April 8, 2022

Mr. David Hughes, et al.
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**RE: REVIEW OF AUGUST 19, 2021 TECHNICAL MEMORANDUM PREPARED FOR 2050 & 2122 OGULIN CANYON ROAD CLEARLAKE, CALIFORNIA 95422
APNs: 010-053-01 & 010-053-02
*EBA Project No. 22-3146***

Dear Mr. Hughes:

EBA Engineering (EBA) has reviewed the August 19, 2021 Hydrogeologic Report titled *Ordinance 3106 Hydrology Report – UP 19-36 Lake Vista Farms, LLC* (NorthPoint Report) prepared by NorthPoint Consulting Group Inc. (NorthPoint) in connection with a proposed 15-acre outdoor cannabis cultivation project on five growing sites encompassing the two subject properties. The project spans the boundary between the eastern portion of the Burns Valley Groundwater Basin (BVGB) and the western portion of Clear Lake Cache Formation Groundwater Basin (CLCFGB).

EBA understands that the purpose of the NorthPoint Report was to comply with Lake County Ordinance 3106, *An Urgency Ordinance Requiring Land Use Applications to Provide Enhanced Water Analysis During a Declared Drought Emergency*. The ordinance stipulates that land use approvals must require the applicant provide sufficient information regarding water supply and demand and characterize impacts to surrounding areas. This includes an evaluation of available water from the project's water source, estimates of groundwater recharge, and the description of cumulative impacts of water use to surrounding areas.

It should be noted that the scope of this letter is not to recreate the work performed by NorthPoint and therefore this review is limited in the evaluation of the findings. For example, the findings in the NorthPoint Report suggest that "the proposed cannabis cultivation would use less water compared to farming hops and would have less impact on the surrounding area". This statement alludes to a conclusion that any impacts to the surrounding area would be less than previous operations, although this is impossible to determine without long-duration pumping tests and historical groundwater elevation monitoring given the respective time durations of both operations. Thus, an evaluation of the validity of the aforementioned statement is beyond the scope of this review. With that being said, the following sections present the results of our review and a discussion of the applicability of the hydrologic and hydrogeologic methods presented in the NorthPoint Report.

Project Water Demand

NorthPoint estimated cannabis water demand at six gallons per day (GPD) per plant and assumed 500 plants per acre, which provides an approximately 9.5-foot by 9.5-foot square for each plant. For the 15-acre project, the daily demand (assumed to be maximum) was estimated to be 45,000 gallons per day (GPD) or cumulatively 31.5 gallons per minute (gpm). Please note that the gpm listed is based on 24 hours of continuous pumping which is not reasonable or advisable. Two growing season durations were evaluated (120 days and 180 days) which yielded an annual water demand between 16.6 and 24.9 acre-feet per year (AF/yr), or approximately 5,400,000 to 8,100,000 gallons per year. It is unclear why different growing season durations were presented. From an annual perspective, these values are considered to be reasonable for the cannabis cultivation methods described within the NorthPoint Report. However, irrigation requirements are well understood to vary throughout a cultivation season based on growth stage of the plant (i.e. development stage, vegetative stage, flowering stage, etc.) and seasonal variables throughout the year which affect the evapotranspiration of the plant.

The NorthPoint Report does not include employee water demand for human consumption, lavatories, hand washing, and non-irrigation related agricultural demands. Information is not provided regarding planned staffing or water consumption. If drinking water and/or restroom facilities are to be provided on-site, a Public Water System permit should be applied for and obtained if at least 25 employees will be on-site for at least 60 days per year to conform to the California Waterworks Standards from Title 22 of the California Code of Regulations. Based on EBA's understanding of cannabis cultivation operations, EBA expects that more than 25 personnel will be needed to administer the 15 acres of cannabis, especially during the initial planting and harvest phases. It is currently unknown if bottled drinking water and portable toilets are proposed or if bathroom facilities are to be constructed. The only improvements illustrated on the Site Map are an existing barn and five polygons for the proposed cannabis grow areas. Therefore, additional information providing a complete project description should be provided and the project water demand estimate should be revised to include all future water usage.

