City of Austin
WATERSHED PROTECTION

Addendum to "Parsimonious Analysis of a Proposed Wastewater Treatment Plant Discharge to the Long Branch Tributary and Barton Creek"
SR-19-13; October 2019

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ABSTRACT

The Sawyer-Cleveland Partnership is proposing to discharge treated wastewater effluent in Long Branch, a tributary of Barton Creek. A WASP model was used evaluate the eutrophication impacts from the proposed discharge through several ponds in the discharge route (Richter 2018). A simplified water quality model based on Chapra (2014) was developed for Long Branch from the WASP model to Barton Creek (Porras 2019). The result was that mesotrophic status of Barton Creek was predicted to be between 1.2 and 27.8 miles under high and low flow conditions, respectively. During negotiations with TCEQ, the applicant decided to reduce the size of development to a commercial restaurant/retail shopping center and lower the requested permit flowrate to 45,000 gpd. If consistent with other TPDES permits on the Barton Springs Contributing Zone, the effluent concentration limits would be 5 mg/L BOD5, 5 mg/L TSS, 2 mg/L NH3-N, and 0.15 mg/L TP, 6 mg/L TN, and 6 mg/L DO. These values were input to a WASP model and the results at the terminus of this model used as input to a parsimonious water quality model capable of predicting periphyton levels downstream (Chapra 2014). The results from the WASP model indicate that even with the reduced flow and more advanced treatment limits, the discharge will result in a trophic status shift based on phytoplankton in Long Branch downstream from the pond system often over the hypereutrophic threshold and well over the eutrophic threshold. Further downstream, the Chapra model indicates that based on benthic algae, the model still predicts a change in trophic status shift from oligotrophic to mesotrophic in Long Branch well above the mesotrophic threshold. However, dilution of nutrients in Barton Creek reduces the predicted algae coverage back into the oligotrophic range.

INTRODUCTION

The interest of the City of Austin in maintaining recharge quality to Barton Springs and creek water quality in the discharge route remains the same as the source documents regardless of the size of development or effluent limits proposed (Richter 2018, Porras 2019). The two models used

in previous analyses were updated using the new flowrate of to 45,000 gpd. Using consistency with the other two approved permits for discharge in the Barton Springs Contributing Zone (WQ0014293001 HCWCID No. 1 – Belterra and WQ0014488003 City of Dripping Springs – South Regional Wastewater Treatment Plant) it is anticipated that the permit would be written with limits of 5 mg/L BOD5, 5 mg/L TSS, 2 mg/L NH3-N, and 0.15 mg/L TP, 6 mg/L TN, and 6 mg/L DO.

The treatment plant was analyzed using the BioWin 5.3 model and assumptions of an MBR skid mounted package treatment plant with units comparable to the manufacturer in the permit application. This provided the other nutrient effluent parameters of TKN 2.07 mg/L, Organic N 0.07 mg/L, and Nitrate-Nitrite N 5.95 mg/L. The WASP model analyzed the impact of the proposed effluent to just downstream of the series of ponds.

