

MEMORANDUM

DATE	16/03/2022
TO	Sheena Clark
FROM	Guy Stock
COPY	Peter Rees, Giselle Degebrodt
PROJECT	South Boulder WWTP Inlet Works
SUBJECT	Peak flow for screen selection
DOC NO	1034-03-05-MEM-001

Wastewater inflow data has been analysed to inform selection and operation of an inlet screen for the South Boulder WWTP.

The sizing of the inlet screen can either cover all flow rates or permit overflow bypass for peaking flows over a nominated flow rate – there is a capital cost implication to larger capacity equipment to manage all flow events. The capital cost should be a balance against the operational cost to remediate the treatment plant when large flow and rags bypass events occur.

Inflow

Instantaneous inflow data measured at five (5) minute intervals between May 2019 – April 2021 was provided by CKB for analysis.

Due to limitations of the flowmeter, the maximum achievable reading was 219 L/s. It is likely flow rates on occasion exceeded this flow rate.

Raw inflow data is presented in Appendix A. The following initial observations were made:

- An average flow of 79.11 L/s was calculated from all the presented data.
- Peak flows tend to occur at 10am and 8/9pm based on average hourly inlet flows (refer Appendix B).
- Periods of high flow are observed to be concentrated around February and March (refer Appendix C).
- High inflow was observed in May and June in 2020. However, during this period are also readings of no flow which may be indicative of a faulty meter. It is understood that the meter (ultrasonic level transducer) has been upgraded and location reset for corrected flow calculations from the Parshall flume water level.

Rainfall

Rainfall data from Bureau of Meteorology (BoM) measured from Kalgoorlie-Boulder Airport (station no. 12038) and Bulong (station no. 12013) was used to determine the degree of stormwater influence on peak flows (refer Appendix D).

Burlong weather station is located approximately 26 kms away from the WWTP and was provided due to gaps present in Kalgoorlie-Boulder airport data.

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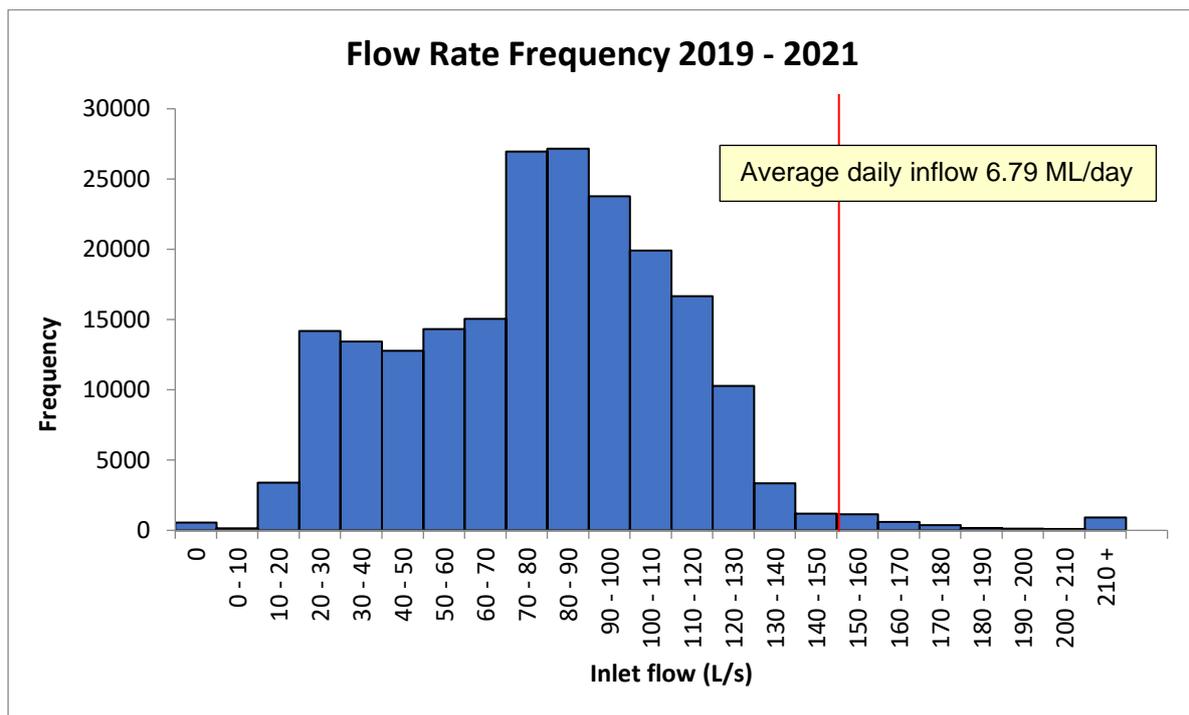
There is a correlation between elevated rainfall and peak inflows, although this was not substantiated for all peak flow events. Two charts presented in Appendix D show a comparison between daily inflows and inflows during days with rainfall less than 1 mm. The latter highlights the occurrence of peak inflows on days without the presence of rainfall. This is most evident during several days between Feb – Jun 2020 that reach inflow volumes greater than 9 ML/day with no recorded rainfall during the day or days prior. The data quality and / or cause of high flows was unclear.

