To: TCEQ Edwards Aquifer Protection Program

Subject: PUBLIC COMMENTS RE: Edwards Aquifer Permit **13001906**

Submitted electronically to eapp@tceq.texas.gov on April 20, 2024

This letter constitutes my Public Comments and Public Meeting Request regarding the Vulcan Construction Materials, LLC Water Pollution Abatement Plan (WPAP) Application in Comal County, Texas (EA Permit No. **13001906**). The subject application is for a new 1,515-acre limestone quarry located between Bulverde and New Braunfels, Texas. It lies totally within the Edwards Aquifer Recharge Zone (Plate 1).

Background

These comments are based on my experience as a geologist who has studied the various karst features present in the Edwards Aquifer Recharge Zone (EARZ), a state-recognized environmentally sensitive area. In 2019, I began studying caves in the area surrounding the proposed Vulcan Comal Quarry (aka Vulcan 3009 Quarry and referred to in this report as the Vulcan Site). Field exploration was conducted to accurately locate and map caves that are the most sensitive karst features present. Information gathered in this report is intended to serve as a resource to the Texas Commission on Environmental Quality (TCEQ) to more thoroughly evaluate this important WPAP application. Cave location coordinates and internal maps of the Study Area are available to the TCEQ upon request.

Geology

The EARZ is defined as the area where the Cretaceous limestone formations of the Edwards Group (commonly called the Edwards Limestone) are exposed at the surface where the rocks have been highly fractured within the Balcones Fault Zone (Plate 2). In Comal County, the Edwards Limestone is composed of the Person and Kainer Formations, from youngest to oldest. In the vicinity of the Vulcan Site, only the Kainer Formation is present. The Kainer directly overlies the older Cretaceous limestone of the Glen Rose Formation of the Trinity Group.

Cave-Prone Zone

The limestone formations present in the EARZ contain a very high density of caves and sinkholes. Comal County is among the top counties in Texas for having the greatest number of known caves (Texas Speleological Survey website). Two of the best-known caves in Comal County, Natural Bridge Caverns and Bracken Bat Cave, are located approximately 6 miles south of the Vulcan Site. Another large cave, Double Decker, is located just 3 miles south of the Vulcan Site. Exploration work conducted in 2019 at Natural Bridge Caverns and Double Decker Cave identified significant new chambers and passages (Herald-Zeitung newspaper, August 22, 2019).

Plate 2 is a USGS geologic map (SIM3366) with cave locations added. It shows that the cave openings in Vulcan Site area occur in the stratigraphic interval extending from the Kainer dolomitic (Kkd) and basal nodular (Kkbn) and into the underlying Upper Glen Rose cavernous (Kgrc) hydrostratigraphic units (Clark et al., 2016). This interval is informally called the “Cave-Prone Zone.”

