Riverview Group

Buffer Zone for LMWQCC

June 2014

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Dear David,

Reasonable Buffer Zone for LMWQCC

Consulting Environmental Engineers (CEE) is pleased to provide this report to Riverview Group regarding a reasonable and appropriate buffer zone (based on air quality considerations) for the Lower Molonglo Water Quality Control Centre (LMWQCC) at West Belconnen, near the confluence of the Molonglo and Murrumbidgee Rivers.

1. Background

The Riverview Group and the ACT Government Land Development Agency (LDA) propose to develop a large area between Belconnen and the Murrumbidgee River in the ACT, and extending into NSW, for urban purposes. The area will potentially yield approximately 6,500 dwellings in the ACT and 5,000 dwellings in NSW over a period of about 40 years. The first stage is the development of a Master Plan which will provide the technical basis for re-zoning the land under the ACT Territory Plan, the National Capital Plan and the Yass Valley Council Planning Scheme.

There are many considerations in the development of the Master Plan including providing for appropriate “odour” buffer distances between the LMWQCC treatment facility and the proposed residential development. This report considers the issues involved in developing a buffer zone for LMWQCC including:

- Existing buffer zone for LMWQCC in the ACT Territory Plan,
- Buffer zones adopted for similar treatment plants in other States and territories;
- Results of preliminary odour modelling to examine the effects of odour emissions and local wind patterns; and
- Consideration of local topography and night drainage breezes.

CEE has a good understanding of the operations of LMWQCC and an appreciation of the likely odour emissions from each treatment area. However it is noted that LMWQCC uses a treatment process specifically designed and operated to achieve a very high degree of phosphorus removal, and this makes the treatment processes somewhat different from other plants in Australia. Thus on-site odour emission measurements are essential to understand the actual odour emissions.

2. Existing LMWQCC Buffer Zone

Under the Belconnen District Precinct Code, LMWQCC has a buffer zone of 1,000 m measured from the centre of the solids handling building (see Figure 1). In this buffer zone, development for residential use is not permitted, to prevent the environmental impacts of odours or other factors from conflicting with more sensitive land uses.

According to the Precinct Code, appropriate compatible uses within the LMWQCC buffer zone may include: (a) Ancillary use; (b) Agriculture; (c) Communications Facility; (d) Land management facility; (e) Major Utility Installation; (f) Minor use; (g) Nature conservation area; (h) Parkland; (i) Road; (j) Rural business; (k) Scientific research establishment; (l) Temporary use; (m) Woodlot) or other uses permitted under the relevant land use policy provided the uses do not provide for on-going habitation by people.

3. Buffer for Other Treatment Plants in ACT

The other treatment plants in ACT are the Fyshwick plant (which is about 5 % of the size of LMWQCC and uses a much less complex treatment process, as the wastes from Fyshwick are re-processed at LMWQCC) and the Queanbeyan plant (about one-ninth the size of LMWQCC).

Neither of these plants currently has a buffer zone, although ACTEW has applied for a 500 m buffer zone around the Fyshwick plant. The Queanbeyan plant is located in the Molonglo River corridor with a good existing buffer of public open space and industrial zoning and is not likely to be encroached by residential development.

4. Features of Treatment at LMWQCC

The quantity of wastewater treated at LMWQCC ranges from 80 to 100 ML/d in dry weather and can reach 500 ML/d in wet weather. An emergency storage dam has been constructed beside the LMWQCC treatment units (see Figure 2) to allow temporary storage of very high flows in wet weather (for subsequent treatment). The storage dam was intended to be used in the peak flow each year but in recent times has been in use for weeks at a time and for more than half the year.

Before making comparisons to other treatment plants of comparable size and treatment arrangements, it is necessary to point out the major components of the treatment arrangements at LMWQCC.

Sewage enters LMWQCC in two trunk sewers - the Molonglo Valley Interceptor Sewer (MVIS) and the Ginninderra Sewer Tunnel (GST). The MVIS serves the CBD and southern Canberra and is 13.4 km long and 2.59 m in diameter. The GST serves the northern and eastern suburbs of Canberra and is 5.5 km long and 2.13 m in diameter.

Additional storage for wet weather flows is required. This can be achieved by using the 147 ML emergency storage dam at LMWQCC, the lagoons at Fyshwick STP and creating additional storage volume in the network.

