



TECHNICAL MEMORANDUM

DATE: July 15, 2015 Project No.: 011-10-15-46
SENT VIA: EMAIL

TO: Nick Ponticello, Ponticello Enterprises Consulting Engineers

CC: Stan Gryczko, City of Davis

FROM: Chris Malone, R.C.E. #51009

REVIEWED BY: Doug Moore, R.C.E. #C058122

SUBJECT: Impacts of the Mace Ranch Innovation Center Proposed Mixed-Use
Alternative on Wastewater Treatment Plant and Sewer Capacity

The purpose of this Technical Memorandum (TM) is to provide an assessment of the impacts of the proposed Mace Ranch Innovation Center (MRIC) mixed-used alternative on the City of Davis (City) wastewater treatment plant (WWTP) and on the sewer system. The key elements of this TM include:

- Background Information
- WWTP Impacts
- Sewer Impacts
- Conclusions

BACKGROUND INFORMATION

A separate MRIC non-mixed-use alternative was previously analyzed for impacts on the WWTP and on the City sewer system. Those impacts were assessed in the following two TMs, respectively:

- Impacts of Innovation Center/Nishi Property Development on Wastewater Treatment Plant Capacity (Final), dated April 2, 2015 (“April 2015 WWTP TM”)
- Impacts of Innovation Center/Nishi Property Development on Wastewater Collection System Capacity, March 25, 2015 (“March 2015 Collection System TM”)

Other documents and information with relevance to the current analysis include:

- An unpublished table titled “Mace Ranch Innovation Center – With Residential Preliminary Sewer Demands, Prepared by Cunningham Engineering Corporation, Revised 2/17/2015” with an associated figure (see Attachment 1 of this TM)

- The Draft Water Supply Assessment for the City of Davis, dated January 2015 (“Draft Water Supply Assessment”)
- The City Sewer System Management Plan, dated August 2012 (“2012 SSMP”)
- The City System Evaluation and Capacity Assurance Plan, dated April 2009 (“2009 SECAP”)
- A series of spreadsheet analyses maintained by City staff examining collection system flows at various locations throughout the City (“City Sewer Spreadsheets”)

The land uses for the MRIC non-mixed-use alternative were defined in Draft Water Supply Assessment. The land uses for the MRIC mixed-use alternative under consideration in this analysis are defined in the table shown in Attachment 1 of this TM. A review of the land use information from the mixed-use and non-mixed-use alternatives indicates that the only difference in flow-producing land uses between the two alternatives is that the mixed-use alternative adds a residential component consisting of 1,700 residents in 850 residential units.

Table 1. Land Use Totals for the Proposed MRIC Mixed-Use Alternative		
Category	Units	Mace Ranch IC
Residential	population	1,700
Residential	dwelling units	850
RD/Office	ft ²	1,510,000
Manufacturing	ft ²	884,000
Office/Non-office	employees	5,633
Retail	ft ²	100,000
Retail	employees	200
Retail	customers	2,842
Hotel	rooms	150
Hotel	ft ²	160,000
Hotel	employees	50
Convention Center	visitors	667
<i>Source: See Attachment 1 to this TM</i>		

WWTP IMPACTS

In the April 2015 WWTP TM, the impacts of the MRIC (and three other proposed development projects) were considered in terms of both average dry weather flow (ADWF) generation, as well as biochemical oxygen demand (BOD) generation. Updated results for the MRIC mixed-use alternative are presented in this section.

ADWF Impacts

In the April 2015 WWTP TM, it was determined that the MRIC, in combination with the adjacent proposed “Triangle” development, would produce 0.111 million gallons per day (mgd) of ADWF based on the use of the City’s sewer flow factors published in the 2012 SSMP, or 0.203 mgd of ADWF based upon indoor water use from the Draft Water Supply Assessment. Subtracting out the proposed Triangle development, those numbers are reduced to 0.107 mgd and 0.197 mgd, respectively.

