



Framework for evaluation of climate change adaptation plans

A case study evaluating City of Melbourne's Climate Change Adaptation Strategy

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3 EXECUTIVE SUMMARY

A framework has been proposed based on the literature review and adaptation of Baker et al. (2012) and Baynham & Stevens et al.'s (2014) frameworks for evaluation of climate change adaptation plans. City of Melbourne's Climate Change Adaptation Strategy (2017) has been used as a case study and evaluated based on the proposed framework. Evaluation of the quality of the plan involves categories of information base, vision, options & plans, actions, and implementation & monitoring. Similarly, contents of the plan have been evaluated based on its inclusion or exclusion of the outcome criteria chosen and advocated by the academic research on the adaptation measures. Results show that the strategy needs to represent and address sea level rise, water quality and threats to biodiversity in a detailed manner though the report is strong on adapting to flash floods, extreme weather events, and maintenance of water quantity. The words 'strategy' and 'plan' have been used interchangeably for the purposes of this report.

2. INTRODUCTION & LITERATURE REVIEW

Global warming and climate related changes are manifest at local, regional, and national scales (IPCC, 2007). Previously, transnational agreements, frameworks and protocols induced a focus on mitigation measures taken by the international and national scales (United Nations Framework Convention on Climate Change, 1992). However, alongside pushing for mitigation measures at global and national scales, there has been a recent focus on complementing the mitigation measures with adaptation strategies at local scales (Baynham & Stevens, 2014; Baker, Peterson, Brown, & McAlpine, 2012). Wheeler (2008) emphasize that such adaptation measures should mirror the research and planning carried out for the greenhouse gas emissions.

Research has emphasized the need for adapting local urban policies and environment to the hazards of climate change. Hurlimann et al. (2014) advocate for embedding the impacts of sea level rise into the planning system while Hennsey et al. (2007) advocate for protecting the quality of water at local levels through adaptation measures. Others have advocated for dealing with urban heat island effect, conservations of biodiversity, protecting quantity of water, and avoiding hazards to the built environment through adaptation strategies (IPCC, 2007; Stone, 2005; Opdam & Washer 2004; Ghassemi, Howard & Jakeman, 1996).

It is in this backdrop that the City of Melbourne came up with its "Climate Change Adaptation Strategy" in 2017.

3.1 CONTEXT

The City of Melbourne is one of the 79 Local Government Areas located within Australia in the State of Victoria. It consists of centre of the city of Melbourne and seven inner suburbs that include East Melbourne, North Melbourne, Parkville, Carlton, Southbank, and Docklands (*Climate Change Adaptation Strategy, 2009*). The City of Melbourne formulated its first Climate Change Adaptation Strategy in 2009, which outlined adaptation strategies to address reduced rainfall, drought, extreme heatwaves and bushfires, intense rainfall and windstorms and sea level rise (*Climate Change Adaptation Strategy, 2009*.) The strategy under evaluation is aimed at evaluation of the 2009 strategy and updating of the same based on the new climate change realities (*Climate Change Adaptation Strategy Refresh, 2017*.)

4.2. METHODS FOR EVALUATION

The strategy has been evaluated based on the outcome criteria that the strategy should seek to achieve because of the proposed adaptation. Any strategy that claims to provide an enabling framework for adapting to hazards of climate change must include these outcome criteria. These have been arrived at through literature review and adapted from the Baker, et al., (2012) and Baynham & Stevens (2014) and reflect the socio-spatial realities of the City of Melbourne.

3.2 4.2.1. OUTCOME CRITERIA

Following are the ten outcome criteria, seven of which (C1-C6 & C8) have been adapted from Bakers et al., (2012) while two (C7 and C9) have been adapted from the Baynham & Stevens (2014) whereas one (C10) has been proposed by the scribe. These criteria and a brief justification of their inclusion is as under. Outcome criteria and their relation to broader structural element of the plan have also been given in Fig-I below.

3.2.1 C 1: Water quality is maintained

Hennesy et al. (2007) report that changes resulting due to climatic conditions may threaten water security. The local governments may find themselves in a vulnerable position if their future freshwater demand surpasses the water resources (Baker et al., 2012).

3.2.2 C2: Water quantity is maintained

Extreme temperatures, irregular rainfall patterns, increasing incidence of impermeable surfaces in the urban areas and saltwater intrusion into freshwater aquifers may impact

on the quality of freshwater, thus causing long term sustainability problems for local governments (Ghassemi, Howard & Jakeman, 1996).