Water Source and Supply

It is reported that five wells will be used on the property. The five wells were installed in 2006, 2011, 2013, and 2020, with an additional well being installed at an unknown date (illegible) but perhaps in 2014 (1075331). EBA reviewed the well logs included in the Report which are described to provide a combined yield of 720 gallons per minute (GPM) based on air lift testing after drilling. Long-duration pumping tests with corresponding groundwater elevation measurements do not appear to have been performed. It should also be noted that at least one additional well is listed for the property (1093073) which was also drilled in 2006, although this well is not included in the report. It is unclear why the six additional wells were drilled over the period of 10 years unless the existing well(s) were not producing enough for the existing uses (i.e., hops) or were seasonally running dry. As such, information is lacking regarding current groundwater elevations in relation to the previous measurements taken during drilling which would demonstrate that overdraft conditions have not occurred or are not occurring.

Per the five provided Well Completion Reports (WCRs), all yield tests were conducted by the water well driller using the air-lift method with a maximum duration of 2 hours. This method uses the application of air to displace groundwater from the well to the ground surface to estimate the well yield and often draws groundwater levels down to the bottom of the well. Thus, the yield value noted on the WCR is essentially a maximum estimate of yield assuming complete drawdown conditions prior to any previous pumping, and therefore air lift tests generally overestimate actual well yield, as is clearly stated on each WCR: *"May not be representative of a well's long-term yield."* While air-lift testing provides an initial indication of potential well yield, EBA would not consider this data sufficient to estimate long-term well yield under the proposed project scenario. Where long-term groundwater water supply comes into question, or where externalities to other potential beneficial uses of groundwater are not well understood, a longer duration pumping test is generally recommended.

Irrigation and Water Storage

The NorthPoint Report describes that irrigation water will be pumped from each well to a 2,500-gallon water storage tank, adjacent to each well, and then delivered to a drip irrigation system. Assuming a total of five 2,500-gallon tanks would be installed, this would yield a daily storage volume of 25,000 gallons or approximately 55% of the average daily demand. Storage capacity is generally recommended to be adequate for at least one day of water supply.

Groundwater Basin Information and Hydrology

NorthPoint cites from the California Department of Water Resources (DWR) Bulletin 118 (DWR, 2003) that the storage capacity of the BVGB is 4,000 AF with a usable storage capacity of 1,400 AF. Upon review of Bulletin 118, it appears that these estimates were first written in 1960 as a part of the Northeastern Counties Investigation – Bulletin 58 (DWR, 1960). Although these values may have been cited in different reports, these storage capacity estimates should be updated with respect to aquifer storage capacity (i.e., pumping tests). This is particularly significant given that the NorthPoint Report utilized a comparison of the estimated future water demand relative to the usable storage capacity as a means to evaluate the cumulative impact of the proposed project on groundwater resources. An estimate of storage capacity for the CLCFGB is not provided although one of the project wells is located in that basin. The significance of this is unknown.

Recharge Rate

NorthPoint used the National Resources Conservation Service Curve Number Method (CNM) to estimate annual groundwater recharge. Pre-project versus post-project recharge analysis was not conducted. The CNM generates runoff estimates for single storm events based on rainfall, land use, and soil characteristics. From the original documentation, prepared by Mockus in 1964, where the rainfall-runoff relation was proposed in Chapter 10 of the CSC National Engineering, the intent of the CNM is restricted to a single storm event. The CNM is based on the following empirical relationship (Equation 1).

$$\frac{F}{S} = \frac{Q}{P - I_a} \qquad \text{(Equation 1)}$$

where F = actual retention (inches)
S = potential maximum retention (inches)
Q = accumulated runoff depth (inches)
P = precipitation depth (inches)
I_a = initial abstraction (inches)

After runoff has started, all additional rainfall becomes either runoff or actual retention (Equation 2).