Flow Frequency

The frequency of flow rates were determined to provide an indication of how the flow rates distributed around the mean flow rate. The frequency of flow was also used to define a peak flow rate which could be used to select an appropriately sized inlet screen.

Figure 1 shows that the data is relatively symmetric with a significant majority of the inflow measurements below 150 L/s (98.35% of the data). Although flow is observed at a rate in excess of 219 L/s, **occurrences above 150 L/s accounted for just 1.65% of the data.**

Figure 1 – Distribution of measured inflow data.

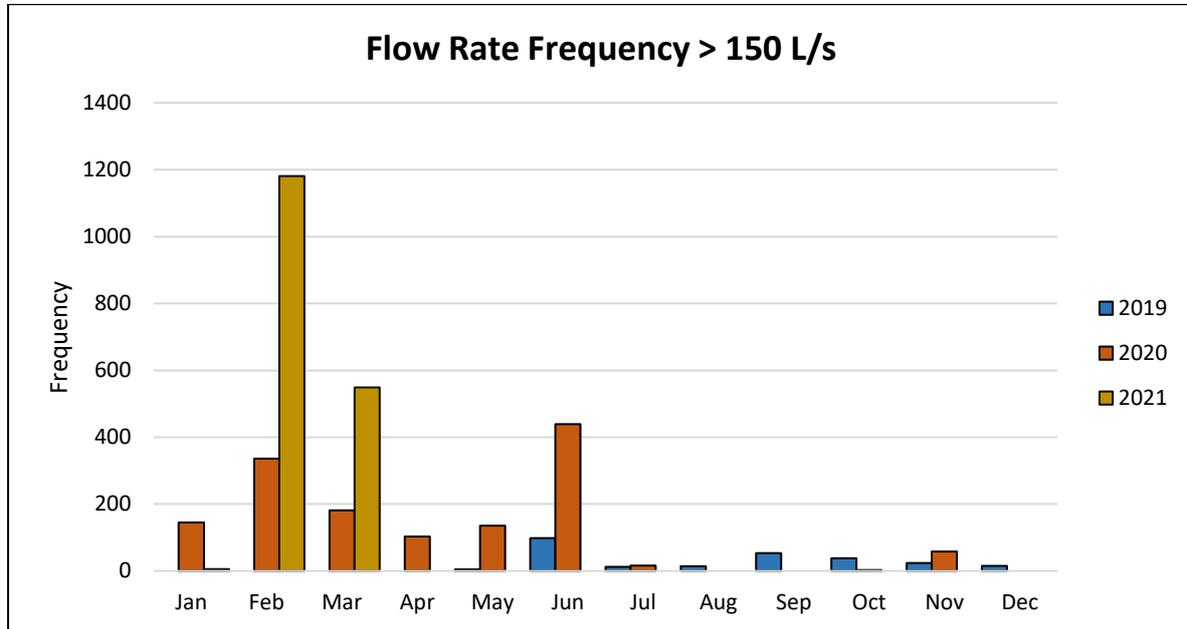


Flows greater than 150 L/s largely occurred during February and March based on 2020 and 2021 data (refer Figure 2). June also experienced a large number of instances inflows were greater than 150 L/s in 2020 and to a lesser extent in 2019.