The table in Attachment 1 indicates that the MRIC mixed-use alternative would add 0.097 mgd of ADWF based on an assumption of 1,700 residents, or two residents per each of the 850 proposed dwelling units, with an assumed flow factor of 57 gallons per day (gpd) per resident. (It should be noted that the figure in Attachment 1 specifies a total of 750 to 850 units. It thus appears that the table in Attachment 1 is conservatively based on the upper end of the range specified in the figure in Attachment 1.)

The 2012 SSMP, which defines wastewater generation factors for various land uses, specifies residential flow factors of 330 gpd for single-family residential units and 230 gpd for multiple-family residential units. While the case was made in the March 2015 Sewer TM that these residential flow factors (especially the single-family residential factor) overestimate actual flows from residential sources, nevertheless, an assumed flow factor of 57 gpd coupled with an assumption of two person per dwelling unit equates to a per unit flow factor of 114 gpd per unit, which is an unusually low residential factor in comparison to typical values found elsewhere. It would seem more appropriate, if somewhat conservative, to assume that the City’s multiple-family residential flow factor of 230 gpd per unit applies. The use of this factor results in an ADWF value from the residential portion of the MRIC mixed-use alternative of 0.196 mgd, which when added to the estimates from the April 2015 WWTP TM results in total site ADWF values of 0.303 mgd (sewer flow factor basis) and 0.393 mgd (water use basis).

In the April 2015 WWTP TM, it was concluded that the WWTP would still have 0.95 mgd of ADWF capacity remaining after all City General Plan buildout development is in place. This result implies adequate capacity for the MRIC mixed-use alternative, even if the other proposed non-General Plan development projects are included (see Table 1 of the April 2015 WWTP TM).

BOD Impacts

In the April 2015 WWTP TM, it was estimated that the WWTP would still have 660 pounds per day (lbs/day) of average dry weather BOD load capacity remaining after all General Plan buildout development is in place. Additionally, it was determined that the MRIC would be expected to generate an estimated 430 lbs/day of BOD (not including the Triangle). It was thus concluded that the available average dry weather BOD load capacity at the WWTP could support the MRIC (and Triangle) alone, but not in combination with any of the other proposed non-General Plan development projects.

In the April 2015 WWTP TM, a determination was made that residential sources within the City generate an average of 0.267 lbs/day per dwelling unit. In addition, a 20 percent safety factor was added to account for the uncertainties in the analysis.

As noted above, the only difference between the MRIC mixed-use and non-mixed-use alternatives is 850 proposed dwelling units. The addition of these units would thus increase the estimated BOD loading of the MRIC from 430 lbs/day to 700 lbs/day. This result exceeds the estimated average dry weather BOD load capacity of the WWTP by a small margin that is within the range of 20 percent safety factor used in the calculations. Due to the uncertainties of the analysis, the marginal exceedance of the estimated average dry weather BOD loading from the proposed project (700 lbs/day) versus the estimated average dry weather BOD load capacity of the WWTP (660 lbs/day) does not conclusively show that the proposed project would result in an exceedance of the BOD load capacity of the WWTP.

SEWER IMPACTS

As noted above, the ADWF generation of the MRIC non-mixed-used alternative is estimated to be 0.107 mgd based on the use of the City's sewer flow factors published in the 2012 SSMP, or 0.197 mgd of ADWF based upon indoor water use from the Draft Water Supply Assessment, after subtracting out the proposed Triangle development. With the addition of 850 dwelling units, and using the City's published flow factor for multiple-family residential of 230 gpd per unit, these numbers increase to ADWF values of 0.303 mgd (sewer flow factor basis) and 0.393 mgd (water use basis), as also noted above.