3.2.3 C3: Impacts of flooding are avoided

IPCC (2007) reports incidence of urban and rural flash flooding due to high intensity and frequency of rainfall events.

3.2.4 C4: Landscape structure, composition and functions are maintained

Opdam & Washer (2004) expect adverse impacts on the landscape and biodiversity because of combined effects of climate change and habitat fragmentation due to rapid urbanization.

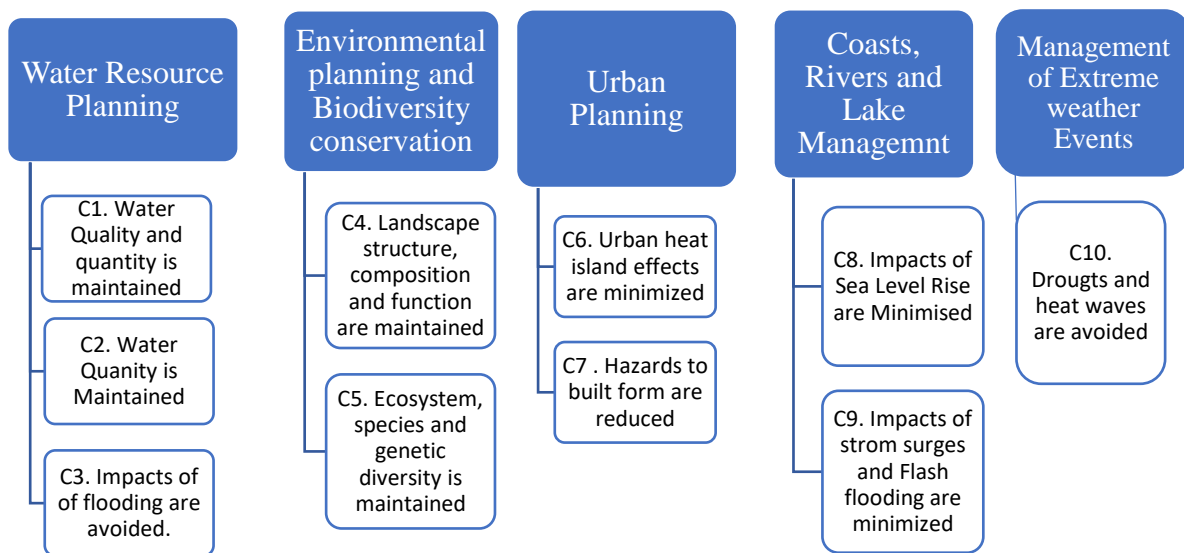


Fig: I: Outcome Criteria, adapted from Bakers et al., (2012, P.4).

