

**ITEM 2. FINAL TRIGENERATION MASTER PLAN****FILE NO: S072288****SUMMARY**

Sustainable Sydney 2030 targets a 70 per cent reduction in greenhouse gas emissions in the City of Sydney Local Government Area (LGA) compared to 2006 levels. Around 80 per cent of the City's greenhouse gas emissions are from centralised power generation, primarily coal-fired power stations.

Sustainable Sydney 2030 identified trigeneration as the principal and largest of the strategic actions that will, collectively, achieve the City's emission reductions target by 2030.

On 6 December 2010, Council resolved to place the interim Decentralised Energy Master Plan – Trigenation on public exhibition, use its environmental leadership and advocacy to evaluate and progress the necessary enabling actions arising out of the interim Trigenation Master Plan and to use the Plan to inform the other Master Plans in the Green Infrastructure Plan. The interim Trigenation Master Plan was placed on public exhibition from 6 December 2010 to 28 January 2011. Consultation meetings were also held with key stakeholders both before and after the publication of the interim Trigenation Master Plan.

The interim Trigenation Master Plan established that 360MWe of trigeneration could be implemented in the four Low Carbon Zones – CBD North, CBD South, Pyrmont/Broadway and Green Square. However, at the time of the publication of the interim Trigenation Master Plan, the City had not received the air quality assessment report from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) or the gas network augmentation network feasibility study from the gas distribution network operator, Jemena. Also, trigeneration for the remaining seven zones in the city needed to be addressed, and further work was undertaken on detailed case studies at the request of the Better Buildings Partnership.

Following the completion of this work, the final Trigenation Master Plan has established that 477MWe of trigeneration and cogeneration could be implemented across the City of Sydney LGA, increasing the reduction in greenhouse gas emissions, together with other related actions, from 18 - 26 per cent to 24 - 33 per cent.

It is recommended that the final Trigenation Master Plan be placed on exhibition for 28 days to obtain public comment, with a report for Council to consider formal adoption of the Plan to follow thereafter.

**RECOMMENDATION**

It is resolved that Council:

- (A) approve the draft final Decentralised Energy Master Plan – Trigenation, as shown at Attachment A to the subject report, for public exhibition for a period of 28 days;

- (B) approve the draft Decentralised Energy Master Plan – Technical Appendix, as shown at Attachment B to the subject report, for public exhibition for a period of 28 days; and
- (C) note that the outcomes of the public exhibition period will be the subject of a further report to Council.

### **ATTACHMENTS**

**Attachment A:** Draft Final Decentralised Energy Master Plan – Trigeneration

**Attachment B:** Draft Decentralised Energy Master Plan – Technical Appendix

**BACKGROUND**

1. When Sustainable Sydney 2030 was released, it was understood that vision alone would not achieve the City's targets. The City needed to take the next step and determine how these actions could be implemented. What was needed was a Green Infrastructure Plan.
2. The commissioning and development of the Green Infrastructure Plan comprises five inter-related Master Plans to determine the most appropriate pathway for achieving the City's vision as follows:
  - (a) Decentralised Energy Master Plan – Trigeneration;
  - (b) Decentralised Energy Master Plan - Renewable Energy;
  - (c) Advanced Waste Treatment Master Plan;
  - (d) Decentralised Water Master Plan; and
  - (e) Automated Waste Collection Master Plan.
3. The Master Plans draw together the reasons for introducing a particular component of Green Infrastructure, the likely impacts and benefits to the City and users, the anticipated technical infrastructure solutions and actions to enable the Master Plan, case studies and technical appendices.
4. In 2009, the City engaged a consortium of Kinesis, Cogent Energy and Origin Energy to develop the Trigeneration Master Plan. An interim version of this plan was placed on public exhibition from 6 December 2010 to 28 January 2011 and, following consultation and further work to complete the Master Plan, the final version of the Trigeneration Master Plan is now complete and is recommended for formal adoption by Council.
5. The final Master Plan comprises the original four Low Carbon Zones plus the following that were not included in the interim Master Plan:
  - (a) air quality assessment confirmation by the CSIRO;
  - (b) gas network augmentation feasibility study by Jemena, the gas network distribution operator for Sydney;
  - (c) increase in trigeneration capacity for the Green Square Low Carbon Zone;
  - (d) additional precinct scale trigeneration in trigeneration 'hotspots' comprising the University of Sydney, Australian Technology Park and Carriageworks, Entertainment Quarter and the industrial precinct in the south of the LGA;
  - (e) additional small scale cogeneration and fuel cells outside of the Low Carbon Zones and trigeneration 'hotspots';
  - (f) detailed case studies on connection to the trigeneration decentralised energy network for particular commercial, residential and university buildings;
  - (g) case study on domestic fuel cells; and
  - (h) update of enabling actions.