As discussed in the March 2015 Collection System TM, peak wet weather flow (PWWF) is the key statistic of interest with regard to sewer lines. To obtain the PWWF, the ADWF is multiplied by a suitable peaking factor to obtain a peak dry weather flow (PDWF) value, and then an appropriate wet weather infiltration and inflow (I&I) flow rate is added to the result. The 2012 SSMP defines the PDWF peaking factor (PF) as follows:

$$PF = 7.67 \cdot ADWF^{-0.093}$$

(It should be noted that the 2012 SSMP contains a misprint showing an exponent of -0.93 rather than -0.093 .) Applying this peaking factor to the two ADWF estimates discussed above yields PDWF values of 0.718 mgd (sewer flow factor basis) and 0.909 mgd (water use basis).

The table in Attachment 1 indicates that the MRIC mixed-use alternative would have an I&I producing land area of 136 acres and I&I flow rate factor of 600 gpd/acre, with a resultant peak I&I flow of 0.82 mgd. The 600 gpd/acre I&I flow rate factor is consistent with the 2012 SSMP; however, it is unclear how the 136-acre land area was determined. According to the Draft Water Supply Assessment, the gross area of the site would be 211 acres. Applying the 600 gpd/acre I&I factor to this acreage produces a peak I&I flow rate of 0.127 mgd. Adding this result to the above PDWF values produces PWWF estimates of approximately 0.84 mgd (sewer flow factor basis) and 1.04 mgd (water use basis). These results compare to values of 0.41 mgd (sewer flow factor basis) and 0.61 mgd (water use basis) for the MRIC non-mixed-use alternative.

As discussed in the March 2015 Collection System TM, according to the City Sewer Spreadsheets, which are based on the sewer flow factors from the 2012 SSMP, the 42-inch diameter trunk sewer north of the proposed MRIC is predicted to flow at 88 percent of capacity at General Plan buildout PWWF conditions, while the 21-inch diameter trunk sewer east of the proposed MRIC is predicted to flow at 84 percent of capacity at buildout PWWF conditions. In addition, the 2009 SECAP

specifies a standard that gravity sewers should not flow at a depth (d) that is more than 75 percent of the pipe diameter (D), which roughly equates to a PWWF that should not exceed 90 percent of the calculated full-pipe capacity of the given sewer line. Given this standard, the remaining available capacity in these lines is estimated to be 0.31 mgd in the 42-inch diameter trunk sewer, and 0.28 mgd in the 21-inch diameter trunk sewer. These results indicate inadequate capacity to accommodate the MRIC (either mixed-use or non-mixed-use).

As discussed in the March 2015 Collection System TM, however, it appears that the City's sewer flow factors overestimate actual ADWF, especially for single-family residential units. It was determined in that TM that reducing the ADWF values in the City Sewer Spreadsheets by 40 percent brings those results in line with the current ADWF values measured at the WWTP. If this 40 percent reduction is applied, the resultant available PWWF flow capacity in the trunk sewer lines in question increases to approximately 5.0 mgd of allowable capacity remaining in the 42-inch diameter trunk sewer at General Plan buildout PWWF conditions, and approximately 1.4 mgd of allowable capacity remaining in the 21-inch diameter sewer at General Plan buildout PWWF conditions. It is thus concluded that adequate buildout PWWF capacity exists in both lines to handle the additional flow generated by the Mace Ranch IC mixed-use alternative.

CONCLUSIONS

The major conclusions of this analysis include the following:

1. It appears that adequate ADWF capacity exists at the WWTP to accommodate the MRIC mixed-use alternative at General Plan buildout conditions, either alone or in combination with the other proposed non-General Plan development projects.
2. The BOD loading estimate presented in this TM suggests that the BOD loading capacity at the WWTP would be slightly exceeded; however, the result is within the 20 percent safety factor used in the calculations. Due to the uncertainties of the analysis, the marginal exceedance of the estimated average dry weather BOD loading from the proposed project versus the estimated average dry weather BOD load capacity of the WWTP does not conclusively show that the proposed project would result in an exceedance of the BOD load capacity of the WWTP.
3. If the City Sewer Spreadsheets and the City sewer flow factors are taken at face value, then inadequate PWWF capacity exists in either the 42-inch diameter trunk sewer north of the proposed MRIC or in the 21-inch diameter trunk sewer east of the proposed MRIC to accommodate the flows from the MRIC mixed-use alternative. However, if the City Sewer Spreadsheet flows are reduced to be consistent with observed flow conditions at the WWTP, then adequate capacity exists in both trunk sewers to accommodate flows from the MRIC mixed-use alternative.