3.2.5 C5: Ecosystem, species and genetic diversity is maintained

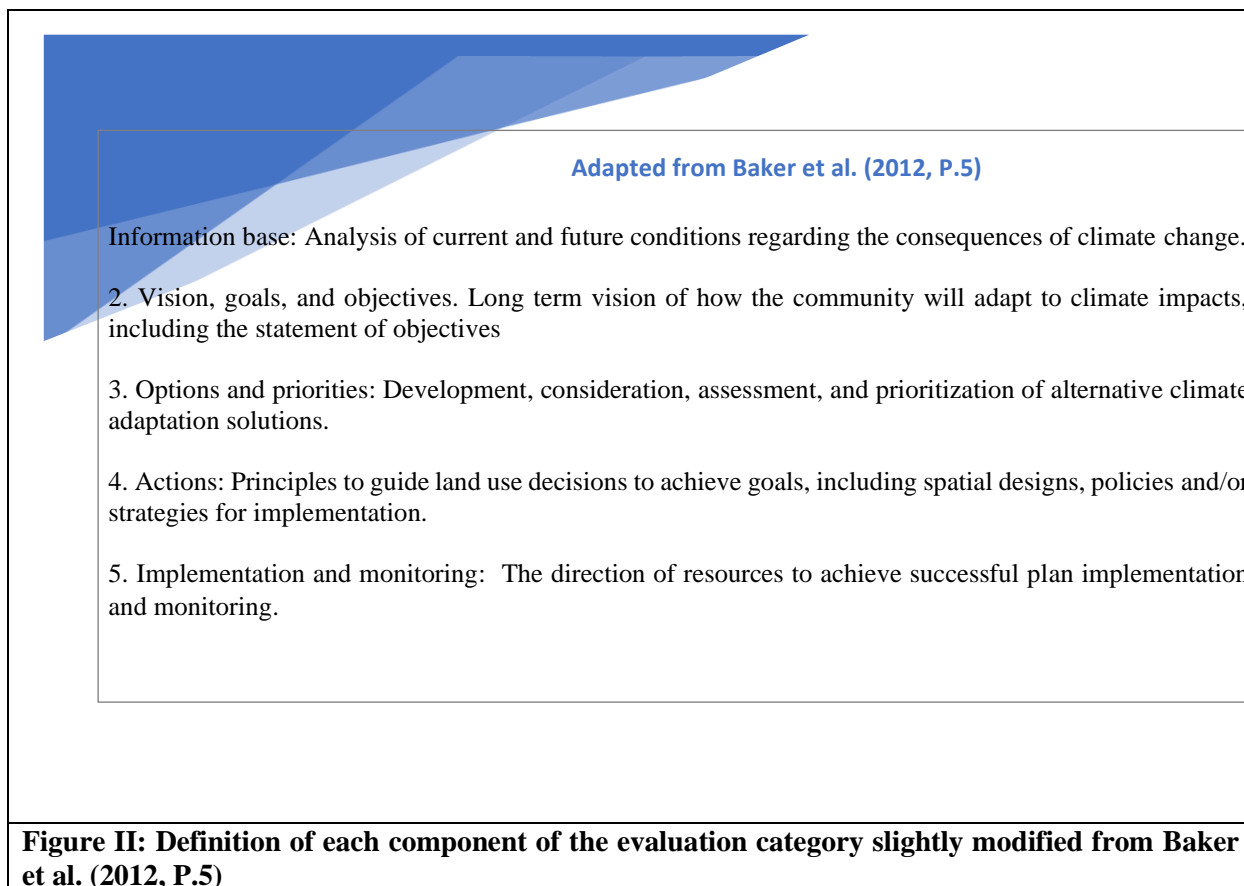
Jentsch & Beierkuhlein (2007) report a possible threat to ecosystems and biodiversity of species because of change in climatic conditions.

3.2.6 C6: Urban heat island effect is minimized

Stone (2005) reports that the average temperature of urban areas and their surrounding rural areas may differ by 3.5-4.5 degree Celsius because of the urban heat island phenomenon. Any adaptation plan for urban areas should consider the impacts of this phenomenon on the overall well-being of the living beings.

3.2.7 C7: Hazards to built form are reduced

Baynham & Stevens (2014) report potential impacts of the change in climatic conditions on the structural and functional sustainability of the built form.



3.2.8 C8: Impacts of sea level rise are minimized

IPCC (2007) estimate a mean global sea level rise from 18-59 cm by 2100. Adapting to this level rise should form a part of any viable adaptation plan. Hurlimann et al. (2014) also mention the need for factoring in sea level rise in urban planning.

3.2.9 C9: Impacts of storm surges and flash floods are minimized

IPCC (2007) report increased incidence of flash floods in the urban area due to extreme weather events.

3.2.10 C10: Droughts and heat waves are avoided

IPCC (2007) reports incidence of extreme weather events like droughts and heat waves due to climatic factors.

4 4.2.2. EVALUATION CATEGORIES

Plan quality is the measure of the ability of the plan to ‘convey clearly, and to provide sufficient evidence and analysis of each of the adaptation outcome criteria within each of the structural

element of the plan' (Baker et al., 2012, P. 5). For the purposes of this evaluation five plan components (information base, goals and objectives, options and priorities, actions and implementation and monitoring) were used to assess plan quality. Figure II as adapted from Bakers et al. (2012) explains the evaluation categories.



A rating criterion adapted from Stevens et al. (2004) was used for scoring of each outcome criteria. Each outcome criteria were rated for each component of the evaluation category i.e information base, goals and objectives, options and priorities, actions and implementation and monitoring. The component was given "0" score if it was not mentioned at all, "1", if it was vaguely mentioned and "2" if the component is fully addressed in the given outcome criteria.

5. EVALUATION OF THE STRATEGY/PLAN

The quality of each outcome criteria, structural/content elements, was evaluated based on five evaluation categories as mentioned in the section 4.2.2. Each outcome criteria could have received a maximum of 10 points, i.e 2 for each evaluation category (information base, Vision, options, actions, and implementation). Thus, as there are 10 outcome criteria, or the content elements evaluated, the plan/strategy can have a maximum score of one hundred (100) points. The plan is a 40-page document which, as earlier recorded, serves two purposes. The first part enlists and evaluates the gains of the earlier strategy of the Council namely, Climate Change Adaptation Strategy 2009, while the second part outlines the future strategy of the Council for adaptation in view of new realities both climatic and non-climatic. The Climate Change Adaptation Strategy Refresh 2017 is crystallized into five goals. The adaptation strategies to fit into these goals sometimes with overlapping emphasis in more than one goals.

