchment area for stormwater treatment and will assist in making the Sparrovale project truly multipurpose and economically viable.	• As above • Limit stormwater quality treatment in HBP to removal of gross pollutants, and medium to coarse sediments, commensurate with ancillary peak flow management needs within the HBP development area. • Implement and refine water quality monitoring program.
The range and type of beneficial uses envisaged.	• The project could sustain a range of uses including stormwater treatment, flora and fauna habitat, aesthetic and landscape enjoyment, and walking/maintenance trails along the margins and through selected areas of the wetland. • There are some areas of remnant indigenous vegetation which could be protected/enhanced if practicable. • Existing spoil dumps are scattered within and in places around the margins of the wetlands. Quality of fill is unknown. • Existing spoil dumps within the greater wetland area do not threaten flood storage capacity or water quality treatment potential and do not have to be removed.	• Maximize range of habitat types. • Consider strategic ground level changes (cut/fill). This could include reshaping of existing spoil dumps. • Encourage natural regeneration. • Plant aquatic species, with terrestrial groundcover, middle storey and upper storey plants as necessary above wetland water levels. • Institute and maintain effective aquatic and terrestrial weed management. • Provide access around and through the area to support maintenance and recreational activities. • Use strategic fill mounding and drainage control to protect remnant saltmarsh communities in the east end of the wetlands if practicable.
The type of eco-system that existed on the land prior to agricultural use.	• Prior to development and construction of levees and barrages on the Barwon River the Sparrovale area would most likely have experienced a combination of influences including freshwater inputs from the Barwon River whenever it exceeded	• Complete freshwater inundation of the wetland at least on an annual basis to levels of 0.95 m or higher. • Design a shallow ephemeral freshwater wetland system. • Provide small areas of greater depth to provide aquatic flora and

Table 1 Factors influencing characteristics of proposed Sparrovale wetlands		
Factor/Influence	**Discussion**	**Key Design Response/Outcome for Sparrovale**
	bankfull levels, and perhaps saline inputs from tidal intrusion. • Some localised deeper areas of more permanent freshwater may have existed. • Vegetation would have comprised a mix of indigenous aquatic, ephemeral and terrestrial communities-largely dictated by water level regimes. Salinity tolerant species would have been more common in the easterly end.	fauna refuge and increase range and diversity of habitat types.
The existing physical characteristics of the area.	• The area is currently grazed and flora and fauna values are very low except for the minor remnant saltmarsh area in the east end. • Weed species present. • Most of land less that 1 m AHD • Site inspection and aerial photogrammetry show an area subject to infrequent flooding and shallow inundation from local catchment runoff in periods following storm events. • With current infrastructure (main Barwon levee and control structures) tidal saltwater intrusion does not occur, and the wetlands are reasonably well protected from Barwon River floods up to 10 years ARI. • In very large floods (> 10 years ARI), the entirety of the wetlands is and will remain subject to inundation from the Barwon River (100 yr ARI flood level is 3.0 m).	• Cease grazing on a staged basis across the site and implement weed control measures. • Use freshwater inundation as a means of control of terrestrial weeds. • Continue shallow inundation regime. • Construct an internal levee to 1.25 m and provide a culvert/gate valve control structure to protect some remnant saltmarsh communities at the east end near the Barwon levee. • Reinstate the original bypass drainage line out of Sparrovale around the north side of Hospital Swamps and reconstruct hydraulic control structures to suit intended operating regimes.
Present and future saltwater influences including saline groundwater intrusion and direct saline flow intrusion as a result of forecast sea level rises.	• The most significant saltwater influence is likely to be input from the saline groundwater in the area, plus evaporative concentration of surface and near surface salts after flooding. • By 2100 forecast sea level rises will permanently inundate Hospital Swamps as part of an extended estuary/Lake Connewarre. • In the absence of the Barwon River levee and the control structures the same fate would befall Sparrovale. Due to its' comparatively higher surface levels the expectation would be for it to largely convert to a salt water marsh. • The assumption is made that the Barwon River levee around Sparrovale wetlands is retained into the future so as to provide assurance of retention of major freshwater wetlands as part of the lower Barwon floodplain, if sea level rise forecasts	• Saltwater influences will be a key part of the design/development of the Sparrovale wetland. • Set the NTWL at 0.95 m AHD to ensure protection against the forecast 2100 sea level rise and to allow 100 mm head to get water out into the lower Barwon pondage if required. • Review and adjust hydrodynamic modelling of lower Barwon floodplain area to assess required level of protection of new freshwater wetlands against future sea level rises and hence the finished crest levels of levees. • Construct an internal levee to 1.25 m and provide a culvert/gate valve control structure to protect some remnant saltmarsh communities at the east end near the Barwon levee. • Inspect and repair/redesign/rebuild the main levee system and control structures as required after review of hydrodynamic modelling, and