$$F = P - I_a - Q \qquad \text{(Equation 2)}$$

Please note that there is no 0.5 multiplication factor associated with I_a in the original derivation of the equations. Combining Equations 1 and 2 yields Equation 3.

$$Q = \frac{(P - I_a)^2}{P - I_a + S} \qquad \text{(Equation 3)}$$

The initial abstraction term is defined as twenty percent of the potential maximum retention which is in turn based on the curve number (Equation 4).

$$S = \frac{1000}{CN} - 10\,, \qquad I_a = 0.2S \qquad \text{(Equation 4)}$$

Assuming that F (the actual retention) is the depth of water available for recharge, it can be shown that the precipitation depth must be greater than I_a in order for runoff and actual retention to occur. For instance, if the curve number is 70, if the I_a term is equal to 0.86 inches, and if the precipitation depth is 1 inch, the runoff would go to zero per Equation 3 and the actual retention would be a negative value per Equation 2. On a storm-by-storm basis, the methods shown above provide reasonable values for runoff and actual retention for instances where the precipitation depth of the storm is greater than the initial abstraction.

When the CNM is applied for a year-long timestep (as was done by NorthPoint), the fundamental relationship between the initial abstraction, precipitation, and runoff is lost, because the value entered for the precipitation depth is significantly greater than the initial abstraction which is defined for a single storm event alone. NorthPoint's methodology to reduce the initial abstraction by one half further exacerbates this because NorthPoint assumes that the first half of the initial abstraction becomes recharge and the second half of the initial abstraction represents evapotranspiration losses (only 0.43 inches per year). In EBA's experience, this estimate of actual evapotranspiration (ET_A) is considered atypically low. This methodology inconsistent with the original definition of the term by Mockus in 1964, where the initial abstraction is a sum of the losses before runoff begins, which include interception, surface storage, and soil moisture retention.

Simply put, the CNM is therefore inaccurate when it is applied on an annual timestep. This is apparent when comparing the NorthPoint recharge values provided for a drought year compared to a normal year, which were 228 AF and 328 AF, respectively. The drought year calculation estimates that 44.6% of rainfall becomes recharge and under the average year only 14.9% of rainfall becomes recharge. As such, the presented calculus indicates that three times more precipitation becomes recharge during droughts at the project site. This is contrary to the frequently observed correlation of drought with lower groundwater surface elevations because of less recharge from rainfall. Furthermore, NorthPoint calculates that 2.9 inches of rainwater are available for recharge if it rains a total of 6.5 inches in the recharge area whereas it also estimates that 4.1 inches (only 1.2 more inches) are available for recharge if it rains 27.5 inches in the recharge area. This calculation forms the basis of the NorthPoint's statement that, "The project recharge area of 954 acres would need just under 1-inch of rain per year to meet the project's demands." EBA respectively disagrees with this statement because it does not accurately account for hydrologic processes that affect recharge under severe drought conditions. It is well understood that aquifer recharge generally occurs during consistent intense storm events that produce runoff and/or flooding.

Cumulative Impact to Surrounding Areas

The NorthPoint Report concludes that the proposed project would not likely have a cumulative impact on the surrounding area based on the following lines of evidence:

1. The previous irrigation demands from hops cultivation are greater than the proposed future cannabis cultivation irrigation demands;

2. The proposed project's annual water demand is 1.8 percent of the usable storage capacity; and

3. The proposed project's annual water demand represents a relatively small portion of groundwater recharge from rainfall within the 954-acre recharge area delineated by NorthPoint in the study.

As previously discussed, EBA does not consider the methods used to estimate storage capacity and groundwater recharge to be reasonable for the intended purpose of the evaluation. Additionally, the NorthPoint Report's assessment of potential cumulative impact to surrounding areas does not assess the potential for induced drawdown in nearby off-site wells and streamflow depletion as a result of potential surface water-groundwater interaction. Performance of a pumping test of adequate duration to estimate aquifer parameters would be necessary to build a better understanding of cumulative impacts. Additionally, the NorthPoint evaluation of cumulative impacts does not consider the proposed project coupled with the groundwater demands of nearby projects, and other reasonably foreseeable projects in the vicinity that could contribute to cumulative impacts similar to those of the proposed project.