Effort has been made to employ uniform and objective scoring approach for evaluating the contents of the strategy. However, the outcome criteria do not always fit into the evaluation matrix. Sometimes the strategy does not give much account of the possible future climate scenario and after mentioning the broader theme names a whole strategy that the Council has already framed up for tackling that climatic issue. Such mentions have been rated weak on information base while strong on actions, accepting the existence of the dedicated strategy as enough proof for effective action (C1). For example, for climatic events like, insufficient water supply, flooding and inundation, and extreme weather events, strategies like 'Elizabeth Street Catchment Integrated Water Cycle', 'Total Watermark: City as a Catchment', and 'City of Melbourne Heatwave Response Plan' have been considered as strong on action but given relatively less score on information, and options and priorities. Similarly, the strategy mentions a climatic issue in passing and then proposes a strategy to deal with a range of other factors without explicitly mentioning the outcome this evaluation is looking for. Such mentions have been rated high on information base while low on action (C5, C8). For example, sea level rise has been mentioned as a climatic issue, but no action strategy has been proposed dealing explicitly with the issue.

Similarly, all the evaluated content has been rated low on the options and priorities category because the plan does not present the pros and cons of different strategies before proposing a solution strategy. C2, C6, C9, C10 have been rated high on 'options and priority' category because the plan has discussed few a few case studies before proposing the solutions. All outcome criteria have been given a score of 1 for "implementation and monitoring" because the plan mentions that 'ongoing implementation and evaluation' plan is fundamental for the success of the strategy. Because the strategy has mentioned the need for implementation and monitoring of the entire plan without outlining the detailed mechanism and structures of it, therefore, a uniform score of 1 has been assigned to each outcome criteria. Table I mentions the score assigned to each outcome category vis-à-vis evaluation categories.

Evaluation Categories  Outcome Criteria 	Information Base.	Vision, Goals and Objectives.	Options and Priorities.	Actions.	Implementation and Monitoring.
Water Quality is maintained or Improved (C1)	0	0	1	1	1
Water Quantity is maintained or Improved (C2)	2	1	1	2	1
Impacts of flooding are minimized or avoided to Water Catchments (C3)	1	1	1	1	1
Landscape structure, composition and functions are maintained (C4)	1	1	1	1	1
Ecosystem, species and genetic diversity is maintained (C5)	1	0	0	0	1

Urban Heat Island effect is minimized or avoided. (C6)	2	2	2	2	1
Hazard reduction to built form is addressed. (C7)	2	1	1	1	1
Impacts of sea level are minimized. (C8)	1	0	0	0	1
Impacts of flash flooding and storm surges are minimized (C9)	2	2	2	2	1
Extreme weather events like droughts and heat waves are avoided. (C10)	2	2	2	2	1

Legend: 0= Item not present, 1= Item present in Plan but vaguely addressed, 2= Item present in plan and fully addressed. (Adapted from, Stevens et al., 2014)

Table I: Scoring of the content of the strategy based on evaluation categories.

5 6.RESULTS AND DISCUSSIONS

The evaluation matrix designed, evaluated the content and quality of ‘Climate Change Adaptation Strategy Refresh 2017’. The Content evaluation depicted the degree of presence/absence of certain components in the strategy under evaluation criteria (C1-C10) while the quality of the plan was measured based on degree to which each component was addressed in terms of five components (information base, vision, options & priorities, actions and implementation and monitoring. The results of the evaluation are depicted at Fig III & Fig IV and V. The strategy has secured a cumulative score of 57 against the evaluation matrix that contained a maximum possible score of 100.