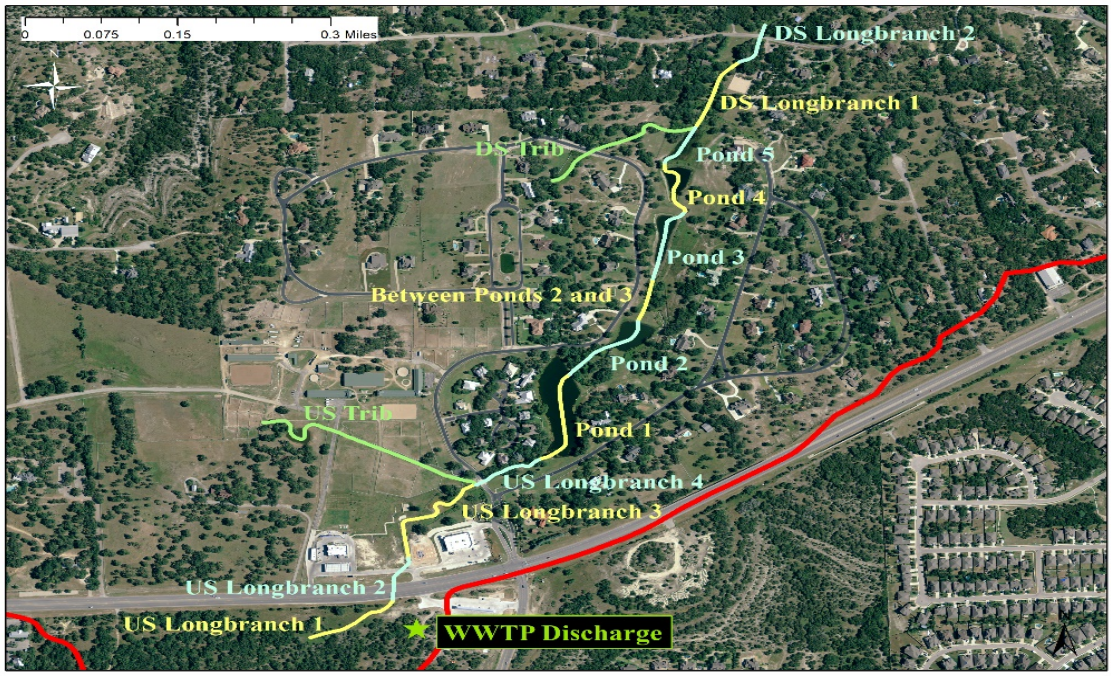

Figure 1: Location of the proposed WWTP and WASP segmentation for the water quality model. The location of the WWTP is southwest of the intersection of US Highway 290 and Sawyer Ranch Rd. on the southern border of the Barton Creek watershed (red line). Figure obtained from Richter (2018).

As with Porras (2019), the parsimonious model from Chapra (2014) was used to take the outputs from the WASP model as inputs in predicting the water quality downstream of the pond system. Given these inputs and preliminary watershed characteristics, Chapra's parsimonious model estimates the impact of the proposed Sawyer effluent for the remainder of Long Branch and downstream in Barton Creek.

CHANGES TO MODEL INPUTS

Physical Geography

No changes in watershed characteristics were necessary to run the WASP model at the lower discharge rate and lower effluent limits. Streamflow inputs from USGS gage 08155200 in Barton Creek were again used to determine flowrates along the length of the discharge route by distributing the gaged flows proportional to subwatershed areas upstream along the discharge route.

Parameter Input Values

The same stoichiometric and rate parameters for nutrients were used for the updated WASP and parsimonious models as were documented for the 92,000 gpd models (Richter 2018, Porras 2019). For the WASP model, as was done in the original effort, the potential evapotranspiration (PET) rates were taken from the Hargreaves equation as calculated by the SWAT watershed model for area. However, the WASP model displayed instability and crashed should the depth of water in the ponds reach a value of 0.05 m. Thus, the ET was set to zero when any pond depth dropped below a value of 0.06 m. This resulted in an ET value of zero for a handful of days in April 1999 for pond 5. In reality, this would just mean that the pond went dry for a few days in April 1999 and there would be no ponded water to evaporate or transpire.

RESULTS

Long Branch Measured Water Quality

Instream water quality analyses were available from a limited sampling effort for nutrients and periphyton in Long Branch. The average of the benthic algae chlorophyll *a* concentration from WPD Site 1975, located in Long Branch just upstream from the confluence with Barton Creek ("All Others" on map below), was 25.5 mg/m^2. This average was in the oligotrophic range based on a threshold of 36 mg/m^2 in Dodds (2006) and a little over the threshold of 20 mg/m^2 in EPA (2000), making the site potentially sensitive to any additional nutrient loading.

