

Appendix B – Injection Wells Hindcasting

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DRAFT

Background

Utilities operates two wastewater treatment plants (WWTPs), the older Main Street facility and the newer Kanapaha facility. The treated wastewater discharged from the Main Street facility goes to Alachua Sink, while treated wastewater from the Kanapaha facility is injected into the aquifer through the Kanapaha well. The University of Florida operates its own wastewater treatment plant and has two injection wells.

Murphree Well Field Withdrawal data

Murphree well field withdrawal data was obtained from SJRWMD and has withdrawal estimates from 1986-2010. The Murphree withdrawal data was divided by Alachua County Public Supply data for corresponding years to get a ratio of withdrawal to public supply for each year. The ratios of reported years (1986-2010) were averaged together to get an average ratio of 0.901955. This ratio was used to hindcast and estimate Murphree withdrawal data going back to 1900 and for 2011-2015.

Kanapaha

The average estimated flow into the well at Kanapaha from January 1982 through February 1984 was 6.1 mgd (Phelps, G. G. (1987)). This value was used to estimate flow from 1979-1981. The Kanapaha wastewater treatment facility came online in 1977 but no month is stated, therefore it is assumed that it came online half way through the year and half of the 6.1 mgd was assigned to 1977 ("Kanapaha Water Reclamation Facility History"). Prior to 1977, the injection rate was set to zero because the wastewater treatment plant did not exist, therefore no water was being injected into the Floridan Aquifer.

Jones Edmunds has a time series of injection flows by month for Kanapaha from 1982 through 2012. Injection flows from each month were averaged to get an estimate for the flow in each given year. These numbers are also reported from Gainesville Regional Utilities Historical Wastewater Flow Rates.

Estimates for 2014-2015 were obtained from a SJRWMD file of wastewater treatment and reuse. This included data from 1995-2017.

From the reported data gathered, the average estimate of water injected for the Kanapaha well was 8.41794 MGD.

Alachua Sink

The main assumption for Alachua sink is that all of the wastewater discharging from the Main Street WWTP is making its way to Alachua Sink. Another assumption made is that before the Kanapaha WWTP came online, that water was also being discharged to Alachua Sink. The flow from the Mainstreet WWTP was hindcasted back to 1930, when the plant came online ("Main Street Water Reclamation Facility").

From 1982-2012, estimates were obtained from Gainesville Regional Utilities Historical Wastewater Flow Rates as well as the time series from Jones Edmunds. Estimates for 2014-2015 were obtained from

SJRWMD file of wastewater treatment and reuse. This included data from 1995-2017. From the reported data gathered, the average of treated wastewater calculated for the Main Street WWTP was 5.8195 MGD.

For the years before the Kanapaha WWTP came online, the sum of the average injection of the treated Kanapaha wastewater ($\overline{Q}_{injection, Kanapaha}$) and the Main Street treated wastewater ($\overline{Q}_{Main Street}$) was divided by the average withdrawal from the Murphree well field ($\overline{W}_{Murphree}$) to find ratio $c1$. The value of $c1$ is 0.59888.

$$c1 = \frac{\overline{Q}_{injection, Kanapaha} + \overline{Q}_{Main Street}}{\overline{W}_{Murphree}}$$

Then, the product of ratio $c1$ and the average Murphree well field withdrawal ($\overline{W}_{Murphree}$) was subtracted from the average of Alachua County Public Supply ($\hat{Q}_{Alachua}$) to obtain an estimate of injection flow for each year of missing data (1900-1977) (*Pre-Kanapaha*).

$$Pre\ Kanapaha = \hat{Q}_{Alachua} - (c1 \times \overline{W}_{Murphree})$$

After Kanapaha came online, the same methodology was applied to calculate ratio $c2$, however, the injection flow from Main Street ($\overline{Q}_{injection, Main Street}$) was used, instead of adding in the Kanapaha flow. This value of $c2$ is 0.24479.

$$c2 = \frac{\overline{Q}_{injection, Main Street}}{\overline{W}_{Murphree}}$$

Then, the estimated injection (*Post-Kanapaha*) is the ratio $c2$ multiplied by the average Murphree well field withdrawal. This was applied for years 1977-1981. The value in 1977 was divided by two, because of the assumption of the Kanapaha WWTP coming online half way through the year. Injection estimates are available starting in 1982.

$$Post\ Kanapaha = c2 \times \overline{W}_{Murphree}$$

University of Florida

The University of Florida wastewater treatment plant was constructed in 1926. In 1959, two injection wells were installed for lake level control. In 1994, the water reclamation plant (WRP) began operation and in 1995 the effluent from the plant was discharged directly to the R2 (Lake Alice - FLA011322_8285) injection well, leaving the other well (R1 – UF well number 001) to be used only for lake level control.

Starting in 1995, injection flow rates from the WRP and total flow rates were reported to FDEP. SJRWMD provided a spreadsheet with these numbers (file name “1995 - PRESENT WW TREATMENT AND REUSE MASTER FILE 051518”). The injection flow rates reported from 1995-2015 were assigned to only well R2 because the reclaimed water is injected directly into that well. Well R1 was set to zero for these years.

To estimate the flow through the wells prior to 1995, the average of the total flow reported from FDEP from 1995-2015 was calculated. This average of 1.890762 MGD was then divided by the average Murphree Well Field withdrawal for reported years (23.7734448 MGD) to get a ratio of 0.79532517. This ratio was then multiplied by the Murphree well field withdrawal data back to 1926 and divided equally amongst the R1 and R2 wells.

Moving Average

Lastly, a 5-year moving average was calculated from the injection rates for each station. This moving average used the current year, and four years prior to calculate an average that was then applied for the given year. For example, the years used to calculate a 5-year moving average for 2015 would include 2011, 2012, 2013, 2014, and 2015.

References

Phelps, G. G. (1987). Effects of surface runoff and treated wastewater recharge on quality of water in the Floridan aquifer system, Gainesville Area, Alachua County, Florida. *Water-Resources Investigations Report, 87-4099*, 62. <https://doi.org/https://doi.org/10.3133/wri874099>

“Kanapaha Water Reclamation Facility History.” GRU, Gainesville Regional Utility, www.gru.com/MyHome/Content/KanapahaWaterReclamationFacilityHistory.aspx.

“Main Street Water Reclamation Facility.” GRU, Gainesville Regional Utility, www.gru.com/MyHome/Content/MainStreetWaterReclamationFacility.aspx.