Figure 1. Existing ACT Buffer Zone for LMWQCC

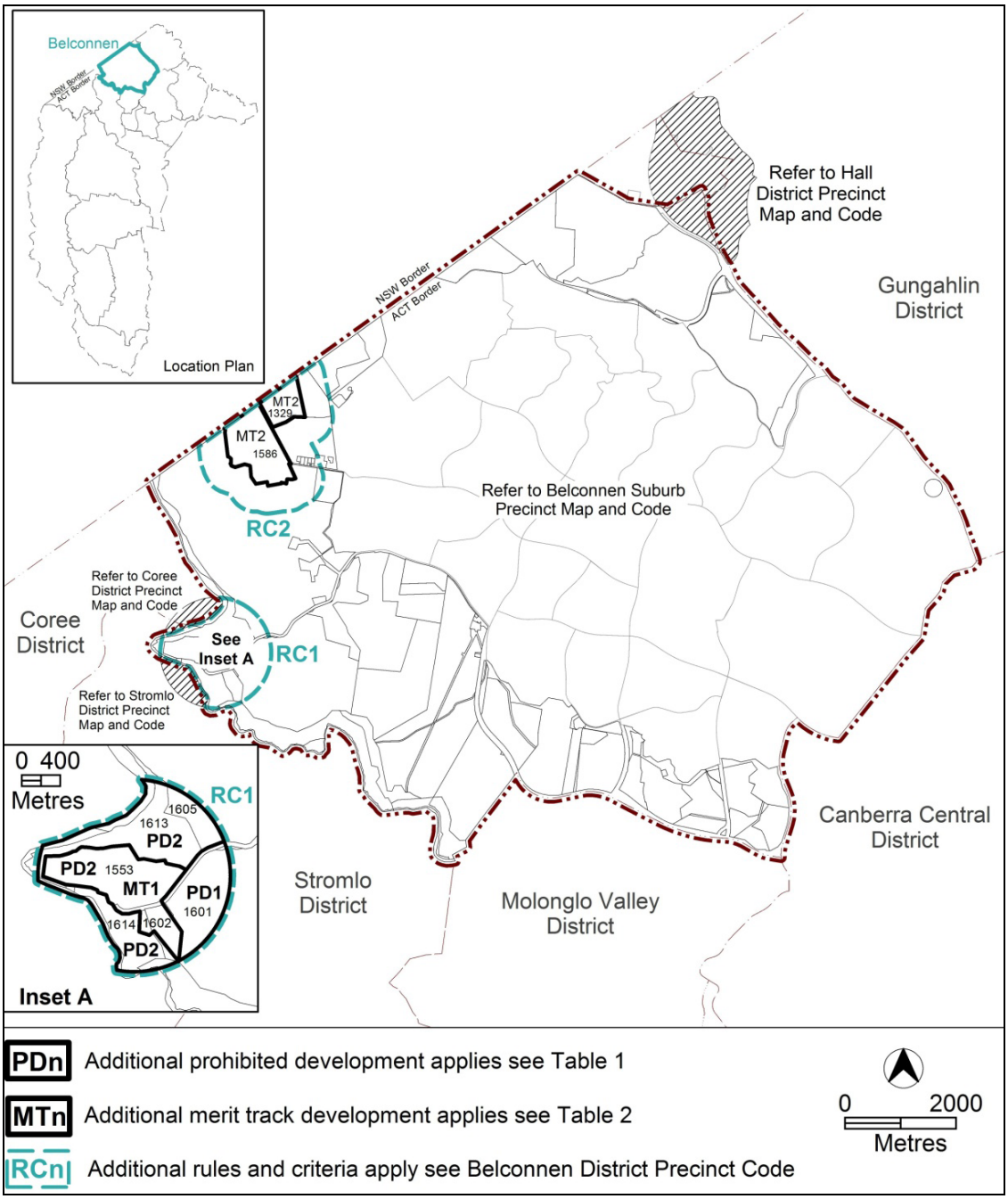
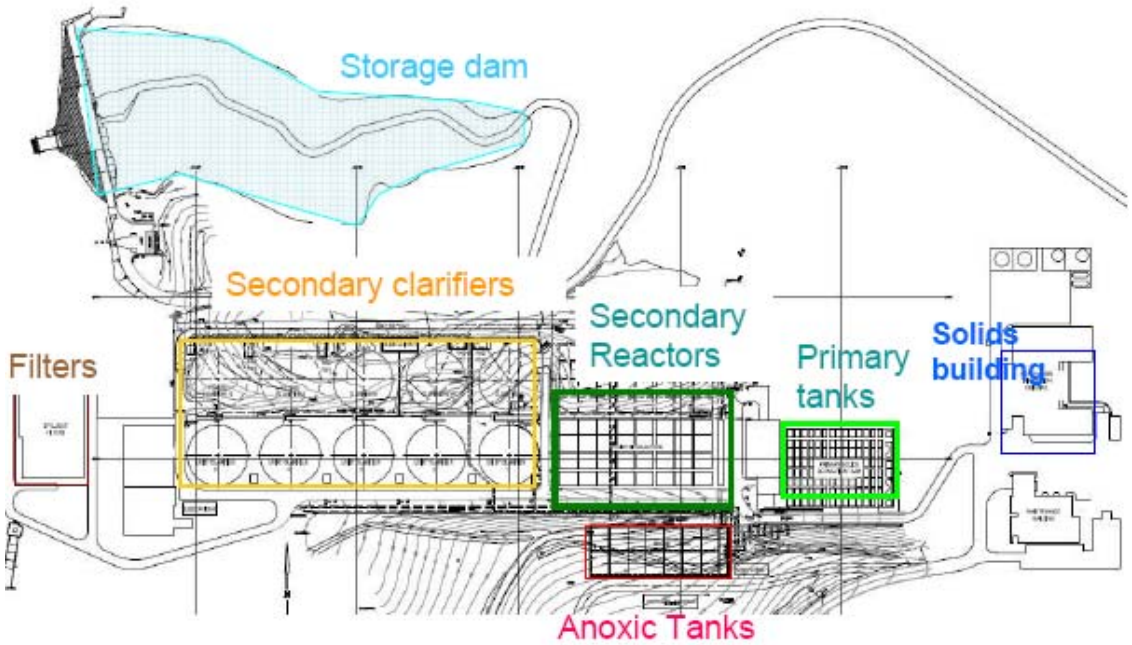


Figure 2. Treatment Units and Storage Dam at LMWQCC



Raw sewage is screened in the lower floor of the solids building through three drum screens with 3 mm apertures. The screenings are incinerated.

After screening, chemicals are added to improve solids and phosphorus removal. The chemicals added are: slaked quick lime to achieve the desired operating pH; soluble iron salt (ferric chloride); and polymer.

Two grit removal tanks flocculate the suspended solids and capture grit from the sewage prior to the primary sedimentation tanks. The grit is incinerated.

This primary treatment process is the heart of the LMWQCC process. Primary treatment generally removes about half the organic solids and thus reduces the load on the secondary treatment stage by half. The reduced load on the secondary treatment process means that the number of secondary treatment tanks and the energy used in secondary treatment also are reduced by half.

The high lime process used in primary treatment at LMWQCC is very effective at removing organic solids and the lime provides the alkalinity needed for nitrification while the high pH in the lime treatment stage captures metals in the sludge, ensuring very low levels of metals in the reclaimed water. In addition, the lime and phosphorus contained in the sludge makes the residual treated solids attractive to farmers for application to land.

The secondary treatment system consists of anoxic reactors (to enhance nitrogen removal) followed by aeration tanks and eight circular secondary clarifiers, each of 36 m diameter. The anoxic reactors enable denitrification to occur under zero oxygen conditions. The aeration tanks provide biological oxidation of carbonaceous and ammoniacal material with an activated sludge.

The secondary clarifiers allow the activated sludge to settle and be returned to the earlier processes, while the clarified effluent flows to the filters. There are four anthracite/sand filters, each fitted with a dissolved air flotation (DAF) unit to enhance capture of residual solids.

Following filtration, the effluent is disinfected using chlorine. The chlorine gas is dosed into the effluent to achieve a chlorine residual. After 45 minutes, the final effluent is dechlorinated using sodium dioxide before release to the Molonglo River via an aerating cascade (see Figure 3).

Figure 3. Release of Final Effluent from LMWQCC to Molonglo River

Solids collected in the treatment processes are dewatered in centrifuges and then incinerated in a multiple hearth furnace. The ash from the furnace is rich in phosphorus and is re-used on agricultural farms in NSW.

4. State and Territory Guidelines

Each State and Territory has Guidelines for separation distances from treatment plants. These guidelines collectively provide an indication of an appropriate buffer zone for LMWQCC.