According to BoM climate data, Kalgoorlie-Boulder airport (station no. 12038) experienced a total of 316.6 mm during 2021, of which 95.2 mm occurred in February. This is above the annual average of 265.5 mm and considerably above the 32 mm average for February. In contrast, 2020 rainfall data showed an annual total of 170.2 mm and 62.2 mm for February. This is likely to contribute to the disparity seen between the frequency of flow rates in excess of 150 L/s shown in Figure 2.

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Figure 2 – Monthly occurrence of inflows greater than 150 L/s.



Basis of Screen Selection

Assuming a design capacity of 150 L/s, data between May 2019 and April 2021 suggests that capacity would have been exceeded for 208 hours (8.7 days) during 219 separate events (Table 1).

This means that for approximately 4 – 5 days of the year, an inlet screen of design capacity of 150 L/s would be partially bypassed by the flow beyond the design capacity.

Operational management of the bypass flows would be required. CKB is recommended to evaluate tolerance to high flow event management or whether the screen should be sized to screen all inflow rates.

Table 1 – Total number of separate events above different flow rates between May 2019 and April 2021.

Flow Rate (L/s)	No. of separate events
> 150	219
> 160	191
> 170	164
> 180	134
> 190	120
> 200	103
> 210	93

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Table 2 – Flow rate frequency and calculated duration of occurrence between May 2019 – April 2021 (assuming flow remains constant over the five-minute duration between readings)

Flow rate (L/s)	Frequency	Hours	Cumulative %
0	563	47	0.27%
0 - 10	136	11	0.34%
10 - 20	3391	283	1.98%
20 - 30	14187	1182	8.85%
30 - 40	13429	1119	15.35%
40 - 50	12783	1065	21.54%
50 - 60	14331	1194	28.47%
60 - 70	15045	1254	35.76%
70 - 80	26953	2246	48.81%
80 - 90	27164	2264	61.95%
90 - 100	23774	1981	73.46%
100 - 110	19916	1660	83.10%
110 - 120	16669	1389	91.17%
120 - 130	10288	857	96.15%
130 - 140	3339	278	97.77%
140 - 150	1193	99	98.35%
150 - 160	1140	95	98.90%
160 - 170	602	50	99.19%
170 - 180	364	30	99.37%
180 - 190	174	15	99.45%
190 - 200	127	11	99.51%
200 - 210	94	8	99.56%
*210 +	911	76	100.00%

*Maximum achievable reading by the flow meter is 219 L/s.

Data Limitations

The effectiveness of the provided inflow data to inform decisions on inlet screen specifications could be limited by how well the WWTP flow meter is functioning and whether the short period of data analysed was representative of normal sewer flows.

There are several instances within the data that show multiple readings of the same value repeated over time. This may be indicative of a fault in the meter. This is most apparent during Feb 2020 where there is a consecutive reading of 159.5 L/s for over nine (9) hours

A disparity is observed between inflow frequencies during the first half of 2020 and 2021 data (refer Figure 2). Therefore, it is difficult to determine what a “normal” year of inflow looks like using just a two-year sample size. This may lead to the inlet screen being either over or under designed.