Table 1. Water Quality Results in Long Branch above Barton Creek 6/27/2019.

		Ammonia-N	Nitrate/Nitrite-N	Phosphorus	TKN	TN (calc)	Org-N (calc)	Benthic Chl-a
Site	Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/m^2
1975	6/27/2019	0.228	<J .008	0.0828	0.377	0.385	0.149	
1975	6/27/2019	<J .008	<J .008	0.0208	0.203	0.211	0.195	
1975	6/27/2019	<J .008	0.0597	<J .008	0.145	0.205	0.137	
1975	6/27/2019	<J .008	0.0318	0.119	0.124	0.156	0.116	
1975	6/27/2019							17
1975	6/27/2019							34
Avg								**25.5**

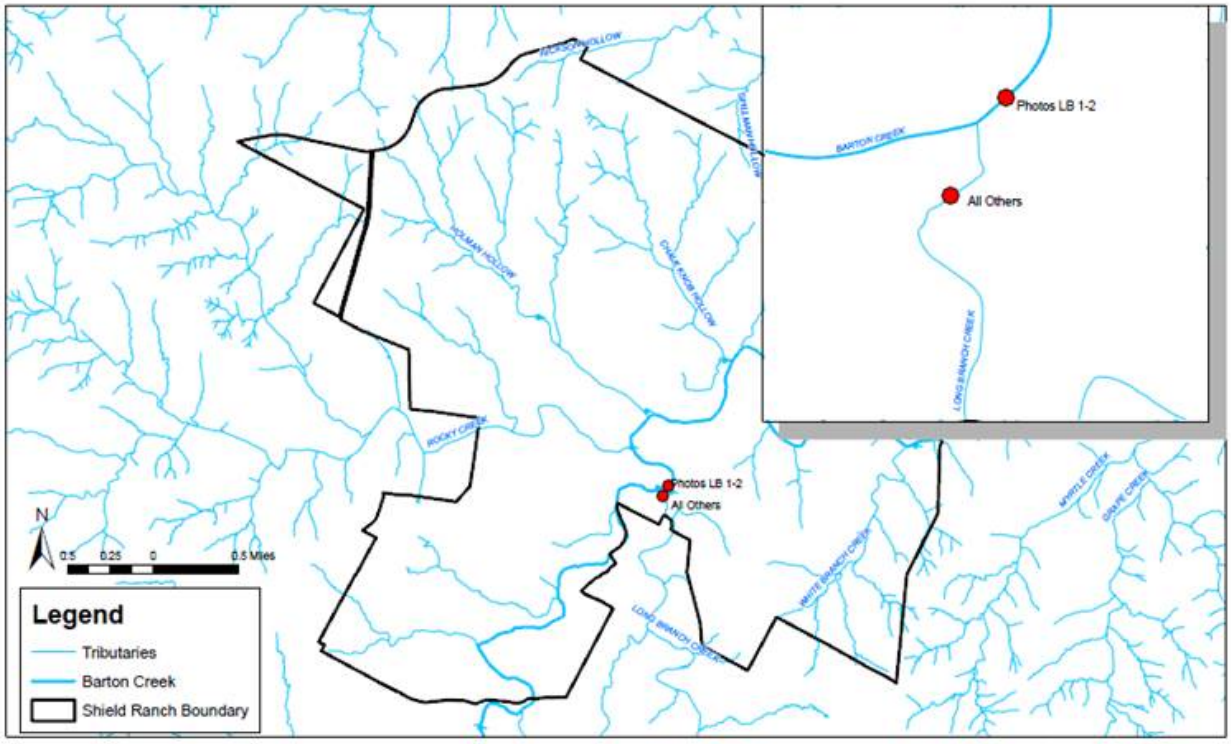

Figure 2: Location of the Sample Station 1975 in Long Branch upstream from confluence with Barton Creek - from photo key showing location of samples ("All Others")

Updated WASP Model Results

WASP model results for the original case with Sawyer-Cleveland at 92,000 gpd (Figure 3) indicated that Long Branch phytoplankton blooms in summer and fall months would be well

over the hypereutrophic chlorophyll *a* threshold of 56 µg/L from Carlson and Simpson (1996) and even further over the eutrophic threshold in EPA Rivers and Streams Nutrient Criteria guidance of 30 µg/L (EPA 2000).