5.1 South Australian Plants

The SA Guidelines[1] for separation distances for treatment plants specify "individual assessment" for large treatment plants.

The Bolivar plant, which is the largest plant, has a large buffer zone (of about 1,000 m). The smaller Glenelg and Christies Beach plants have small buffer zones. The Port Adelaide plant was closed owing to an inadequate buffer zone as development encroached on the plant and the wastewater transferred to the Bolivar plant (which has a large buffer zone) for treatment.

5.2 NSW Plants and Guidelines

NSW Planning has defined a minimum 500 m buffer for all new treatment plants. The three largest plants in NSW (North Head, Bondi and Malabar) have only primary treatment and are not comparable to LMWQCC. The nearest house is 900 m to the north of the North Head WWTP. The Bondi and Malabar plants are either fully underground (Bondi) or partly underground (Malabar), and only provide primary treatment. The Cronulla plant is smaller but has a defined 500 m buffer in planning legislation and a larger buffer in practice, as does the Wollongong plant.

The largest plant in Newcastle is at Burwood Beach (45 ML/d) and it has a 700 m buffer, even though there is no sludge processing at the plant.

5.3 Victorian Plants and Guidelines

The three largest plants in Melbourne are at Werribee, Carrum and Mornington. The Werribee plant has a very large buffer (> 1,500 m) but this is a hangover from the former use as a farm and the current treatment processes are not comparable to LMWQCC.

The Carrum plan has secondary treatment plus a Class A recycling water reclamation plant, with extensive storage of raw sewage in wet weather and large sludge drying beds and stockpiles. Thus the plant is comparable to LMWQCC in terms of process arrangements, but is three time the size of LMWQCC (240 ML/d compared to around 80 ML/d). The buffer zone for the Carrum plant ranges from 1,200 m to 1,800 m, depending on the direction, with the large buffer size resulting from the wet weather sewage and sludge storage lagoons.

The Mornington plant is much smaller than LMWQCC but has similar treatment processes and a buffer (after encroachment of rural residential dwellings) of about 500 m. All secondary treatment processes at the plant are covered to control odour emissions and vented through odour control facilities.

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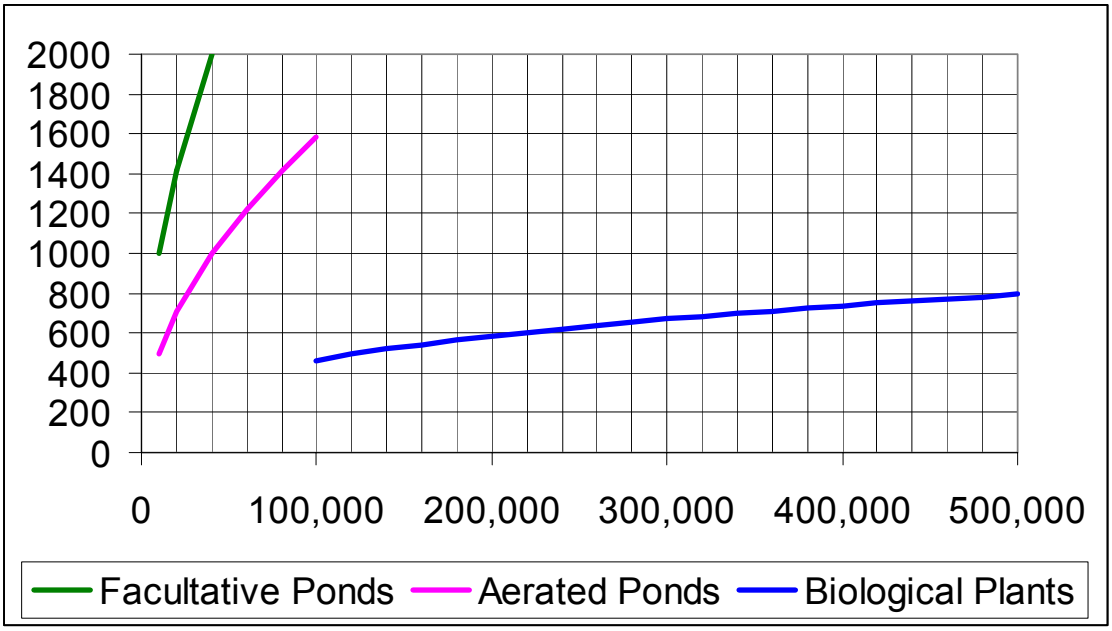
[1] South Australian EPA (December 2007). "Guidelines for Separation Distances".

Victorian EPA Publication 1518[2] lists recommended separation distances for "industrial residual air emissions" (which are elevated emissions resulting from factors such as process upsets or failure of emission control equipment). In the case of treatment plants, Publication 1518 recommends buffer distances that increase with plant capacity and depend on the type of treatment process, as illustrated in Figure 4. For the LMWQCC, the buffer zone according to the VIC EPA Guidelines would be about 800 m from the process units, close to a radius of 1,000 m from the centre of the plant (and similar to the existing ACT buffer zone).

Figure 4. Victorian EPA Buffer Zone Guidelines



5.4 West Australian Plants and Guidelines

The WA EPA's separation distance guidelines[3] do not specify buffer zones for treatment plants, recommending that each site be considered separately.

The Alkimos plant is a secondary plant with a similar ultimate capacity as LMWQCC and has a statutory buffer of 500 m from the outside perimeter of treatment units – about 700 m radius. The Subiaco plant is of similar capacity to LMWQCC with lime treatment of sludge, and has extensive covers on primary and secondary processes to control odour emissions. The Subiaco plant has a buffer that extends 800 m to the west and 600 m to the north and south.

The Woodman Point plant has a statutory buffer extending for 750 m to the east and 1,000 m to the west. The plant is of about twice the size of LMWQCC and has extensive covers on primary and secondary processes to control odour emissions.

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[2] Victorian EPA (May 2013). "Recommended Separation Distances for Industrial Residual Air Emissions". EPA Publication 1518.
[3] WA EPA (June 2005). "Separation Distances between Industrial and Sensitive Land Uses". Final Guidance No 3.

5.5 Summary of Recommended Buffer Zone from Guidelines

This review of the buffer zone on comparable treatment plants in Australia indicates that, for a buffer distance expressed as a radius from the centre of the plant:

- The minimum buffer radius is 500 m;
- Mid-range buffer distances are 600 to 800 m; and
- The maximum buffer distance is about 1,400 m;

On this basis, the existing buffer distance of 1,000 m radius for LMWQCC could be considered to be reasonable.