## AIR QUALITY ASSESSMENT

6. The trigeneration systems for the four Low Carbon Zones will reduce absolute Nitrogen Oxide (NOx) emissions by over 5,000 tonnes a year. However, these NOx emissions will be reduced at the coal fired power stations (i.e. in the Hunter Valley) and replaced by 220 tonnes of NOx emissions in the city. Across the Sydney metropolitan area, NOx emissions are approximately 91,000 tonnes a year, so trigeneration would represent 0.2 per cent of Sydney's NOx emissions compared to transport, which represents 78 per cent of Sydney's NOx emissions. It is expected that the 0.2 per cent NOx emissions will be more than offset by the implementation of other City of Sydney strategies, particularly the "Connecting our City – Transport Strategies and Actions" plan.
7. The trigeneration systems will also use best available techniques in reducing NOx emissions by fitting selective catalytic reduction to the gas engines to reduce NOx emissions to 50mg/m<sup>3</sup> of air, compared to the Interim DECC Nitrogen Oxide Policy for Cogeneration in Sydney and the Illawarra, which specifies a maximum of 250mg/m<sup>3</sup> of air. 50mg/m<sup>3</sup> of air is about half of the NOx emissions of a modern gas fired boiler.
8. The air quality assessment was confirmed by the CSIRO report.

## GAS NETWORK AUGMENTATION

9. The Jemena Gas Network Augmentation Feasibility Study confirmed that the medium pressure gas network in the city was capable of connecting 360MWe of trigeneration provided two levels of gas network augmentation are undertaken:
  - (a) augmentation to the medium pressure (secondary) gas network is required before 47MWe of trigeneration demand is connected (estimated 2015); and
  - (b) augmentation to the high pressure (primary) gas network is required before 147MWe of trigeneration demand is connected (estimated 2020).
10. The primary gas network augmentation (as per 9(b) above) would also enable 360MWe or more of trigeneration to be connected without further augmentation. The costs of the gas network augmentations would be funded mostly, if not entirely, against a long term Use of System Agreement with the trigeneration operator (i.e. Cogent Energy). This is similar to how gas connections to power stations are funded.

## GREEN SQUARE

11. The increase in gross floor area in the Green Square Low Carbon Zone has increased the trigeneration capacity from 20MWe to 32MWe and the trigeneration capacity in the four Low Carbon Zones from 360MWe to 372MWe. The revised assessment was carried out by Kinesis which showed that the reduction in total greenhouse gas emissions had increased to 140,176 - 147,311 tonnes a year for the Greater Green Square study area based on Option 3 – residential and non-residential hot water, space heating and space cooling. These additional reductions in greenhouse gas emissions are not included in the final Trigeneration Master Plan but are included in the Summary of the Final Trigeneration Master Plan in this report.

**TRIGENERATION 'HOTSPOTS'**

12. The four trigeneration 'hotspots' where precinct scale trigeneration networks could be implemented are:
  - (a) University of Sydney;
  - (b) Australia Technology Park and Carriageworks;
  - (c) Entertainment Quarter near Centennial Park; and
  - (d) the industrial precinct in the south of the LGA.
13. The trigeneration 'hotspots' will increase precinct scale trigeneration capacity from 372MWe to 410MWe across the LGA. The trigeneration 'hotspots' assessment was carried out by Kinesis.

**DOMESTIC FUEL CELL CHP**

14. The trigeneration/cogeneration capacity outside the four Low Carbon Zones and the four trigeneration 'hotspots' amounts to 67MWe and will increase trigeneration/cogeneration from 410MWe to 477MWe across the LGA.
15. The capacity is based on small scale cogeneration systems, primarily for individual residential and small scale commercial buildings. Given that there are a range of small scale cogeneration or combined heat and power technologies available that could deliver this capacity, Kinesis, who carried out the assessment, has based the domestic combined heat and power technology on domestic fuel cell combined heat and power, due to its much higher electrical efficiency and its ability to double the reduction in greenhouse gas emissions against other available domestic combined heat and power technologies. However, this is a new technology and may require some support to materialise these efficiency gains and reductions in greenhouse gas emissions.