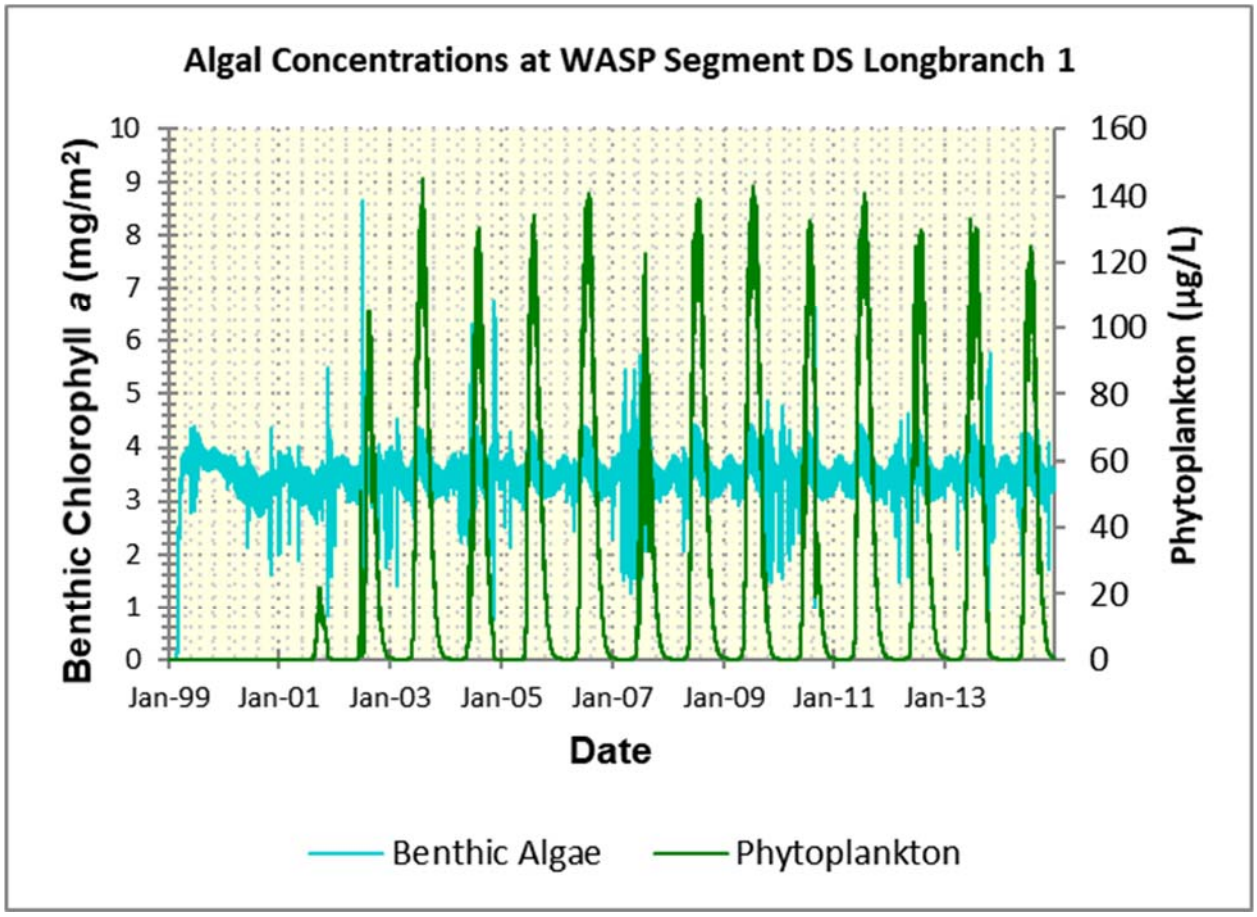

Figure 3. WASP model results from 92,000 gpd and applicant requested effluent limits.