6. Computer Modelling for LMWQCC

The shape of the buffer zone for LMWQCC depends on the distribution of emissions from the various process units, local wind conditions, the interaction between night drainage flows in the Molonglo and Murrumbidgee River valleys and the height of the inversion layer above LMWQCC.

A preliminary assessment of the likely extent of odour was made using the Ausplume dispersion model using local wind conditions. This is a robust modelling system that has been used successfully in the ACT, SA, NSW and Victoria in the past for treatment plants, but can only be considered to be approximate in the case of LMWQCC owing to the complex topography and wind patterns at the site, and the unknown height of the inversion layer.

The assumptions used in this odour modelling are listed below:

- Odour emission rates for the various process units, based on recent measurements at LMWQCC, as listed in Table 1.
- Allowance of odour emissions from the storage dam under various scenarios;
- Consideration of odour control measures for stacks with very high odour emission rates; and
- One year wind file containing hourly vales of wind speed, wind direction (as measured at Canberra airport) plus stability category and mixing height calculated from hourly solar radiation and cloud cover. A second set of model predictions were made using winds measured at the LMWQCC plant.

According to the ACTEW Odour Guidelines, the odour concentration corresponding to a significant risk of odour nuisance ranges from 2 OU in the case of high density urban development to 7 OU for an isolated residence. A similar range of limiting odour levels is defined in the SA EPA Odour Guidelines (also using a 3-minute averaging period and 99.9 percentile odour predictions).

Case 1 reflects the basis treatment units, excluding sludge processing (for example, assuming that sludge is taken off site for processing). This case provides an idea of the basic odour potential of the combined primary, secondary and tertiary treatment plant. Total odour emissions are 22,660 OU/s.

Case 2 assumes the emergency storage dam is in operation. This adds an estimated odour emission of 7,680 OU/s so the total increases to 30,360 OU/s.

Table 1. Odour Emissions from LMWQCC

Source	Emission rate	Case 1 OU/s	Case 2 OU/s	Case 3 OU/s
Inflow regulation	2	72	72	72
Sludge Bld –vent	2	1,800	1,800	1,800
Grit tanks	4.7	499	499	499
PST-1	1.1	3,829	3,829	3,829
PST-2	5	781	781	781
Anoxic1	3.5	6,174	6,174	6,174
Anoxic Weirs	11	1,100	1,100	1,100
Reactor 1	0.5	741	741	741
Reactor 2	0.5	741	741	741
SC 1-4	0.3	1,361	1,361	1,361
SC 5-8	0.3	1,361	1,361	1,361
SC 9-10	0.3	680	680	680
Filters	0.2	520	520	520
Sludge Building		3,000	3,000	3,000
Total-process units		**22,660**	**22,660**	**22,660**
Storage dam			7,680	7,680
Total with dam			**30,340**	**30,340**
Flue Stack				5,200
Stack A – S&I Bld				4,034
Stack B - S&I Bld				8,170
Stack D				3,750
Sceen Stack				2,800
Total, with stacks				**54,294**

Case 3 adds the emissions from the solids building assuming incineration of sludge, screenings and grit, with effective odour scrubbers on major stacks. This adds an estimated odour emission of 23,954 OU/s so the total increases to 54,294 OU/s. Case 3 provides an indication of the minimum level of odour control excepted at LMWQCC in the medium term.

Wind Files

Figures 4 and 5 show the wind roses for winds measured at LMWQCC (local winds) and at Canberra airport (regional winds). Both roses show that strongest winds come from the north-west and weaker winds come from the south-east, corresponding to night drainage winds down the Molonglo and Murrumbidgee Valleys.

Night drainage flows at LMWQCC are particularly complex because the plant is at the junction of the Molonglo and Murrumbidgee Valleys, each with their own drainage flows, plus a smaller drainage from the hills to the north and east of the plant. It is expected that a series of inversion levels would form, with different wind patterns in the different layers, and with a general flow towards and downstream in the Murrumbidgee Valley, which would be the dominant drainage flow. The dispersion model does not have all the inversion layers and will over-predict odour.