It should be noted that if the volume or BOD content of the wastewater generated from the MRIC site is significantly higher than current planning assumptions indicate, the above conclusions may not be applicable.

Mixed-Use Alternative

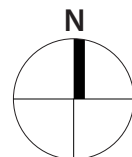
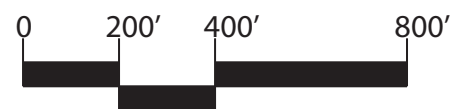
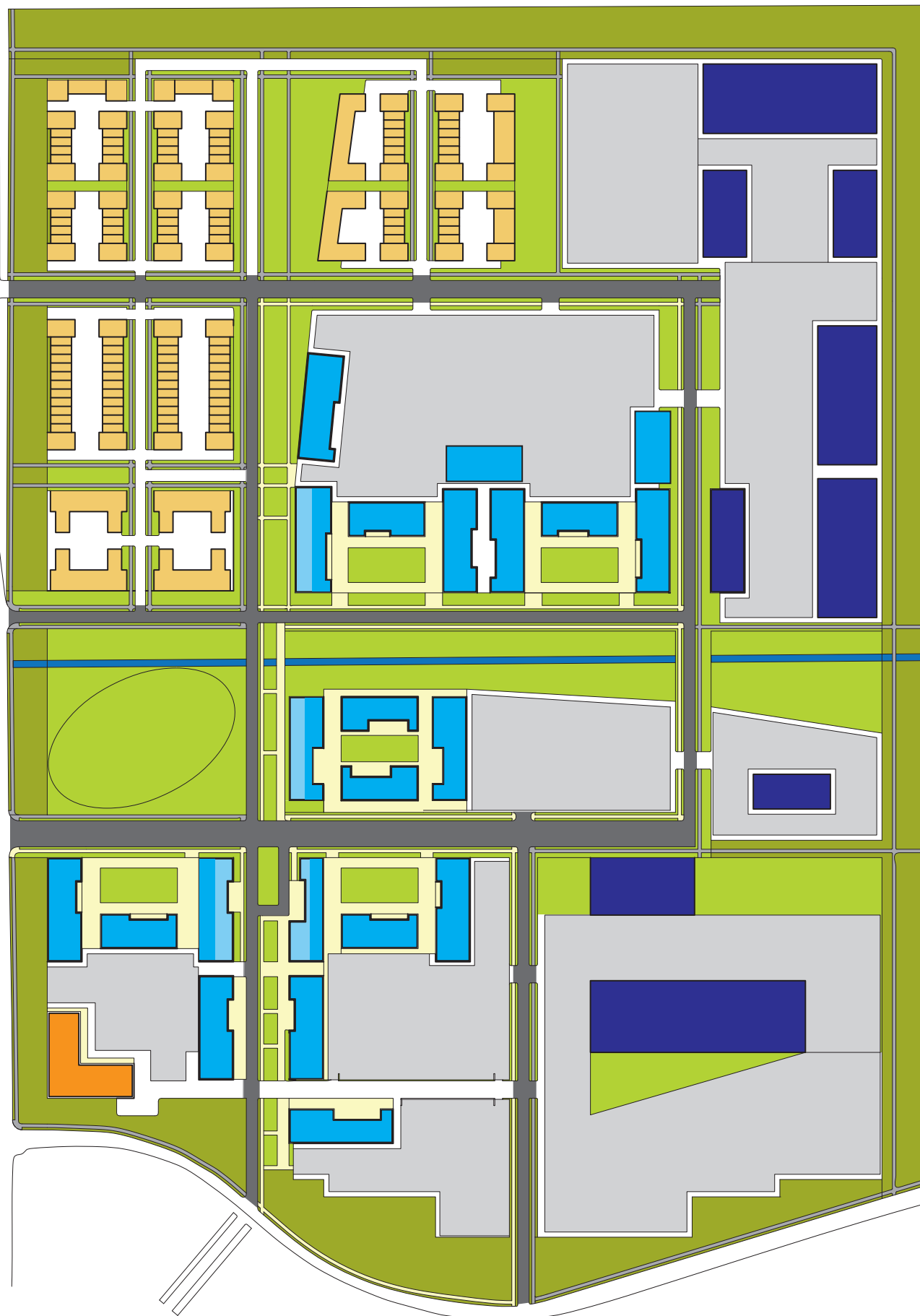
Total Programs