**CASE STUDIES**

16. The Better Buildings Partnership was consulted on the detailed case studies to be included in the final Trigeneration Master Plan. The case study buildings comprised:
  - (a) Commercial Building No. 1 (office accommodation);
  - (b) Commercial Building No.2 (office building with intensive energy consumption due to high tenancy requirements);
  - (c) University of Technology, Building 10 (heritage educational building);
  - (d) Highgate (high rise residential tower); and
  - (e) Broadway Shopping Centre (retail accommodation).
17. The case study buildings are all existing buildings in the CBD North, CBD South and Pyrmont/Broadway Low Carbon Zones and the case studies are intended to inform building owners and tenants of the typical requirements, potential costs and savings for connection to the trigeneration decentralised energy network. The case studies were carried out by WSP.

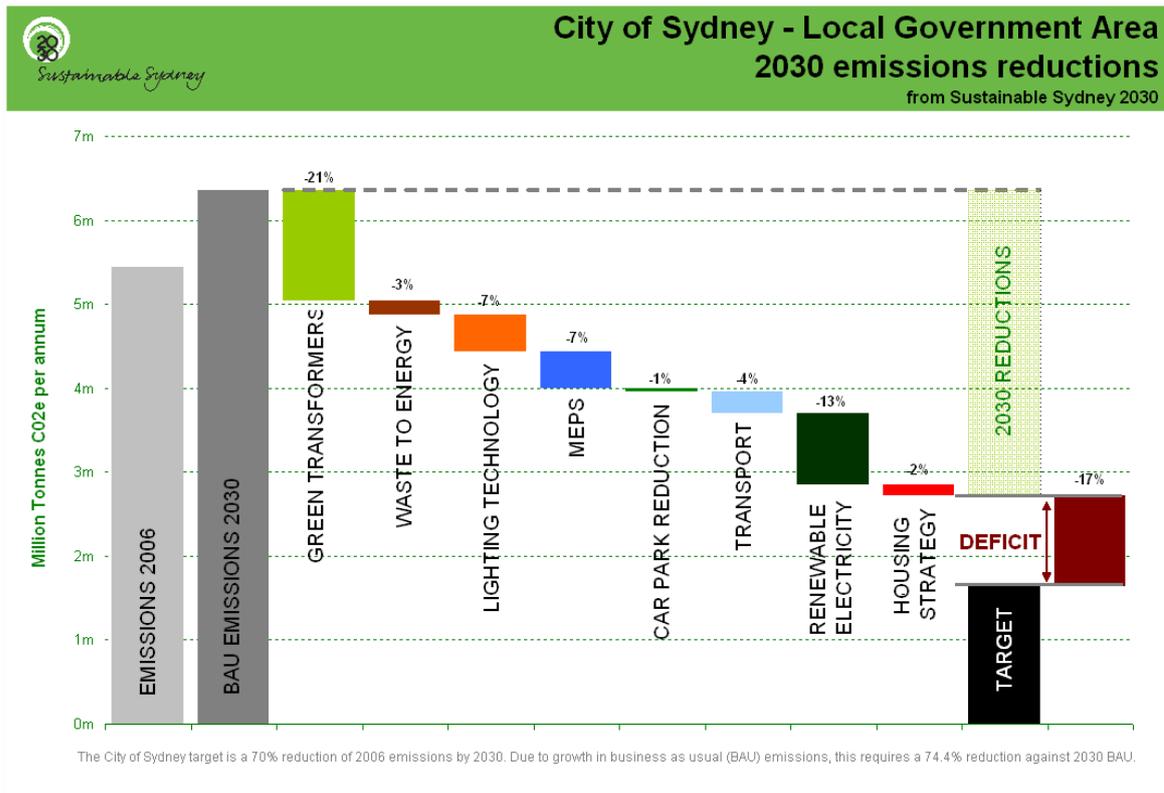
18. In addition, a case study was carried out by the City of Sydney into the application of domestic fuel cells in individual homes.