Figure 4. Wind Rose – Measurements at LMWQCC

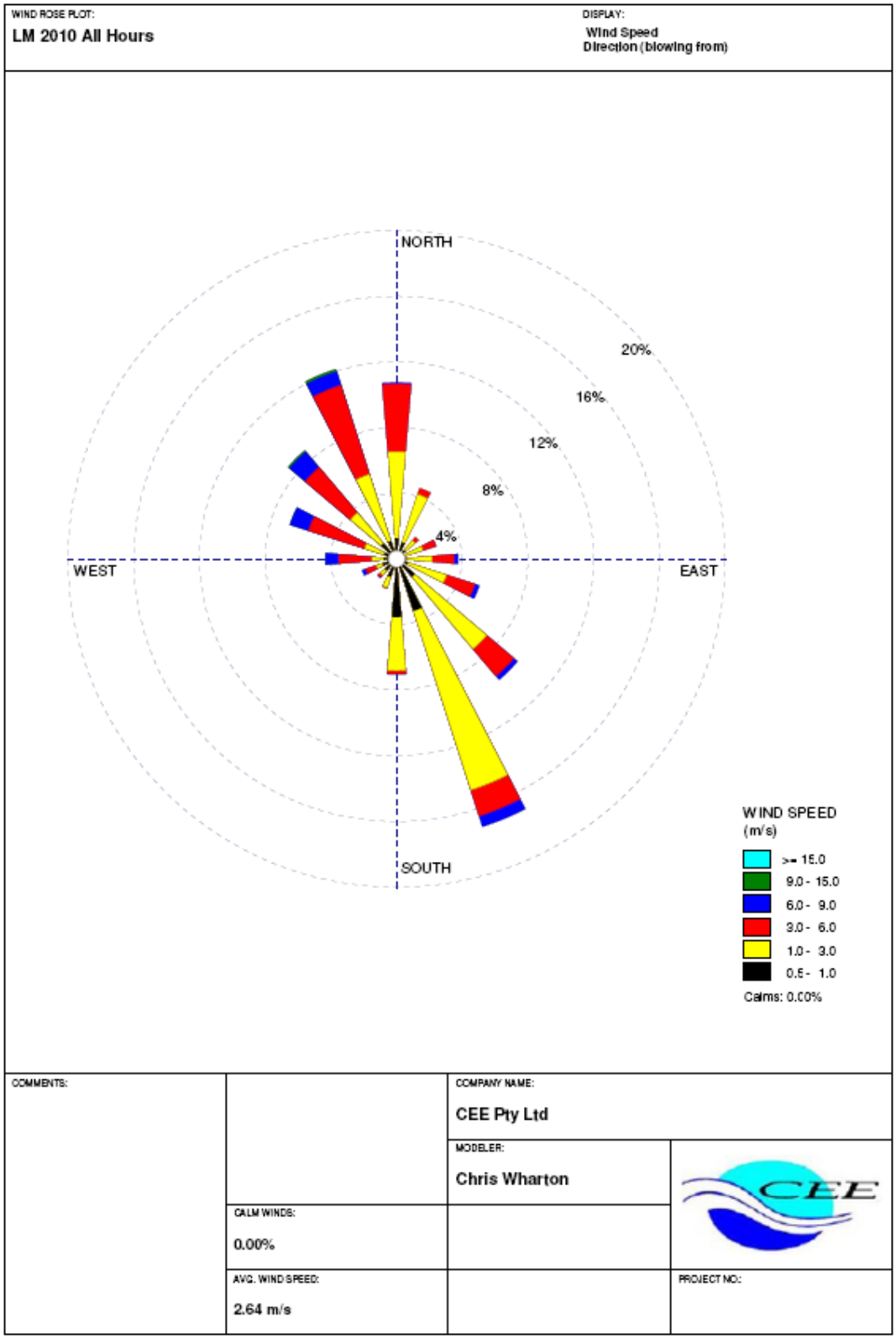
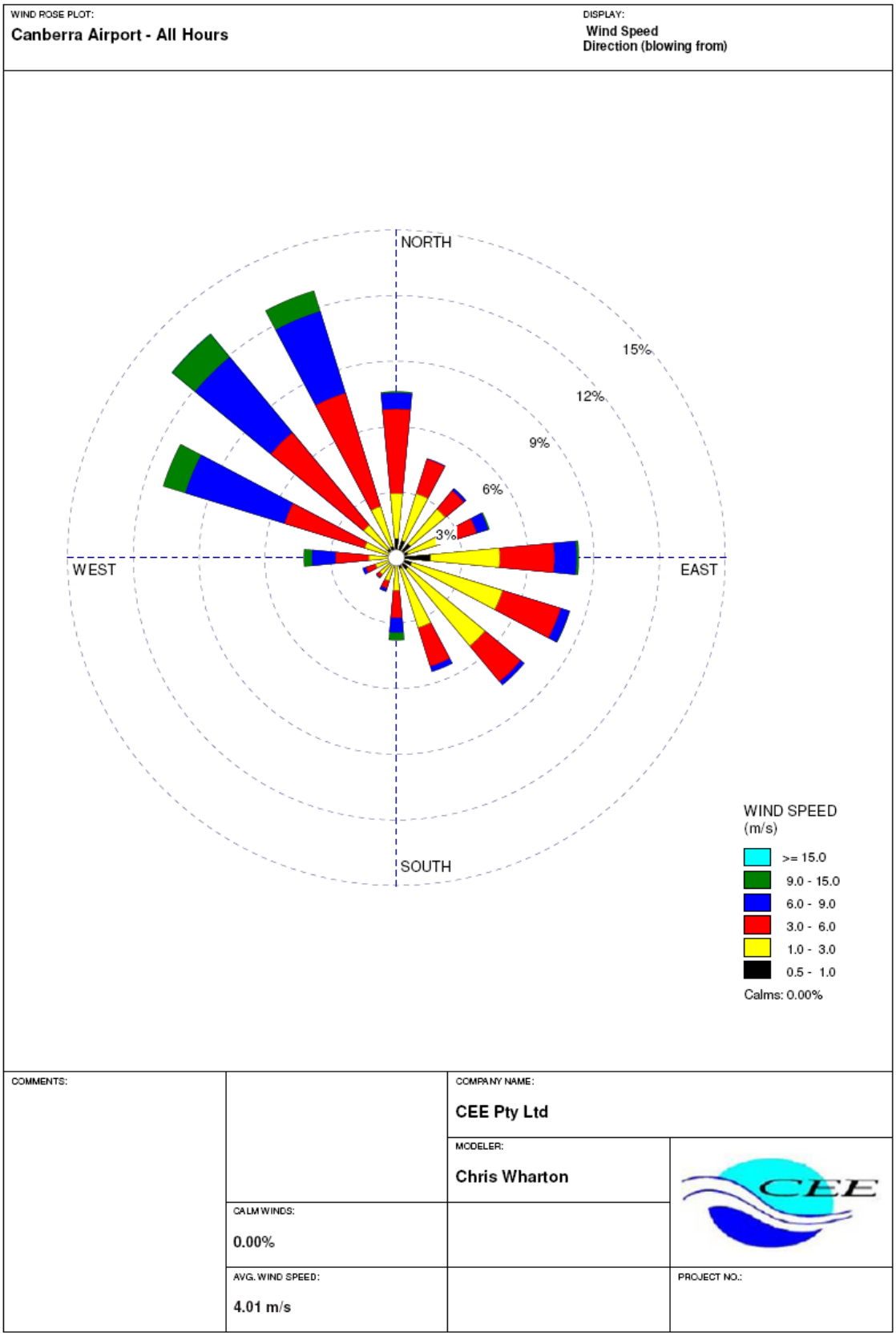