Table 1 Factors influencing characteristics of proposed Sparrovale wetlands		
Factor/Influence	**Discussion**	**Key Design Response/Outcome for Sparrovale**
	eventuate. This objective could also be achieved through construction of an internal levee-in which case part or all of the existing levee could be abandoned. • There may be a need for enhanced flushing flows to be captured through Sparrovale at times to control soil salinity and support dependent vegetation communities. Local catchment runoff may be insufficient as the only source of freshwater.	maintain into the future. • Reinstate northern outlet from Sparrovale to the Lower Barwon River. • Design this same structure to enable transfer of water from the lower Barwon pondage back into the wetlands if deemed necessary for environmental reasons (e.g., soil and vegetation management). • Reinstate the original bypass drainage line out of Sparrovale around the north side of Hospital Swamps and reconstruct hydraulic control structures to suit intended operating regimes. • Implement and refine water quality monitoring program.
The range of aquatic environments already established in the Lower Barwon Wetlands area	• The area has a wide range of aquatic habitats including coastal estuary, intertidal areas, saltmarshes, shallow freshwater to saltwater lakes, and shallow freshwater lakes. • The ecosystem type that may once have existed along the lower Barwon is ephemeral brackish to freshwater marsh	• Establish wetland as predominantly an ephemeral brackish to freshwater marsh. • Implement and refine water quality monitoring program.
The costs associated with any large scale construction or earth moving or re-vegetation	• Often the highest cost components in establishment of constructed wetlands are earthmoving and establishment of indigenous aquatic, ephemeral and terrestrial vegetation. • Costs may be minimised by utilizing the existing landforms and relying on natural regeneration. If deeper water areas are required these can often be constructed by levee formation and/or minor excavation. • Reconstruction of the main levee may be cost-prohibitive after review of hydrodynamic modelling to confirm appropriate crest levels for protective levees. It may be preferable to utilize the new internal levee only and abandon the current levee-at least in part.	• Use existing landforms wherever possible. • Minimize excavation. • Reshape existing spoil dumps to create trails and extra habitat diversity. • Use cut/fill techniques to avoid double-handling of materials. • Develop predominantly shallow rather than deep wetlands. • Encourage natural regeneration rather than planting, through strategic use of inundation and weed control techniques. • Remove stock grazing as a staged process commensurate with weed management capacity. Remove all stock from land below 1.0 m in the first instance. • Review and adjust hydrodynamic modelling of lower Barwon floodplain area to assess required level of protection of new freshwater wetlands against future sea level rises and hence the finished crest levels of levees. • Confirm what parts of the main levee system need reconstruction, if any.