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Sewerage Scheme Modelling

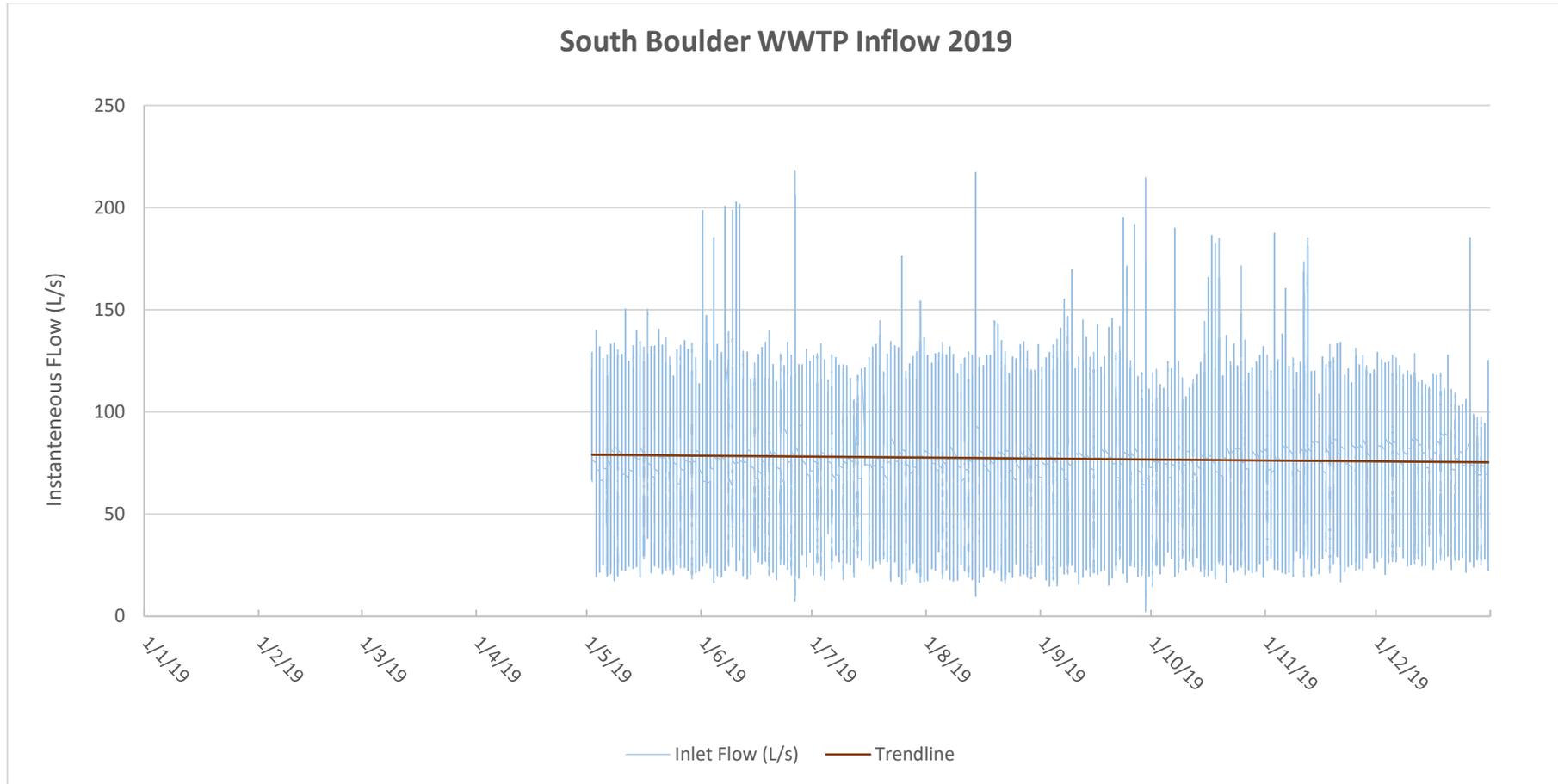
CKB has had the Kalgoorlie – Boulder sewer scheme modelled for forecast population growth. It is recommended to review the forecast modelled peak instantaneous flow rates when evaluating the WWTP inlet screen capacity.