Figure 5. Wind Rose – Measurements at Canberra Airport

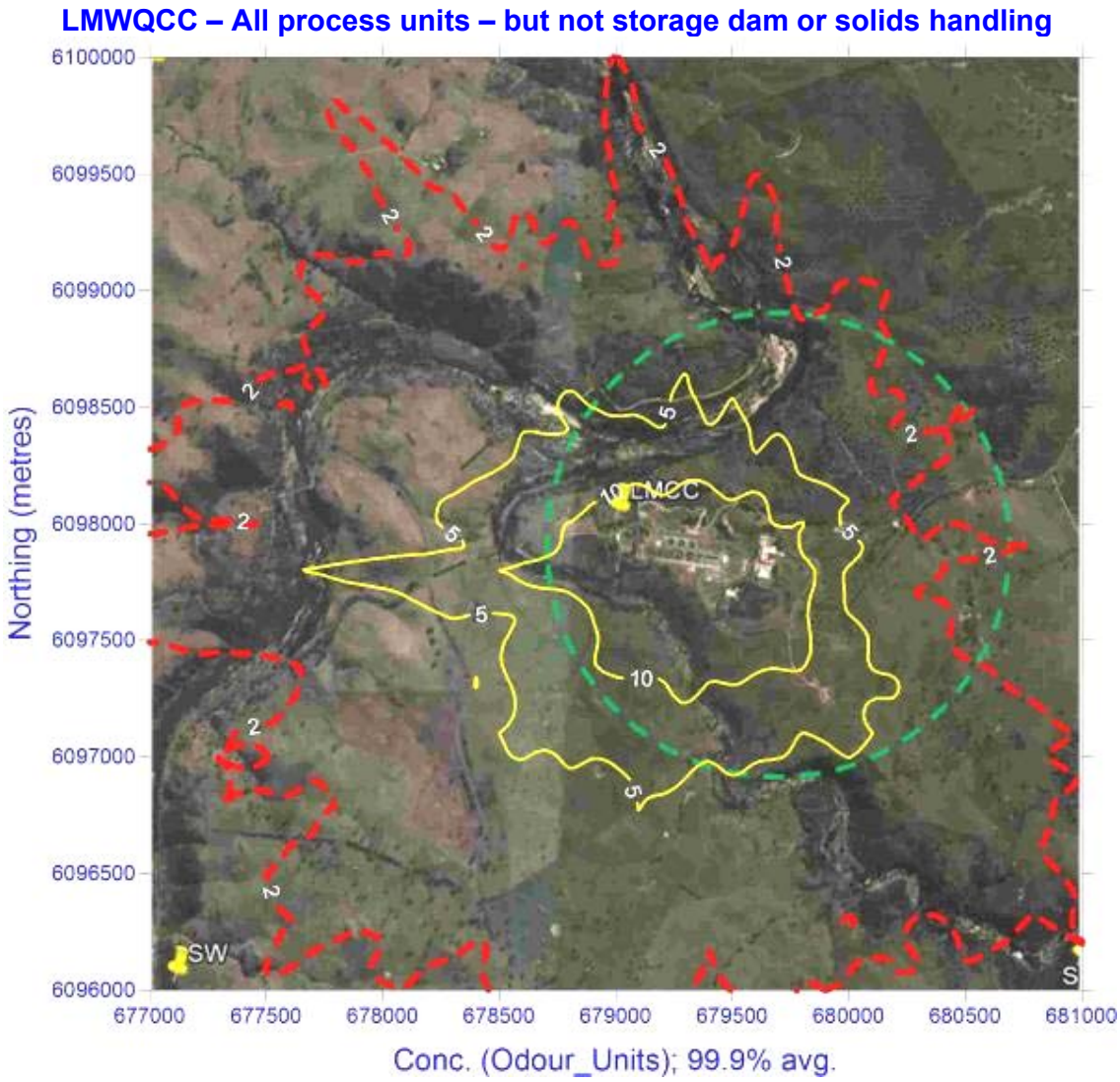


Odour Model Prediction – Case 1 – Process Units Only

Figure 6 shows the predicted odour contours for emissions from all process units at LMWQCC with the emergency storage not being used. It can be seen that the 2 OU contour extends a considerable distance downstream and upstream in the Murrumbidgee Valley, as would be expected because the winds would be channelised by the valley profile. In an easterly direction, the 2 OU contour extends to about the 1 km radius buffer zone (shown as the green circle in Figure 4).

As the nearest residence in the proposed Riverview development is approximately 1,200 m east of LMWQCC, odour nuisance is not likely to be an issue under normal operations of the treatment plant.

Figure 6. Predicted Odour Contours for LMWQCC – Process Units



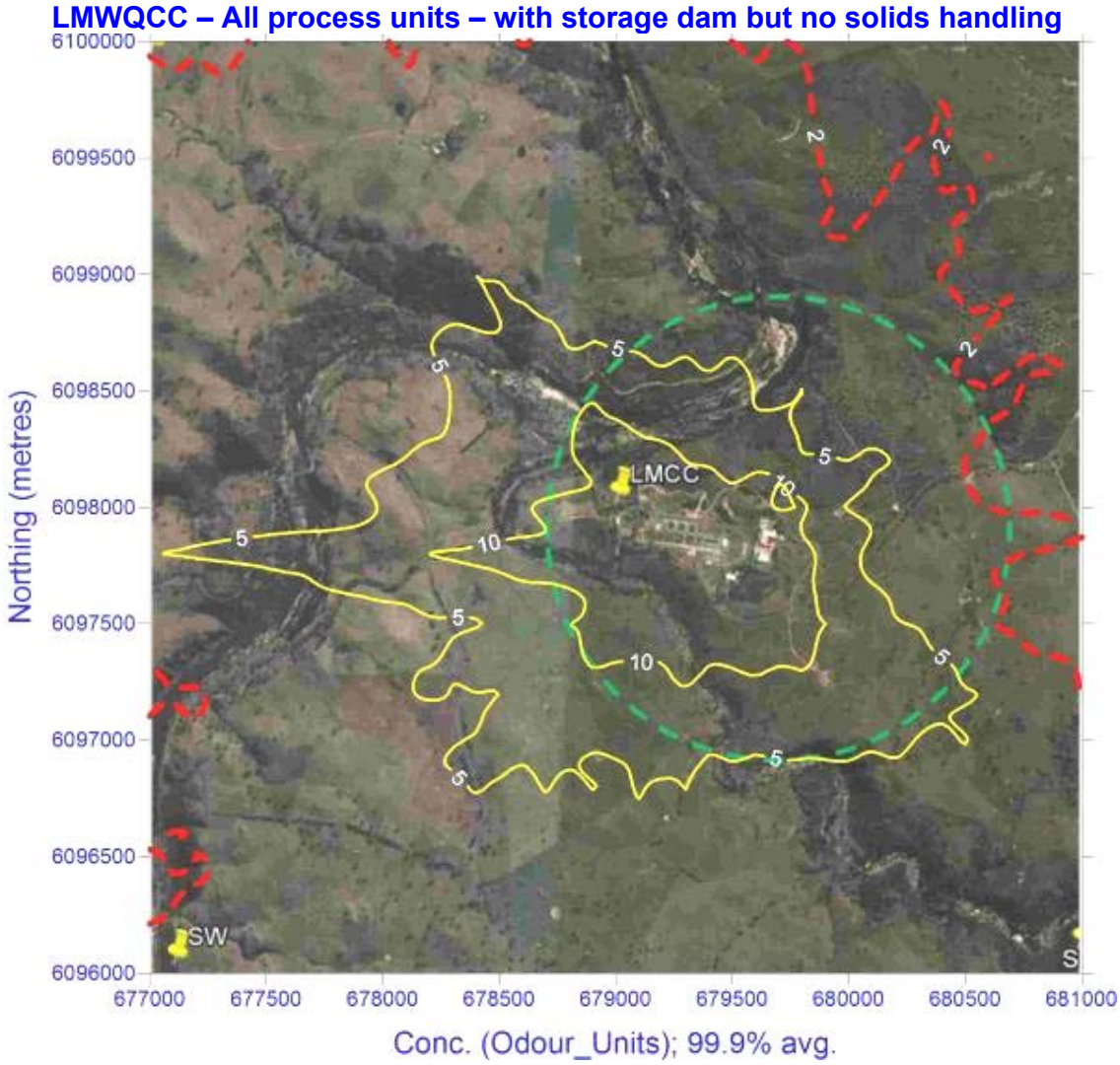
Odour Model Prediction – Case 2 – Process Units and Storage Dam