Table 2 Wetland Design Intent and Ecosystem Objectives for Sparrovale Wetland	
Time Frame	**Wetland Design Intent and Ecosystem Objectives**
Short Term (0-5 years)	• Finalise land ownership agreements/arrangements. • Implement water quality monitoring program. • Review and adjust hydrodynamic modelling of lower Barwon floodplain area to assess required level of protection of new freshwater wetlands against future sea level rises and hence the finished crest levels of levees. • Carry out land environmental audit and contamination assessment. • Carry out flora and fauna assessment, cultural heritage assessment, hydrologic modelling and groundwater assessment. • Prepare Wetlands Master Plan and Wetlands Management Plan. • Prepare biological monitoring program. • Remove stock grazing from land below 1.0 m at least, including areas of vegetation to be protected. Requires stock fencing of land below 1.0 m. • Institute weed management activities on land between 0.5 and 1.0 m. • On land below 0.95 m, reshape existing spoil dumps in conjunction with access trail provision (to levels >0.95 m) and excavation of selected areas of deeper water (to 0.0 m). • Provide initial sedimentation area at wetland entry near Charlemont Road. • Construct an internal levee to 1.25 m and provide a culvert/gate valve control structure to protect some remnant saltmarsh communities at the east end near the Barwon levee, and to control water levels in the upstream wetland. • After review of hydrodynamic modelling and confirmation of levee protection requirements, inspect and repair/redesign/rebuild the part or all of the main levee system and control structures as required, and maintain on an annual basis. • Reinstate the original bypass drainage line out of Sparrovale around the north side of Hospital Swamps and reconstruct hydraulic control structures to suit intended operating regimes. • Investigate advantages and disadvantages of diversion of dry season Armstrong Creek flows to Sparrovale along north side of Baenchs wetland • Carry out targeted re-vegetation activities on lands below 1.0 m
Medium Term (5 to 30 years)	• Visually inspect and maintain the main levee system and control structures on an annual basis. • Reinstate northern outlet from Sparrovale to the Lower Barwon River. • Design this same structure to enable transfer of water from the lower Barwon pondage back into the wetlands if deemed necessary for environmental reasons (eg., soil and vegetation management). • Remove stock grazing from balance of land. • Carry out targeted re-vegetation activities across balance of area. • Implement landscape/recreational management plan. • Implement biological monitoring program. • Continue water quality and biological monitoring programs (with appropriate adjustments to sites and parameters after review).
Long Term (30 to 100 years)	• Inspect and maintain the main levee system and control structures on an annual basis. • Continue water quality and biological monitoring programs.

Most of the works/activities listed in Table 2 are incorporated in DCP Project DI_DR_13 – Sparrovale Wetland-Management Plan and 10 Year Implementation Works (refer Section 5). The balance engineering works are covered in DCP Project DI_DR_12 – Sparrovale Wetland-Construction.

Land acquisition arrangements for the Sparrovale wetlands are covered in DCP project DI LA 22 and 23 (Sparrovale and Cold Winds).

4. Risks Associated with the Sparrovale Wetlands

This review adopts a semi-qualitative approach due to the lack of comprehensive data to enable any form of quantitative assessment for all risk factors. Each of the key environmental social and economic issues relevant to wetland operation and use will have a level of risk associated with them.

The system used here is based on assessing Likelihood and Consequences of occurrences and hazards as outlined in Australian Standards for Risk Management (AS/NZS, 2000, 2004). This involves the process of identifying the potential hazards and then going through a process of evaluating the likelihood and consequence of each factor. These risk factors were then rated for its "likelihood" from rare (1) to almost certain (5) as is set out in Table 3 below.

Table 3 Descriptors of "Likelihood"

Level	Descriptor	Description
1	Rare	May occur only in exceptional circumstances i.e. once in 100 years
2	Unlikely	Could occur in unusual circumstances
3	Moderately likely	Might occur or should be expected to occur in a 5 to 10 year period
4	Likely	Will probably occur within a 1 to 5 year period
5	Almost certain	Is expected to occur every year with multiple occurrences

Following the assignment of a likelihood ranking, the risk factors were then appraised for "consequence" from insignificant (1) to catastrophic (5), for both the environment and human health, as set out in Tables 4 and 5 respectively.