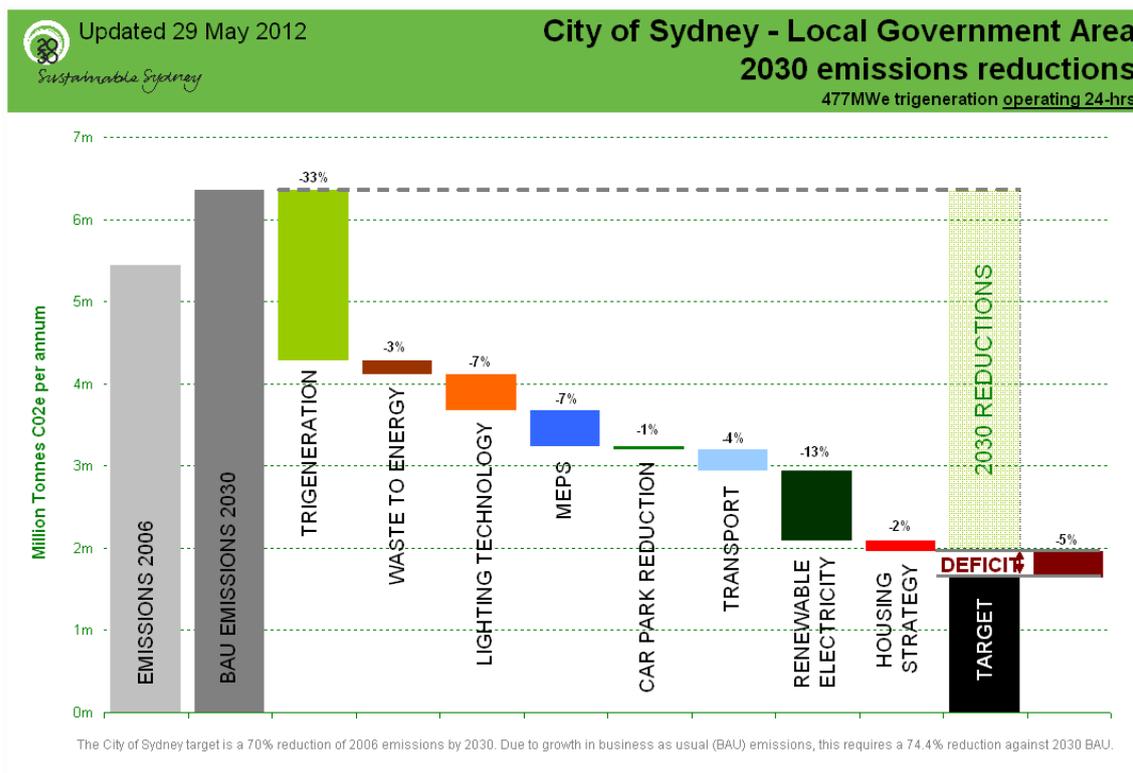
### ENABLING ACTIONS

19. Twelve enabling actions to deliver the Trigeneration Master Plan were identified in the interim Trigeneration Master Plan. Following consultation, key revisions to two of the previous enabling actions and three new enabling actions have been incorporated in the final Trigeneration Master Plan:
  - (a) **Enabling Action 3: Recognise the Decentralised Energy Network in Mandatory Disclosure and NABERS** – additional details to recognise the phased nature of decentralised energy networks and the surplus low carbon electricity exported to other buildings within the precinct or zone, until the low carbon electricity can be balanced with the completion of the decentralised energy network. This recognition to be administered through a decentralised energy plan for new development, such as in Dandenong, or through a published decentralised energy plan like the City of Sydney’s Decentralised Energy Master Plan – Trigeneration. This recognition needs to be actioned by the Federal Government to prevent perverse incentives for individual small scale trigeneration for a landlord’s base load in individual buildings, over precinct scale trigeneration of much greater capacity and efficiency and significantly greater reduction in greenhouse gas emissions.
  - (b) **Introduce Environmental Upgrade Agreements and Infrastructure Levy for Decentralised Energy** – enabling action to extend Environmental Upgrade Agreements to new development in addition to existing development.
  - (c) **Enabling Action 13: Streamline State Environmental Planning Policy Planning Approvals for Decentralised Energy** – enabling action for a more streamlined planning approval framework where co/trigeneration facilities and thermal reticulation networks are separately defined and identified as ‘development permitted without consent’.
  - (d) **Enabling Action 14: Streamline Easements and Access Arrangements for Decentralised Energy** – enabling action for streamlined mechanisms for surveying and registering easements and access arrangements onto property titles to ensure that trigeneration thermal reticulation networks on private and government land can be readily installed and maintained.
  - (e) **Enabling Action 15: NSW Handbook** – enabling action to develop and provide a NSW Handbook or Good Practice Guide on Co/Trigeneration Development.
20. Some of the enabling actions, such as introducing rate variations and the Low Carbon Zone recognition scheme, may have financial implications for Council. A further report will be submitted to Council covering these particular enabling actions. This will also include any enabling action that may be required for enabling domestic fuel cell combined heat and power.