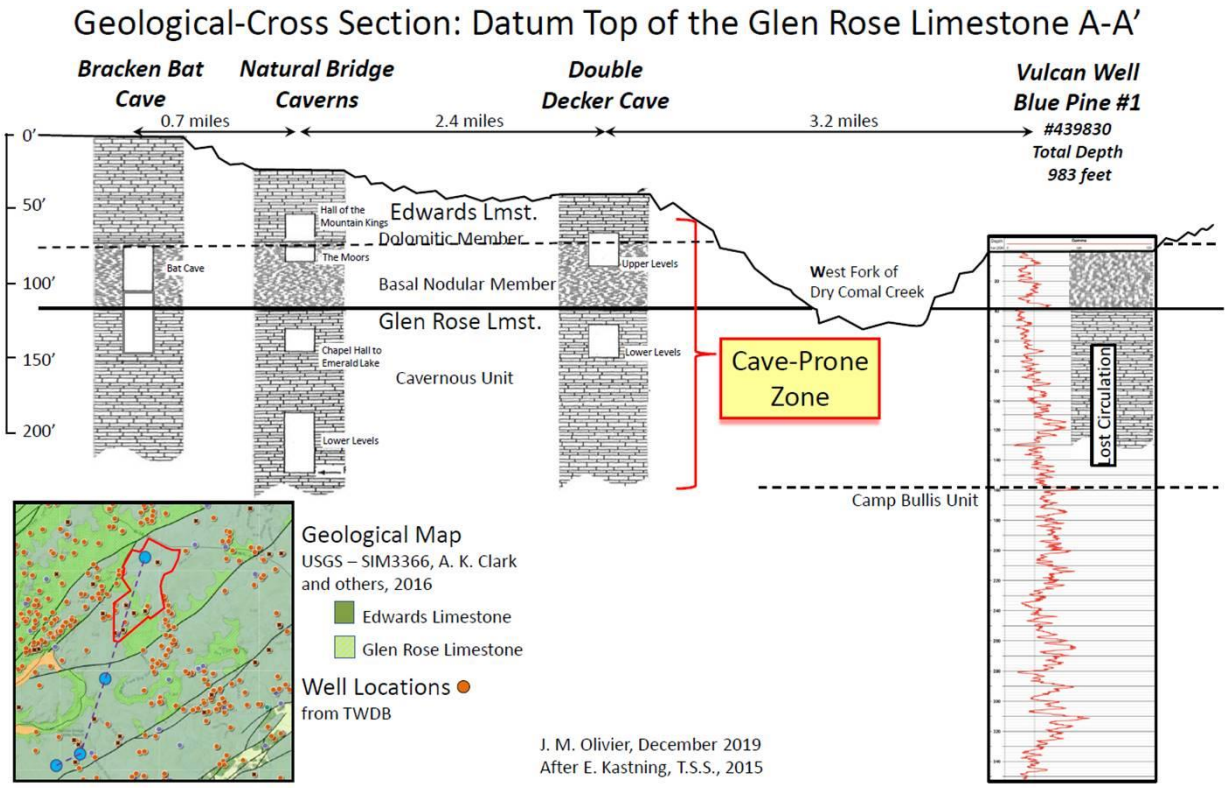

Figure 6. South to north stratigraphic cross section showing the stratigraphic interval that would be affected by the proposed Vulcan Quarry. A detailed location of the cross section is shown on Plate 1

Figure 1. Stratigraphic cross-section (Source: J.M. Olivier after E. Kastning).

Stratigraphic cross-section A-A' (Figure 1 and Plate 1) shows the chambers at Natural Bridge Caverns, Bracken Cave, and Double Decker Cave. On the northern end of the cross-section, a water well drilled on the Vulcan Site lost circulation in a highly permeable interval while being drilled from a depth of 63 – 143 ft. This interval correlates to the Cave-Prone Zone, indicating the potential that significant caves may exist under the Vulcan Site. It also shows the high probability that the entire area is hydrologically connected with both the Edwards and Trinity Aquifers (Gary, et al., 2011).

Caves Near the Vulcan Site

The most complete database of caves in Texas is maintained by the Texas Speleological Survey (TSS), a non-profit corporation made up of cave explorers. In 2016 there were 224 caves listed for Comal County. The TSS does not make exact cave locations available to the general public in order to protect landowners from potential trespassing.

For this study of the Vulcan Site, the TSS provided the location of 16 cave clusters, shown as circles on Plate 2. These clusters contain 48 known caves in the database. The cave names are listed on the legend on Plate 2. Within a 2-mile distance of the quarry site, there are 6 clusters containing 26 caves in the TSS database as of 2019. More caves have since been added to the TSS database as a result of this study.

Over 30 caves and other sensitive features such as sinkholes, springs, and wells were investigated in the Study Area (Table 1 will be made available to the TCEQ upon request). Caves are indicated on Plate 2 by numbered Xs. Ten caves have been mapped internally, three of which were previously unknown to the TSS. Several of these caves were discovered by shallow digging in sinkholes.

The largest concentration of caves occurs in a 1500-acre area extending south from the Vulcan Site boundary to slightly beyond FM 1863. Exploration access was also granted by a private landowner to 500 acres immediately to the west of the Vulcan Site. Access to the north and east was limited to smaller properties generally containing less than 5 acres. It should be noted that areas on the map showing an absence of caves can often be attributed to a lack of exploration access rather than to a lack of actual caves.

Six caves were mapped in detail by teams of volunteer cave explorers led by Dr. Benjamin Hutchins from Texas State University. The largest cave mapped thus far is Double Decker Cave. During exploration, a new chamber was discovered, bringing the cave's total dimensions to 1,680 ft in length and 108 ft in depth.