Table 4 Descriptors of "consequence" for the environment

Level	Descriptor	Description
1	Insignificant	Insignificant impact
2	Minor	Potentially harmful to local ecosystem with local impacts contained to site
3	Moderate	Potential harm to regional ecosystem with local impacts primarily contained to site
4	Major	Potentially lethal to local ecosystem. Predominately local, but potential for off-site impacts.
5	Catastrophic	Potentially lethal to regional ecosystem or threatened species. Widespread on-site and off-site impacts

Table 5 Descriptors of "consequence" for human health		
Level	**Descriptor**	**Description**
1	Insignificant	Insignificant impact. No identified illness
2	Minor	Minor impact for small population. Minor illness or irritation that does not require medical treatment
3	Moderate	Minor impact for large population. Minor illness that requires medical treatment (visit to a doctor)
4	Major	Major impact for small population. Serious illness that requires hospitalization
5	Catastrophic	Major impact for large population. Permanent disability, incapacitation or death

In assessing human health impacts there needs to be consideration of the various population subgroups whether it be the asset operations staff, the young, the fit, the aged, immune suppressed people, or children, due to the open uncontrolled nature of the site and the wide spectrum of possible uses in those areas.

Having developed ratings for both likelihood and consequence the analysis can proceed to attain an overall risk rating. Having done this there can be an exploration of components leading to this assessment and also some thoughts assembled as to potential remediation measures. A semi -quantitative risk analysis was used to identify and rank the key risks at the Sparrovale site using the five point scoring systems outlined in Australian Standard (AS/NZS, 2000, 2004) shown in Table 6.

Table 6 Semi-quantitative risk matrix for risk rating assessment					
LIKELIHOOD	**CONSEQUENCE**				
	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Almost certain (5)	5	10	15	20	25
Likely (4)	4	8	12	16	20
Moderately likely (3)	3	6	9	12	15
Unlikely (2)	2	4	6	8	10
Rare (1)	1	2	3	4	5

Risk Rating	Low 1-4	Medium 5-10	High >10

The level of risk normally determines the type and extent of mitigation measures that will be required on a site. Where a high risk to the environment and/or human health has been identified, mitigation measures should be introduced to reduce the risk to an acceptable level (i.e. <= 4 wherever practicable). Factors with a medium or low risk should also have practicable management measures implemented if these can further reduce risk at a reasonable cost.

Table 7 lists the potential risks associated with the proposed Sparrovale wetlands and stormwater inputs to them and to Hospital Swamps. It also gives estimates of risk rating and potential responses to mitigate such risk.

It can be seen from Table 7 that implementation of the measures proposed under the DCP Projects DI_DR_12 and DI_DR_13 (particularly the Wetlands Master Plan and Wetlands Management Plan), will reduce risks to acceptable and reasonable levels.

Table 7 Risk, Risk Rating and Potential Mitigation Measures for Sparrovale Wetland						
Description of Risk	**Ratings without mitigation measures**			**Potential Mitigation Measure to lower risk rating**	**Ratings with Mitigation measures**	
	Likelihood	**Consequence**	**Risk Rating**		**Likelihood**	**Risk Rating**
General levels of contaminants in the urban runoff including Heavy Metals, PAH's and nutrients that may accumulate in wetland over time	4	3	12	• Pre-treatment to best practice standards in Armstrong's Creek Precincts and substantial pre-treatment of stormwater in horseshoe bend precinct, as described in SWMS Oct 2013. • Scheduled desilting and reset of the upstream sediment traps and less frequently the treatment wetlands needs to be programmed to reduce the accumulated levels. • Monitoring of accumulation of sediments in the sediment ponds and wetlands needed on an annual basis	1	3
Contaminated stormwater from upstream spills e.g. chemical, herbicide, petrol, oil from the catchment, entering the treatment train under rainfall event condition	4	4	16	• Stormwater treatment train will provide effective trapping of spills. • Continual monitoring and emergency alerts. • Establish emergency contact protocol with CFA/EPA. • Close penstocks and other isolation device as soon as spill occurs. Rehabilitate the system, replant as necessary • Monitor until event resolved.	1	4
Nutrient export by treatment wetlands under certain conditions (eg in plant die-off if water levels high)	2	3	6	• Set wetland depths and hydraulic controls to ensure optimal depths for plants are not exceeded for long periods.	1	3
High salinity from groundwater or other source (tidal influence and rising sea level) leading to die-off of freshwater aquatic vegetation	3	4	12	• Annual reduction in salinity of wetland in Autumn/Winter storm events. • Minimize excavation particularly where it intersects the groundwater table. • Provide alternative freshwater source (eg Barwon River. • Maintain levee to exclude sea level rise threat	1	4
Occurrence of blue green algal blooms and production of algal toxins which impact on wetland biota and birdlife.	3	4	12	• Nutrient removal in upstream treatment train. • Minimize extent of deep open water. • Create optimal conditions for aquatic plant growth so that primary productivity is dominated by plant growth rather than algal growth.	1	4
Proliferation of pest species eg carp and consequent poor water quality	4	4	16	• Ensure periodic drying out of wetland. • Avoid large areas of deep open water. • Provide means of artificial drawdown of wetland.	1	4