**REDUCTIONS IN GREENHOUSE GAS EMISSIONS**

21. The interim Trigenation Master Plan identified 360MWe of trigenation capacity across the four Low Carbon Zones. This would reduce greenhouse gas emissions for connected buildings by 39 to 56 per cent and reduce emissions across the LGA by 18 to 26 per cent. This equates to 1.1 to 1.7 million tonnes of greenhouse gas emissions savings a year. On top of these emissions savings, a further 2.5 to 3.5% reduction can be added from reduced greenhouse gas refrigerants relating to the displaced electric chillers. Heat fired absorption chillers, used by trigenation that will replace electric chillers, have zero Ozone Depletion Potential and zero Global Warming Potential.
  
22. The final Trigenation Master Plan identifies 477MWe of trigenation and cogeneration capacity across the LGA. This, together residential cooling at Green Square and other related measures, would reduce greenhouse gas emissions across the LGA by 23 to 33 per cent. This equates to 1.4 to 2.05 million tonnes of greenhouse gas emissions savings a year. This substantially reduces or eliminates the forecast deficit to achieve the City’s 70 per cent emissions reduction target by 2030 as shown in the waterfall charts below.





23. Further emission reductions are expected to be brought about by the City's Renewable Energy and Advanced Waste Treatment Master Plans to be reported to Council later this year.

**SUMMARY OF THE FINAL TRIGENERATION MASTER PLAN**

24. A summary of the final Trigeneration Plan is detailed below:

Key Performance Results	Low Carbon Zones <sup>1</sup>		Hot Spots		Fuel Cells	Total	
	7AM-10PM	24 Hours	7AM-10PM	24 Hours	Hot Water	7AM-10PM	24 Hours
Connected Floor Area	21,427,636	21,427,636	3,038,000	3,048,000	10,008,932	34,474,568	34,474,568
Trigeneration Installed Capacity (MW <sub>e</sub> )	372	372	38	38	67	477	477
Trigeneration Fuel Gas Consumption (TJ/yr)	17,164	27,260	2,500	3,000	2,700	22,364	32,960
Low Carbon Electricity Generated (GWh/yr)	2,018	3,027	210	290	310	2,538	3,627
GHG Savings (Tonnes CO <sub>2</sub> /yr)	1,152,566	1,755,204	104,000	150,000	177,000	1,433,566	2,082,204
GHG Reduction for Connected Buildings	40%	57%	29%	41%	43%	-	-

Key Performance Results	Low Carbon Zones <sup>1</sup>		Hot Spots		Fuel Cells	Total	
	7AM-10PM	24 Hours	7AM-10PM	24 Hours	Hot Water	7AM-10PM	24 Hours
GHG Reductions Across City of Sydney LGA	19%	27%	2%	3%	3%	24%	33% <sup>2</sup>

Note: <sup>1</sup> Data for revised Green Square low carbon zone taken from Kinesis Green Square – Green Infrastructure Concept Plan – 18 April 2011. Reduction in greenhouse gas refrigerants not included in either the interim or final Trigeneration Master Plan also included in this Summary.

<sup>2</sup> Total reduction in greenhouse gas emissions based on the final Trigeneration Master Plan, revised Green Square low carbon zone (32MWe) and an allowance for reduced greenhouse gas refrigerants from displaced electric chillers for air conditioning (approximately 1 per cent saving), bringing the total reduction in greenhouse gas emissions across the LGA to 24 to 33 per cent.