Recommendations

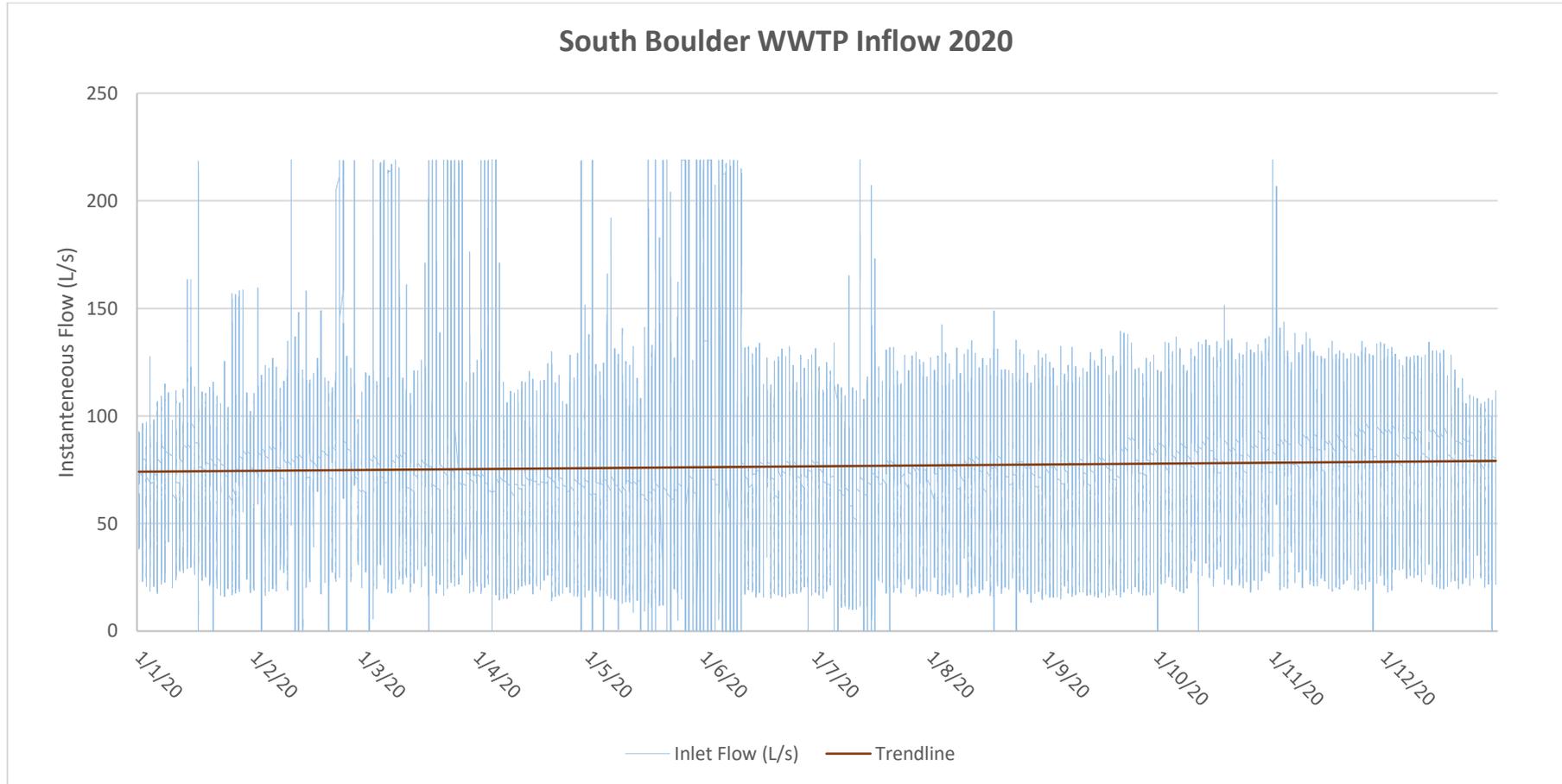
- Preliminary advice is that the data indicates an instantaneous peak flow rate of 150 L/s with occasional bypass flows to be operationally managed.
- Operators will be consulted for the basis of design above.
- Pricing of dual screens will input to the basis of design decision.