Figure 7 shows the predicted odour contours for LMWQCC with the emergency storage full of raw sewage. In this case, it can be seen that the 2 OU contour extends further from the plant and to about 200 m beyond the 1 km radius buffer zone.

Thus urban development outside the 1 km buffer zone is likely to impose a requirement on LMWQCC to manage odour emissions from the existing treatment units and the emergency storage to a higher level than occurs at present.

Measurements of odour emission rates, local winds and the inversion height would be needed to develop an odour control strategy and cost estimate.

Figure 7. Predicted Odour Contours for LMWQCC – Using Storage Dam



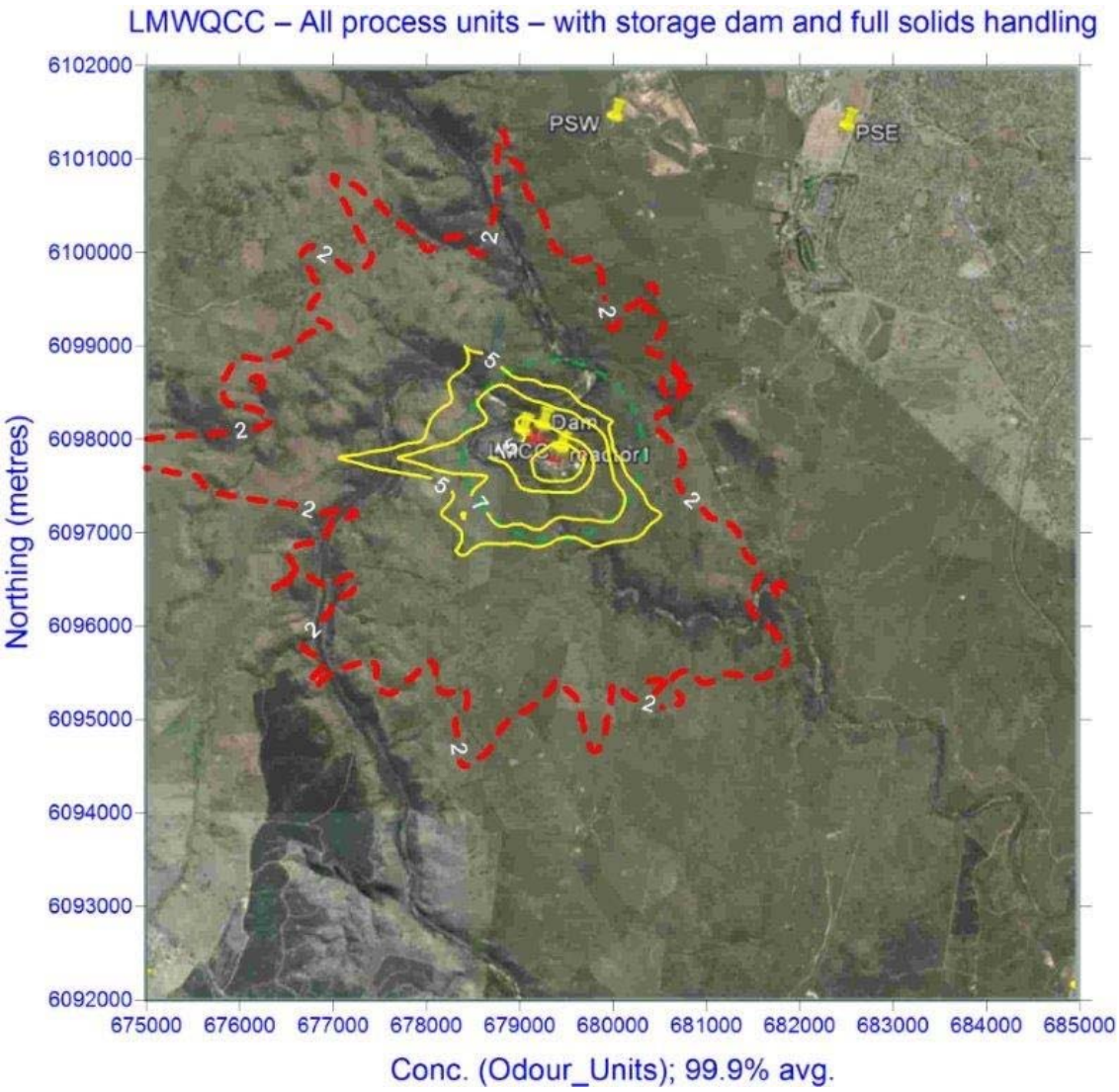
Odour Model Prediction – Case 3 – Process Unit, Dam and Solids Handling

Figure 8 shows the predicted odour contours for LMWQCC for all process units, the storage dam and the stack discharges from solids handling (with odour scrubbers). In this case, it can be seen that the 2 OU contour extends well away from the plant and well beyond the 1 km radius buffer zone. The model predicts odour will extend for a considerable distance down the river valleys, as would be expected. There could be minor intrusion of odours inside the proposed Riverview development area.

Urban development outside the 1 km buffer zone is likely to impose a requirement on LMWQCC to manage odour emissions from the existing treatment units and the emergency storage to a higher level than occurs at present. Experience at other large treatment plants shows that odour control is necessary when there is residential development within 1 km of the plant.

Figure 8. Predicted Odour Contours for LMWQCC – Current Operations

LMWQCC – All process units – with storage dam and full solids handling



8. Recommended Buffer Zone for LMWQCC

The Territory Plan currently includes a 1 km radius clearance zone around the LMWQCC within which residential and other sensitive uses are prohibited. This zone was established a decade ago. Until the Riverview proposal, there was no urban development within 3 km of LMWQCC and thus no need for ACTEW to commit resources and funds to minimising odour emissions. For example, odour scrubbers in the solids handling building have been decommissioned to save energy, as there was no social benefit from their operation.