**KEY IMPLICATIONS**

**Strategic Alignment - Sustainable Sydney 2030**

- 25. Sustainable Sydney 2030 is Council’s plan to make Sydney green, global and connected by 2030, reflecting our residents’ aspirations for the City’s LGA. Around 90 per cent of respondents to the original Sustainable Sydney 2030 consultation survey said that they wanted urgent action on climate change.
- 26. Around 80 per cent of the city’s greenhouse gas emissions are from centralised power generation, primarily coal-fired power stations, and this is where much of the cost-effective emissions reduction potential lies.
- 27. Objective 2.1 of Sustainable Sydney 2030 seeks to increase the capacity for local energy generation and water supply within City boundaries as part of:
  - (a) Green Transformers (co-location of trigeneration, recycled water treatment and waste collection/utilisation); and
  - (b) the Green Infrastructure Plan comprising decentralised energy, recycled water, advanced waste treatment facilities and automated waste collection.
- 28. Objective 2.4 of Sustainable Sydney 2030 seeks to demonstrate leadership in environmental performance through the City of Sydney’s operations and activities.
- 29. Sustainable Sydney 2030 has a reduction target of 70 per cent in greenhouse gas emissions by 2030. A significant part of this target will be realised through the installation of around 477MWe of trigeneration and cogeneration within the City’s LGA. This amount of trigeneration is estimated to supply around 70 per cent of the LGA’s electricity requirements by 2030.

**Organisational Impact**

- 30. Organisational capacity is already established and committed to within the City of Sydney to develop and implement green infrastructure as proposed by this and other Green Infrastructure Plans.

**Risks**

31. Gas distribution network capacity in sufficient volumes to connect the trigeneration network to was not confirmed at the time of the interim Trigeneration Master Plan. However, this risk has since been mitigated by Jemena's Gas Network Augmentation Feasibility Study included within the final Master Plan.

**Social / Cultural / Community**

32. By generating energy locally and matching local generation supply with local demand, this Master Plan should help reduce high network costs and new coal fired power stations.

**Environmental**

33. This Master Plan will reduce electricity consumption by 30 per cent and peak electricity demand by 60 per cent across the four Low carbon Zones alone. It will also reduce greenhouse gas emissions by 24 to 33 per cent across the City's LGA, making the primary contribution towards reducing 2006 greenhouse gas emissions by 70 per cent by 2030.

**Economic**

34. This Master Plan proposes more efficient ways to produce and distribute energy which, when implemented, should result in cost savings to users through avoided network charges and reduced exposure to the carbon tax at competitive energy supply rates.

**BUDGET IMPLICATIONS**

35. There are no further budget implications with the completion of the final Trigeneration Master Plan. However, there are a number of enabling actions outlined in the Master Plan which could have future financial implications for the City. In order for the City to implement these particular actions, approval from Council would be sought where required in accordance with existing financial delegation and approvals processes.

**CRITICAL DATES / TIME FRAMES**

36. Subject to formal adoption by Council, there are no critical dates or time frames other than those contained in the final Trigeneration Master Plan.

**PUBLIC CONSULTATION**

37. The Trigeneration Master Plan was developed in direct response to the local energy generation and water supply targets (termed Green Transformers) within Council boundaries as part of the Green Infrastructure Master Plan in Sustainable Sydney 2030, which was subject to the most extensive consultation ever undertaken by Council.

38. The interim Decentralised Energy Master Plan – Trigeneration was placed on public exhibition from 6 December 2010 to 28 January 2011. No negative responses were received. In addition, key stakeholders were consulted both before and after the publication of the interim Trigeneration Master Plan and changes have been made to the Master Plan to reflect these consultations. In particular, the detailed case studies requested by the Better Buildings Partnership, who own 60 per cent of the commercial floor space in the City’s LGA, have been included in the final Master Plan.
39. In addition, details of the Trigeneration Master Plan were presented in a City Talk to the public at Sydney Town Hall on 25 October 2010 and in other public and industry presentations since then. Progress of the trigeneration program has been the focus of the Annual Sustainable Sydney 2030 Report Back public presentations over the past two years.
40. Due in part to significant efforts of the City, there is a much greater level of understanding about trigeneration by the general public, industry, and major stakeholders since the interim Decentralised Energy Master Plan – Trigeneration was launched in December 2010. It is therefore suggested that this final and updated Master Plan be placed on public exhibition for 28 days.
41. During the public exhibition period, the document would be available on the City’s website along with a facility to email comments. In addition, meetings will be held with major stakeholders to communicate the updated Master Plan.

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