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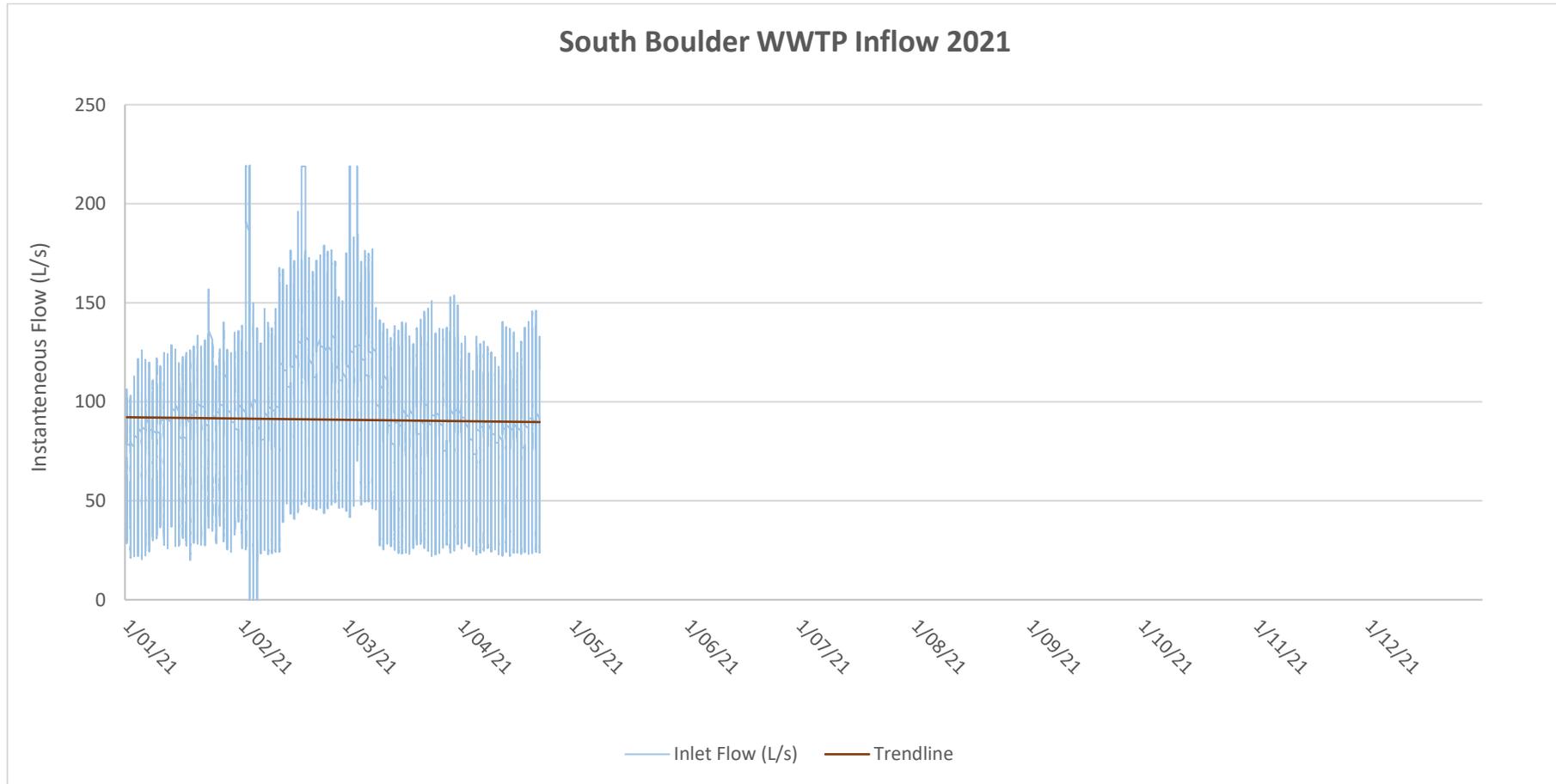
APPENDIX A – INFLOW DATA