WASP model results with Sawyer-Cleveland at 45,000 gpd, 0.15 mg/L TP, 6mg/L TN are shown in Figure 4. Phytoplankton blooms in summer months are often over the hypereutrophic threshold and well over the eutrophic threshold.

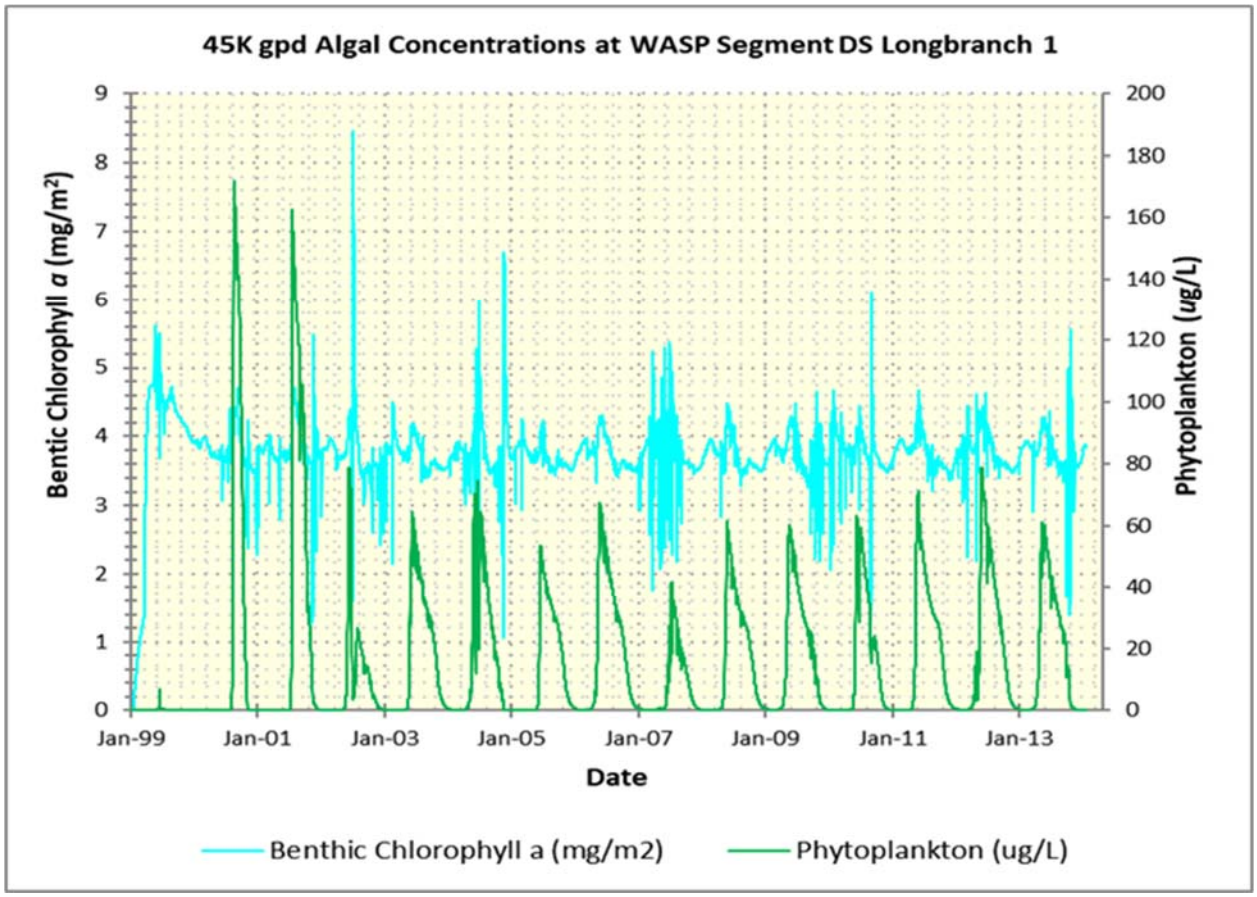

Figure 4. Updated WASP model results at 45,000 and anticipated TCEQ effluent limits from BSCZ dischargers.