Table 7 Risk, Risk Rating and Potential Mitigation Measures for Sparrovale Wetland						
Description of Risk	**Ratings without mitigation measures**			**Potential Mitigation Measure to lower risk rating**	**Ratings with Mitigation measures**	
	Likelihood	**Consequence**	**Risk Rating**		**Likelihood**	**Risk Rating**
Occurrence of high populations of mosquitoes carrying diseases	4	4	16	• Remove grazing to eliminate stock pugging. • Avoid small isolated pockets of shallow water (ensure natural predators have free access to all water areas). • Encourage aquatic plant growth and invertebrate habitat. • Maintain a small refuge area for aquatic life that does not dry out.	1	4
Human contact problems including risk of dermatitis and drowning	3	5	15	• Provide signage explaining that body contact uses are prohibited. • Design a shallow wetland with any deeper areas reasonably inaccessible from edges. • Provision of exclusion fencing where appropriate	1	5
Growth of pest plants	5	2	10	• Monitor to observe early infestation, making control easier. • Manipulate water depths to eliminate pest species. • Implement pest control measures, early spot spraying, cutting and painting, burning, etc.)	2	4
Harbouring of pest animals	4	2	8	• Monitor and control as necessary. • Strategic exclusion fencing. • Pet controls on nearby subdivisions.	2	4
Generation of smells or other poor aesthetic wetland condition	2	2	4	• Smells normally generated in instances of natural processes of die-off of plants and algae. • No intervention is recommended - adequate setbacks of adjacent development will minimise complaints.	2	4
Site contamination due to prior land use activities	2	3	6	• Carry out site audit and contamination assessment. • Implement audit recommendations-focussing on isolation and stabilisation of suspect materials within the site-no offsite removal is required, unless materials in the highest hazard categories are discovered in the audit process.	1	3

References

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Craigie NB M (2013) *Armstrong Creek Urban Growth Area Horseshoe Bend Precinct. Stormwater Management Strategy*. Neil M Craigie Pty Ltd, October 2013.

Environmental Flows Technical Panel. 2006. *The Environmental Flow Determination for the Barwon River: Final Report – Flow Recommendations.* Report prepared by Lloyd Environmental Pty Ltd, Fluvial Systems Pty Ltd & Ecological Associates Pty Ltd, for the Corangamite Catchment Management Authority, February 2006.

Lloyd Environmental Pty Ltd, Dalhaus Environmental Geology, Ecological Associates Pty Ltd (2011) *Flow/ecology relationships and scenarios for the Lower Barwon Wetlands environmental entitlement*: Final Report to Corangamite CMA 23 Sept 2011

PPK. (2000). *Reedy Lake, Geelong – Draft Water Level Management Plan.* Report prepared for Parks Victoria, PPK Pty Ltd, South Melbourne, Victoria.

Water Technology (2010) *Barwon River Lower Breakwater Management Options Report* prepared for Corangamite Catchment Management Authority June 2010.

Appendix 1 A review of the DCP_DI_DR_13 project cost estimates

The summary table for DCP project DI_DR_13 Sparrovale Wetland-Management Plan and 10 Year Implementation Works is attached.

The quantities, rates and costs listed in the DI_DR_13 summary table are considered generally appropriate. However it is suggested that some changes are needed for Items 2.2, 2.3, 3.3, and 5.1, 5.2 and 5.3 as set out below.