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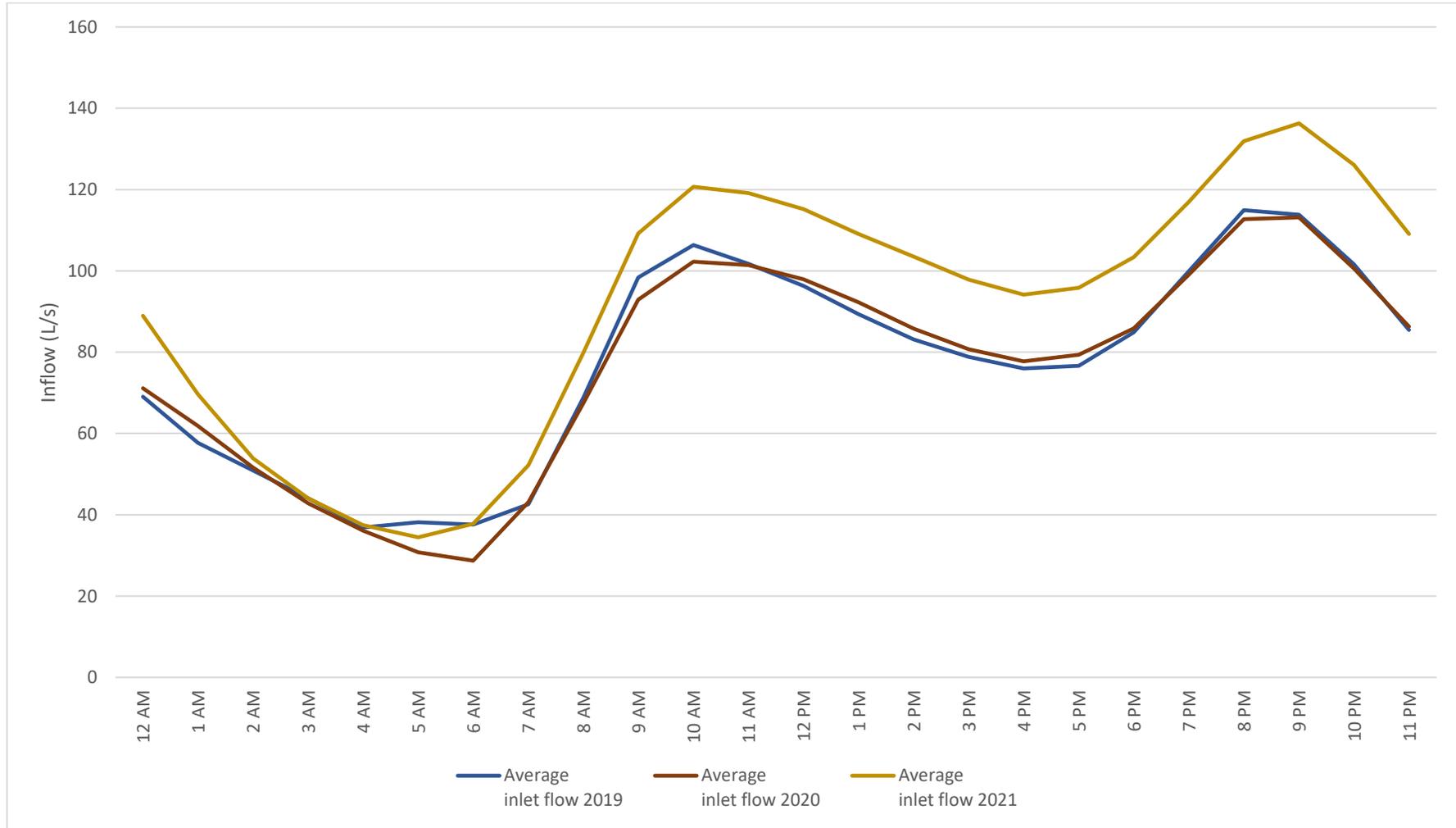