Updated Parsimonious Model Results

The Chapra model results based on the input from original WASP model results at 92,000 gpd from Sawyer-Cleveland is shown in Figure 5. It is a bit more conservative than the WASP model but easier to extend downstream into Barton Creek. The results show a change in trophic status from oligotrophic to mesotrophic based on the benthic algae chlorophyll *a* concentrations being well above the mesotrophic threshold of 36 mg/m^2 (Dodds 2006) or 30 mg/m^2 (EPA 2000).

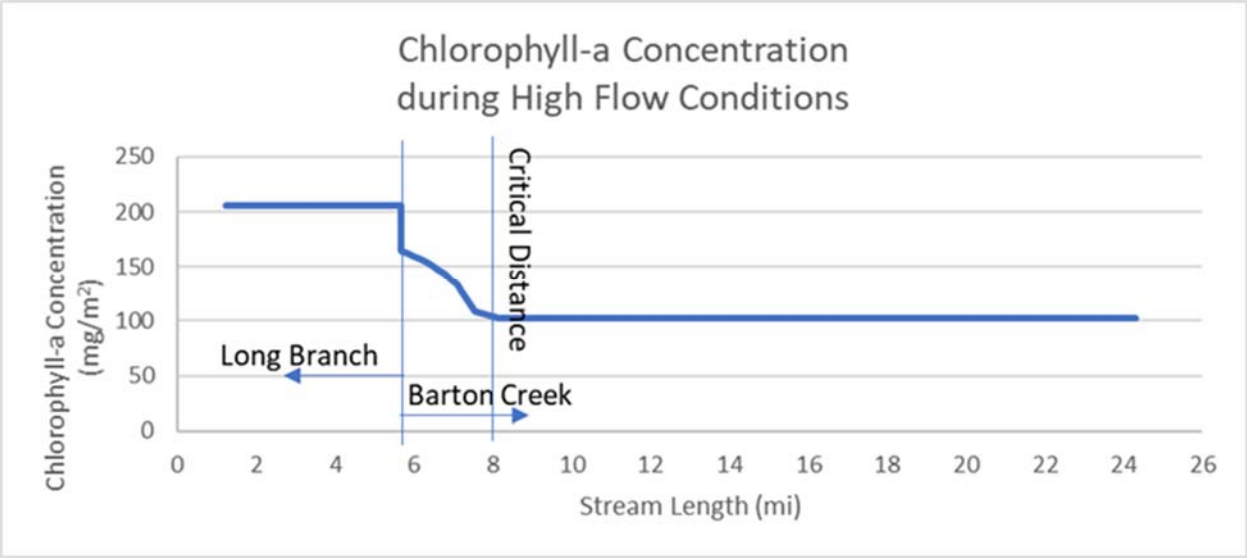

Figure 5. Chapra model results from 92,000 gpd and applicant requested effluent limits.

The Chapra model based on input from updated WASP model results with Sawyer-Cleveland at 45,000 gpd, 0.15 mg/L TP, 6 mg/L TN is shown in Figure 6. Based on benthic algae, the model still predicts a change in trophic status from oligotrophic to mesotrophic in Long Branch with density being well above the mesotrophic threshold of 36 mg/m^2 (Dodds 2006) or 30 mg/m^2 (EPA 2000). However, dilution of nutrients in Barton Creek reduces the predicted algae coverage back into the oligotrophic range.