- R&D : 1,580,000 sqft.
- Manufacturing : 884,000 sqft.
- Hotel Conference : 150,000 sqft.
- Ancillary Retail 40,000 sqft.
- Total Sq Footage : 2,654,000 sqft.

Proposed Housing

- Total number of units: 750-850 units
15-20 du/ac

- Note:
1. Within the areas indicated as ancillary retail the program is allowed at a kiosk or as a mixed-use subcomponent within buildings that otherwise serve R&D/Office/Research.
 2. Areas demarcated by two colors may accommodate either use.



10-15 Dwelling Units/Acre
Townhomes



15-20 Dwelling Units/Acre
Live-Work Lofts



25-30 Dwelling Units/Acre
Apartments

**Mace Ranch Innovation Center - With Residential
Preliminary Sewer Demands**

Prepared by Cunningham Engineering Corporation
Revised 2/17/2015

Sewer Loading

	Floor Area (SF)	Population Ratio (person/sf)	Sewered Population Employee (person)	Sewered Population Other (person)	Per Person ADD (gpd)	Industrial Use Demand (gpd/1000)	Total ADD (gpd)	Total ADD (mgd)
RD/Office	1,510,000	0.0024	3,553		15		53,294	0.05
Manuf.	884,000							
Office		0.0024	2,080		15		31,200	0.03
Non-Office						90	79,560	
Hotel	160,000							
Emp/Other			50		15		750	0.00
Guest Rooms				150	150		18,000	0.02
Convention	50,000	0.0133		667	15		3,000	0.00
Retail	100,000							
Employee		0.0020	200		15		3,000	0.00
Customer				2,842	3		8,526	0.01
Non-Residential	2,654,000		5883	3659			197,330	0.12
Subtotal:								
Residential				1,700	57		96,900	0.10
Project Total:				5359			294,230	0.21

Total ADDF	0.21 mgd
PF=[7.67*(ADDF)^-0.093]	2.45
PDWF=ADDF*PF	0.53 mgd

Infiltration and Inflow

Land Area (ac)	Per unit I&I (gpd/ac)	Total I&I (gpd)	Total I&I (mgd)	
136	600	81,600	0.08	13%
PWWF = PDWF + I&I			0.61 mgd	

NOTES

- 1 For preliminary planning purposes, it is assumed that inside water use is equivalent to sewer use. Unit demands are based the Draft Water Supply Assessment prepared for the City of Davis by Brown and Caldwell, January 2015.
- 2 Population Ratios for RD/Office and Retail obtained from BAE Urban Economics Report, dated December 2014. Ratios for other uses derived from California Uniform Building Code Occupancy Levels and City of Davis Standards. Convention center ratios have been reduced to 20% of maximum occupancy with the assumption that maximum capacity events do not occur on a daily basis. Retail customers are based on the draft Water Supply Assessment report. Residential population is based on 850 units with resident ratio of 2.0 person/unit.
- 3 Peak demand for convention center is based on full occupancy. Average day demand is based on expected average use of 30% capacity.
- 4 Peak demand for hotel room is based on full occupancy. Average day demand is based on expected average use of 80% capacity.
- 5 Peaking factor equation per City of Davis standards
- 6 I&I unit flows are per City of Davis standard values
- 7 "Hotel - Guest Rooms" space is estimated based on 150 rooms.