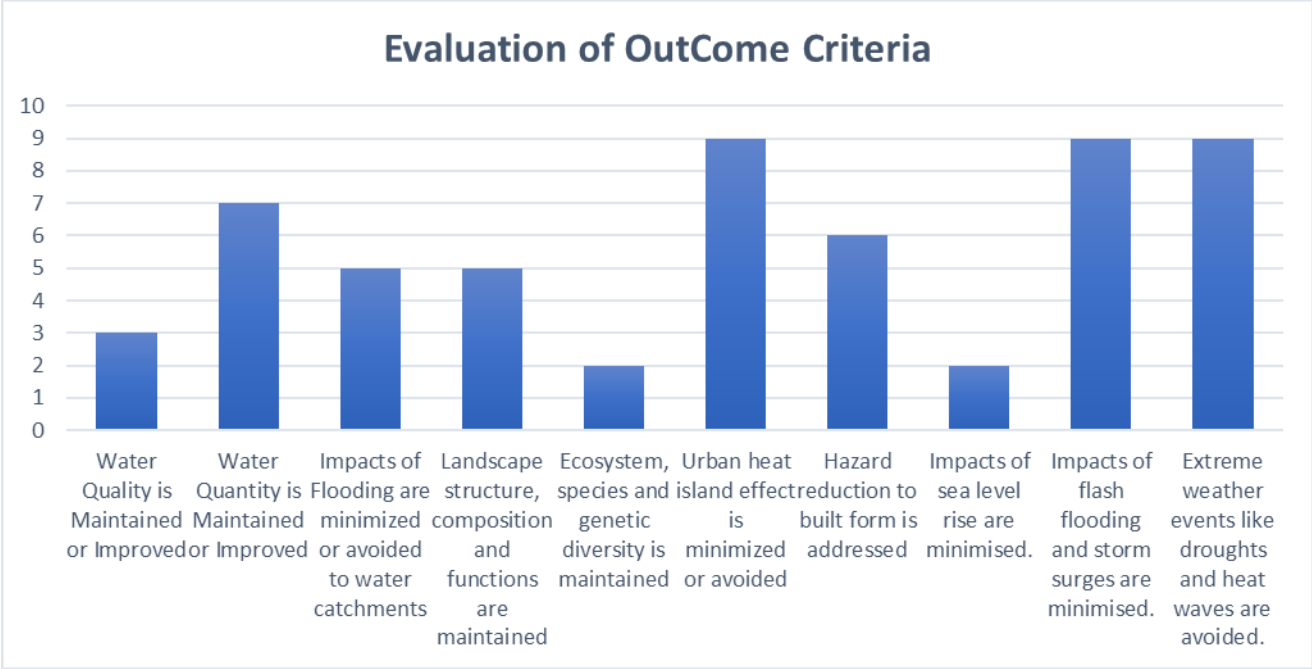


Fig III: Results showing the degree to which each outcome criteria is addressed in the strategy as measured against evaluation categories of Information, vision, priority, action, and monitoring & evaluation.

The results depict that the contents of the plan have strongly addressed and better planned for urban heat island effect, impacts of flash floods and extreme weather events like droughts and heat waves. It also has, relatively fairly, addressed and planned for maintenance of water quantity and reduction of hazards to the built form. However, it seems that the contents of the plan do not address and plan for the hazards associated with the sea level rise, climatic threats to the water quality and does not explicitly focus on the maintenance of ecosystems and biodiversity.



Fig IV: Quality of the strategy assessed against given categories.

Analysis of the plan quality depicts that it is high in information and action while limited space has been earmarked for outlining and quantification of the future objectives. Similarly, relatively little attention has been paid to the proposition of alternative solutions to address the problem at hand. However, it must also be underscored that it has explicitly addressed the climatic factors to the built environment and the issues arising out of urban heat island effect. It explicitly addresses the urban flooding phenomenon and proposes strategies (water sensitive urban design, greening strategies) at specific urban locations to address the issues.

Effort has been made to evaluate the strategy as objectively as possible, however, at the same time an element of subjectivity cannot be ruled out. This subjectivity may have unconsciously crept in because the writer had gone through both strategies (2009 and 2017) before devising an evaluation matrix. Unconscious factoring in of the elements of the 2009 strategy in the evaluation of 2017 strategy, therefore, cannot be ruled out. Similarly, the high rating assigned to some of the categories based on mere presence of the separate action strategies containing similar name may suffer from factual inaccuracy if one delves deep into those action strategies/plans. It seems that a holistic picture of the strategy/ plan could have emerged in terms of its efficacy to address the adaptation framework to climate change if both of plans had been considered as one and evaluated together.