Preliminary odour modelling in this study indicates that odours from LMWQCC do extend beyond the 1 km radius buffer zone. While it is likely that this preliminary modelling exaggerates the extent of odour (several factors, including steep local topography, inversion levers at times of weak winds and decay of hydrogen sulphide with distance, will reduce the extent of odour) it is still considered that a higher degree of odour control at LMWQCC will be required with urban development extending to within 1.2 km of the plant.

The urban development proposed in the Riverview proposal will require LMWQCC to manage odour emissions from the existing treatment units, the emergency storage and solids handling to a higher level than occurs at present.

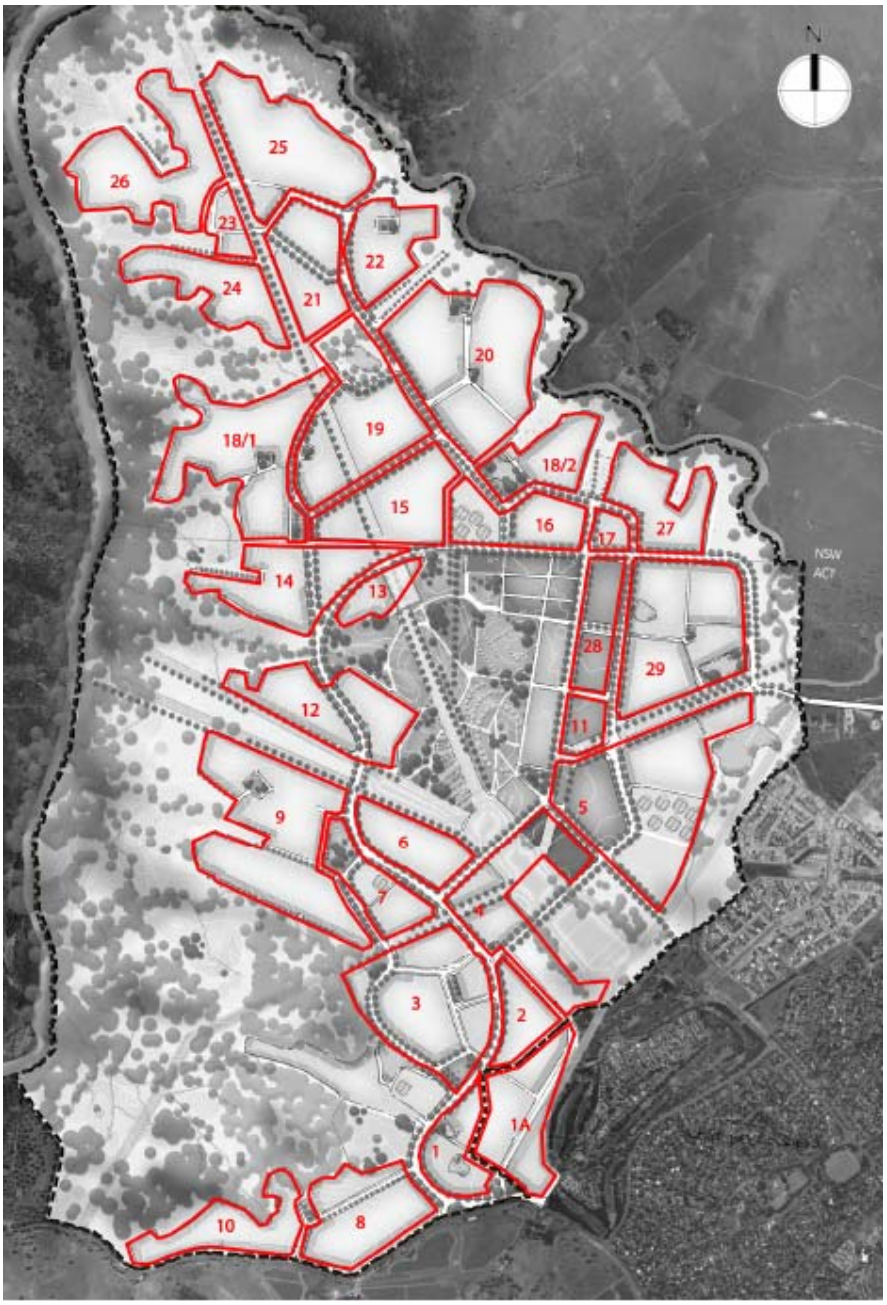
In response to this change in circumstances, ACTEW will need to undertake investigations into odour control, and seek approval from the environmental and funding regulators to undertake ameliorative actions at the plant. It is expected that ACTEW's work for investigations, designs, approvals, construction and commissioning will take several years.

The staging of the proposed development of the West Belconnen project is set out in Figure 9. Whilst each stage does not exactly equate to one year's development it is expected that on average this will be the case. It can be seen from the staging plan that the project extends over a long timeframe and that development is not programmed to occur close to LMWQCC for 8 to 10 years. Given this timing, the proponent has committed to not proceed with urban development on any land within a zone 600 m outside the current clearance zone for a period of six years from January 2014. It also is noted that development is not proposed to encroach closer to the plant than 200 m outside the current clearance zone

In our view, the existing 1 km radius buffer zone around LMWQCC is consistent with the buffer zones provided in other States for comparable treatment plants. Thus it is expected that the current clearance zone will remain in place although this could be reviewed within the next 2 to 5 year period. When ACTEW technical investigations are concluded, ACTEW could request an adjustment to the clearance zone which would be done through the usual processes involved in varying the Territory Plan.

Ian Wallis
June 2014

Figure 9. Stages in Development of Riverview Area



Indicative Staging Plan

Note on Odour Emission Rates:

Odour emission rates are derived from the results of testing conducted by Emissions Testing Consultants (ETC) in 2014. Generally the 75 % emission rate was adopted for modelling. Testing was conducted at the sites listed below:

1. *Inflow regulation chamber*
2. *Screens building*
3. *Incineration building vent*
4. *Stack A*
5. *Stack B*
6. *Incineration building*
7. *Grit channel*
8. *Primary sedimentation tanks*
9. *Primary sedimentation tank outlet launder*
10. *Level control tanks*
11. *Incinerator discharge stack*
12. *Anoxic tank*
13. *Bioreactors*
14. *Secondary clarifiers.*