It may be noted that many of the concerns we have are related to current lack of knowledge (e.g., there is no contaminated site audit and no levee audit), so it appears that very conservative estimates have been adopted to mitigate the chance of Council inheriting responsibility for future higher costs. Listing these unknowns as Prime Cost items in the DCP program schedules may be appropriate to protect everyone's interests.

DI_DR_13 Item	Issues of concern	Discussion
2.2 and 2.3	• Inspection and aerial photos indicate no large surface rubbish stockpiles are evident across the lowest parts of the properties. • Imported fill stockpiles appear to be mainly around the higher margins. • Estimates are high and appear to allow for offsite removal.	• Given the vast size of the site there is no reason why rubbish and contaminated fill cannot be disposed of onsite in landscape mounds or levee berms. • Audit costs OK but contamination treatment costs are likely far too high. Should be a PC item subject to audit outcomes.
3.2	• Existing levee may be largely abandoned after hydrodynamic review completed. As a minimum repair/rebuild works on existing levee will be required on Barwon River frontage.	• Should be a PC item after completion of hydrodynamic modelling review.
3.3	• Very high estimate for very low level works requirement within Sparrovale.	• Other than the inlet sediment basin itself (which will be a Council asset to manage into the future) there is no requirement for sediment removal across the general Sparrovale wetlands area now or for many decades into the future. • The inlet basin itself should not require sediment clearing within 5 years after its construction, because of the upstream sediment management assets. It is unlikely to be built within 5 years. • Maximum $50,000 over 10 years.
5.1	• Duplicates initial audit • Way too high given full repair of the levee will be carried out at the start-and then only if need is confirmed after hydrodynamic modelling review. Partial repairs/rebuild may only be required on the Barwon River frontage.	• Suggest biannual visual inspection (plus a check after floods) is all that is required for the final design levee systems. • Say $25,000 total over 10 years.

DI_DR_13 Item	Issues of concern	Discussion
	• Any major flood damage repair required thereafter will not be a DCP item.	
5.2	• Estimate too high • $10,000 initial first assessment is part of initial management plan and flora and fauna assessment. • Follow-up assessments should be 2 years afterwards, then at 5 years and 10 years.	• Suggest $30,000 total over 10 years.
5.3	• Conflicts with recommendations of water quality monitoring program we have supplied. • Estimate is too high.	• Short term need (say years 1-5) for Sparrovale is one site only at existing outlet. $5,000 in year 1. For years 2-9 this site should be $2,500/year. Total $27,500 for 10 years. • In years 5-10 two extra sites come online in Sparrovale. Assume both online at end year 5. • The wetland inlet site is $15,000 for the 5 years. • Ditto for the Barwon outlet. • Total $57,500-say $60,000 for 10 years.

We accept the clear nexus between the need for the Sparrovale project and the development of HBP in full, and therefore support funding of the purchase of the land by HBP, together with the various investigations, reviews and Management Plans required to facilitate conversion of the land to wetland uses. It is also apparent that the project has potentially very high future social and environmental values which extend well beyond the HBP.

Armstrong Creek Horseshoe Bend Precinct - Development Contributions Plan **1 October 2013**

SPARROVALE WETLANDS

DCP Project DI_DR_13 - SPARROVALE WETLAND - MANAGEMENT PLAN AND 10 YEAR IMPLEMENTATION WORKS

Delivery, establishment and management of the Sparrovale Wetlands (*Sparrovale* and *Cold Winds* properties) for the first 10 years of the Precinct's life to effectively transition the site form a degraded farmland to a functional, integrated and sustainable wetland system.