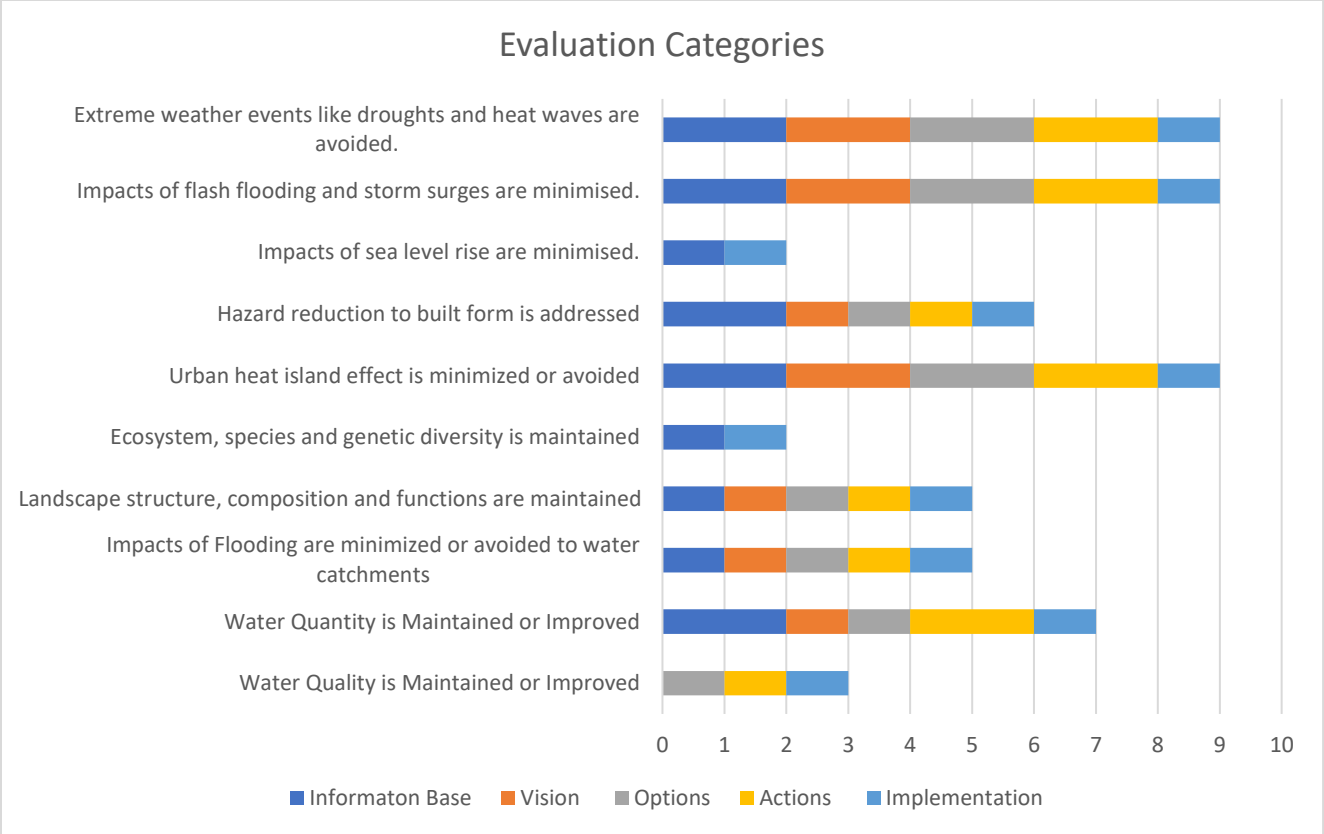


Figure V: Contents of the plan and the constituent evaluation category.

7.RECOMMENDATIONS

The result of the evaluation signal that the plan needs a revisit to make it more reflective of the ground climate realities. In its present shape it does little to consider the adverse effects to urban areas in the urban built form. Numerous studies have advocated for embedding impacts of sea level rise in planning frameworks (Hurlimann et al. 2014; IPCC 2007). Similarly, there is need to consider impacts of the climate factors on quality of water aquifers, genetic diversity, and maintenance of health ecosystems for thriving of diverse living beings (Jentsch & Beierkuhle 2007; Hennesy et al. 2007).

8. CONCLUSION

The strategy in its present form is quite responsive to adapting to the climatic changes arising out of urban flash floods, urban heat island effects, extreme weather events like droughts and heatwaves and water quantity. The Council is employing ‘delivery’, ‘collaboration’ and ‘partnership’ mode of governance to deliver on the climate change imperatives. There has been a mention of attaching sustainability measures to the approval of capital works in the Council areas, yet it remains desirable that Council attaches greater significance to dealing with impacts

of sea level rise, water quality and maintenance of ecosystem. There is a need for embedding these imperatives in the planning process.

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