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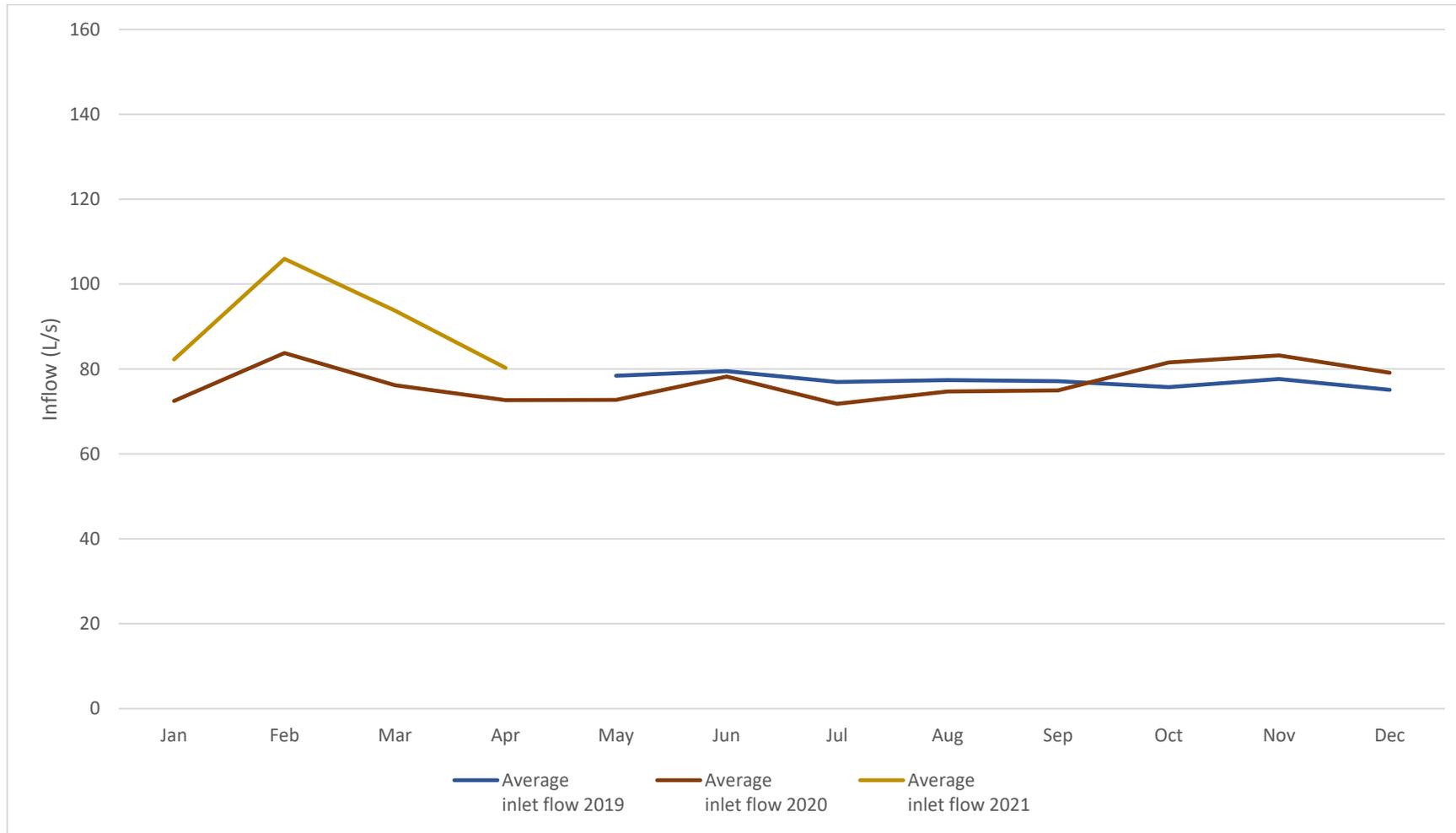
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APPENDIX B – AVERAGE HOURLY INFLOW



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APPENDIX C – AVERAGE MONTHLY INFLOW



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APPENDIX D – DAILY INFLOW & RAINFALL