Conclusions

It is EBA's professional opinion that the following additional information should be required prior to approval of the project:

- Environmental impacts from regional groundwater pumping may induce long-term irreversible consequences on BVGB groundwater sustainability. The proposed approximately 8,100,000 gallons per year of groundwater extraction may further exacerbate these potential consequences. An evaluation of the cumulative impacts of this project, along with other projects in the area should be integrated into the Report.

- Groundwater extraction at the proposed magnitude may cause streamflow depletion in nearby surface waters and may cause nearby wells to go dry. Additional assessment should be conducted to evaluate these potential impacts. It is EBA's opinion that an appropriately designed pumping test would be necessary to adequately evaluate these concerns.

- The hydrogeologic formation's ability to provide sufficient groundwater to meet proposed project demands over a planning horizon (including employee and other groundwater uses) should be validated and the aquifer's response to long-duration groundwater production should be characterized using formation-specific methods. This characterization should include an evaluation of the magnitudes and extents of pumping influences from all five wells over an appropriate time horizon (such as the expected project lifetime).

- NorthPoint's utilization of the CNM on an annual timestep to estimate aquifer recharge is, in EBA's opinion, an inappropriate utilization of the method. Additional work should be performed to properly characterize aquifer recharge at the project site, and to estimate pre-project and post-project recharge variability during normal and drought conditions.

- Provide an estimate of hydrogeologic parameters of the formation (transmissivity and storativity) based on the pumping test and recovery data. Ninety percent of aquifer recovery after pumping the maximum daily demand should be used as a general rule of thumb before the next pumping cycle begins.

- The use of the 1960 DWR estimate for the BVGB storage capacity should be revisited, and a storage capacity estimate should be provided for the CLCFGB. Revise estimate of cumulative impact area storage capacity given information obtained during pumping tests described above.

- A maximum daily demand (which includes any additional employee water usage) should be developed and utilized in this evaluation in addition to evaluation of the magnitudes and extents of pumping influences from all five wells over an appropriate time horizon (such as the expected project lifetime).

- Groundwater elevation measurements should be taken and compared to groundwater elevations measured by the well driller at time of drilling to better characterize the potential for aquifer overdraft.

- Additional storage to allow for flexibility in pumping, thereby not exacerbating drawdown or over pumping in one area should be considered.

Limitations

This review was prepared in accordance with generally accepted standards of professional civil engineering and hydrogeologic consulting principles and practices at the place and time this review was performed. This warranty is in lieu of all other warranties, either expressed or implied. The conclusions presented herein are based solely on information made available to us by others, and includes professional interpretations based on limited research and data. This review was conducted solely for the purpose of evaluating groundwater supply and project demand with respect to the vicinity of the project site and does not include an evaluation of potential subsurface impacts (i.e., nitrates, arsenic, or other inorganic and/or anthropogenic sources) that may be present in groundwater. This report has been prepared solely for David Hughes, et al., and any reliance on this report by third parties shall be at such party's sole risk.

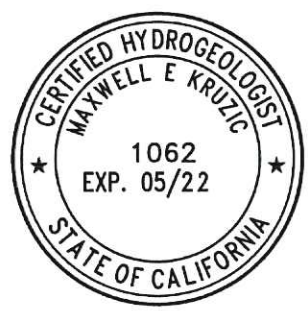
Closing

EBA appreciates the opportunity to be of service to you on this project. If you should have any questions regarding the information contained herein, please do not hesitate to contact our office at (707) 544-0784.

Sincerely,

EBA ENGINEERING

Brian M. Wallace, PE, QSD, MS, MBA
Project Engineer



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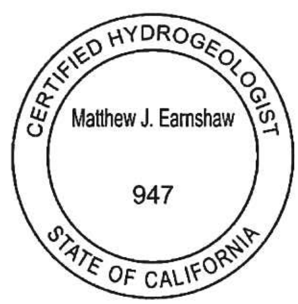

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