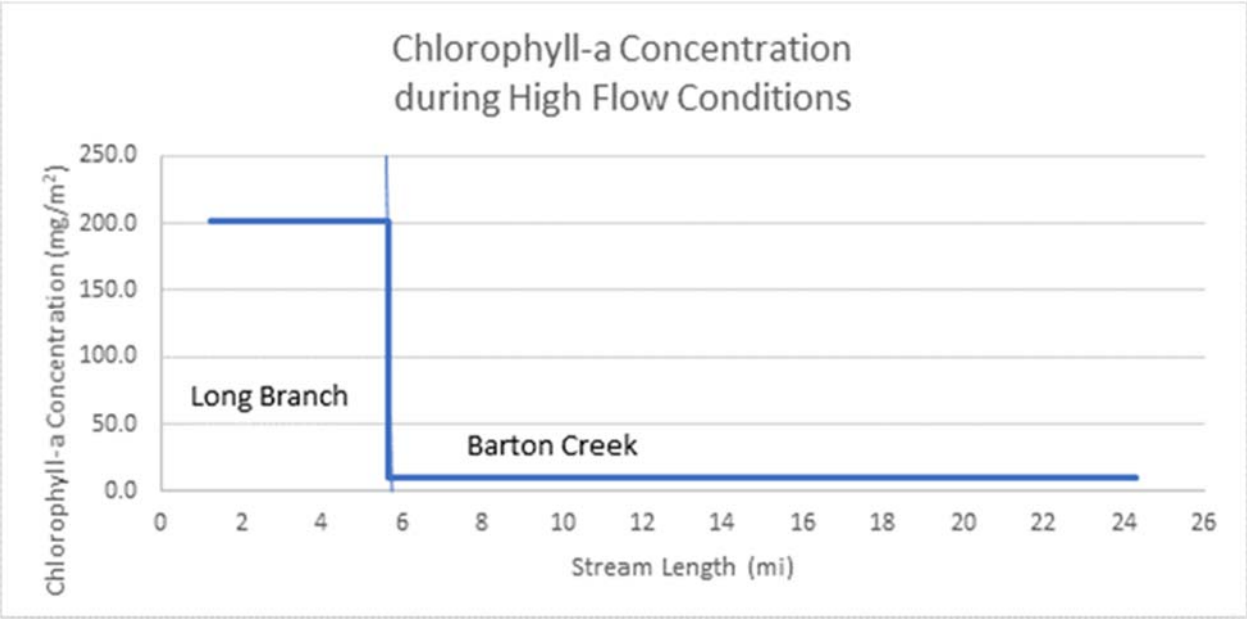

Figure 6. Updated Chapra model results at 45,000 and anticipated TCEQ effluent limits from BSCZ dischargers.

CONCLUSION

The modeling previously performed for Long Branch and Barton Creek was repeated with modified flow and effluent quality for the proposed Sawyer-Cleveland TPDES wastewater discharge permit. The flow was reduced to 45,000 gpd by the applicant and the anticipated effluent limits from TCEQ comparable to other approved permits in the Barton Springs Contributing Zone watershed are 5 mg/L BOD5, 5 mg/L TSS, 2 mg/L NH3-N, and 0.15 mg/L TP, 6 mg/L TN, and 6 mg/L DO. The results from the WASP model indicate phytoplankton chlorophyll *a* concentrations are often over the hypereutrophic threshold and well over the eutrophic threshold in the string of ponds along Long Branch downstream from the discharge. The results downstream from the Chapra model indicate a change in trophic status from oligotrophic to mesotrophic in Long Branch based on benthic algae chlorophyll *a* concentrations. However, dilution of nutrients in Barton Creek reduces the predicted algae coverage back into the oligotrophic range. Although the change in trophic status for Long Branch is concerning and should be considered above "de minimis", the impacts to Barton Creek may not be above "de minimis" levels if interpreted as a trophic level change.

REFERENCES

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