Item	Description	Qty	Unit	Rate	Cost	Notes / Comments
1	GOVERNANCE				$ 350,000	
1.1	Preparation of Sparrovale Wetlands Master Plan	1	Item	$ 50,000	$ 50,000	
1.2	Preparation of Sparrovale Wetlands Management Plan	1	Item	$ 100,000	$ 100,000	Seek State and Federal endorsement
1.3	Preparation of Sparrovale Wetlands Flora and Fauna Assessment (including a potential Fauna Conservation Management Plan)	1	Item	$ 75,000	$ 75,000	
1.4	Preparation of Sparrovale Wetlands Cultural Heritage Management Plan	1	Item	$ 50,000	$ 50,000	
1.5	Preparation of Sparrovale Wetlands Hydrological Model, Ground Water Assessment and Water Management	1	Item	$ 75,000	$ 75,000	effective management of water flows and retention to sustain the wetland during its establishment (including flood gate operation and Barwon River Flood Mgt).
2	ENVIRONMENTAL MANAGEMENT				$ 2,000,000	
2.1	Land Environmental Audit and Contamination Assessment	1	Item	$ 75,000	$ 75,000	The two properties have had a history of illegal fill and rubbish dumping on the site.
2.2	Rubbish Removal	1	Item	$ 100,000	$ 100,000	Making the site safe and fit for purpose.
2.3	Land Contamination - Mitigation works (contamination materials / soils, etc)	1	Item	$ 250,000	$ 250,000	
2.4	Fencing Works - Rabbit proofing, boundary improvement, gates, etc)	1	Item	$ 350,000	$ 350,000	Removal of existing areas of rural fence and replacement with appropriate public land / access control fencing.
2.5	Weed Mapping and Management (inclusive of burning)	500	Ha	$ 1,500	$ 750,000	Complete via an annual weed management program and routine mapping to support program (~ $75,000 pa)
2.6	Wetland revegetation (salinity management, ground and levee stability, etc)	1	Item	$ 250,000	$ 250,000	
2.7	Pest Control	1	Item	$ 150,000	$ 150,000	Pest control and management, including rabbit warren removal ($15K pa). The land has an known issue with the presence of rabbit and foxes.
2.8	Sparrovale Wetland - Buffer planting / screening	1	Item	$ 75,000	$ 75,000	
3	DRAINAGE WORKS				$ 1,025,000	
3.1	Levee Audit - Assess structural integrity and ability to meet performance	1	Item	$ 75,000	$ 75,000	
3.2	Levee Improvement Works (improve structural integrity, erosion, etc)	1	Item	$ 500,000	$ 500,000	
3.3	Sedimentation Management	3	Item	$ 100,000	$ 300,000	Works undertaken once every 3 years, including grass and plant re-establishment
3.4	Levee Access - Improved access tracks and access to the levee	1	Item	$ 150,000	$ 150,000	combination of walking and vehicular tracks to allow maintenance access during critical times of the year (eg: pre and post flood events)
4	PUBLIC ACCESS MANAGEMENT				$ 330,000	
4.1	Establishment of a public viewing area (car parking, seating, fencing, etc)	1	Item	$ 250,000	$ 250,000	Targeted access and viewing point for the public to avoid sporadic and uncontrolled access to the site.
4.2	Wetland Signage (interpretive, no access areas, etc)	1	Item	$ 50,000	$ 50,000	
4.3	Alcoa Powerline Easement - Improvement vehicle access	1	Item	$ 30,000	$ 30,000	The establishment of a wetland on the land will result in additional water depth and limitation on access to the easement. This access need to be maintained for maintenance and emergency management.
5	MONITORING				$ 325,000	
5.1	Engineering - Routine Levee Audit (risk and structural)	5	Years	$ 15,000	$ 75,000	Undertaken every 2 years
5.2	Biodiversity Assessment and Monitoring	10	Years	$ 15,000	$ 150,000	Annual monitoring
6.3	Water Quality Monitoring	20	Years	$ 5,000	$ 100,000	Bi-annual monitoring of stormwater quality, flows and water table
					$ -	
	TOTAL				$ 4,030,000	Excl. GST

** The above works exclude initial civil works required to construction new internal levee, drainage channels, flood gate / values works and general maintenance access tracks. (refer Horseshoe Bend Precinct Development Contributions Plan; project DI_DR_12 - Sparrovale Wetland - Construction)*

All costs prepared by the City of Greater Geelong