The closest caves to the Vulcan Site include X9, located only 500 ft from the western fenceline. It consists of a vertical chamber beginning with a very small surface opening (2.5x2.5 ft) and dropping vertically 32 ft. Equally close to Vulcan's fenceline is X4, reported by the former White Ranch foreman to have a 10x10 ft chamber (C. Hopmann, personal communication).

X5 consists of 2 caves located just 875 ft south of Vulcan's fenceline. The 2 caves share a common 10 ft-wide opening, and extend 30 ft in opposite directions along an east-west trending fault. The caves have the potential of extending much further; however, collapsed rubble and nesting vultures prevented additional exploration. Cave X2 is approximately 5,000 ft to the west along the same fault. It is 113 ft long and 62 ft deep, and has not yet been fully explored.

The high occurrence of caves around the Vulcan Site is a clear indication of the area's high sensitivity to groundwater recharge in the EARZ. The size of Double Decker Cave shows the risk that quarrying in the Cave-Prone Zone could encounter a large cave (>1,000 ft in length, or >100 ft in depth). The direct connection of sinkholes to caves in this area shows that the environmental sensitivity of sinkholes might easily be underrated, and therefore go unprotected by the current TCEQ sensitivity-rating system.

Geologic Assessment & Sensitivity Scoring System

A *sensitive feature,* as defined by the TCEQ, is "a permeable geologic or manmade feature located on the recharge zone or transition zone where the potential for hydraulic interconnectedness between the surface and the Edwards Aquifer exists, and rapid infiltration to the subsurface may occur." A point system is used to score the sensitivity of features based on a classification of three variables: feature type (5 - 30 points), orientation with respect to structure, and a field-based assessment of relative water infiltration rate (5 - 35 points or greater). Environmental protection is given only to features with a combined score of 40 or greater.

By feature type, the most sensitive are caves, swallow holes, and zones of clustered or aligned features. These are given a base score of 30. Sinkholes, solution cavities, faults, and solution-enlarged fractures are given a score of 20. Other natural bedrock features and non-karst depressions are given a score of 5.

The relative water infiltration score is usually the determining factor for which features require special protection (i.e. a combined score of 40 and above). Unfortunately, the determination of water infiltration is much more arbitrary because it is usually based on indirect evidence, such as the accumulation of leaves and sediment present due to water inflow into a karst feature. No direct observation of water infiltration is required (TCEQ Report F-0585, p. 12).

Caves are the most common type of karst feature given protection. Although sinkholes are often caused by the partial collapse of caves just below the land surface, they are generally not given protection because their water infiltration rate is often difficult to judge. This poses a significant challenge for assessing the Vulcan Site because a large percentage of the caves in the surrounding area were only discovered by digging in sinkholes.

Vulcan Geologic Assessment

A total of 37 sensitive karst features were identified in the Geologic Assessment for the 1,515-acre Vulcan Site (Pape-Dawson Engineers, 2024). According to the TCEQ scoring system, 7 of the karst features, including three caves, require protection. The density of sensitive features appears anomalously low when compared to the surrounding area. Immediately to the north across SH 46, 38 sensitive features were found on 158 acres (Frost GeoSciences, Bigbee Tract Geologic Assessment, 2021). Immediately to the south of the Vulcan Site, the Edwards Aquifer Authority investigated 1,581 acres for potential inclusion in a conservation easement program and determined the property has a very high direct-recharge potential because of the numerous caves and sinkholes observed (Schindel, 2021, EAA Geological Evaluation of the Froboese Ranches, Comal Co., TX). A regional study using lithology as a predictive tool of cave entrances also indicates that more caves could be expected at the Vulcan Site (Veni, 2005).

The hydrogeology of the Vulcan Site is similar to that along strike to the northeast and southwest (Smith, P.G.#4955, 2024). The low density of sensitive features including cave entrances reported in the Vulcan Geologic Assessment could be due to the fact that the previous landowner modified the ground surface to prevent cattle from falling in (C. Hopmann, personal communication, 2024). It could also be a function of the somewhat arbitrary system being used to rate sensitive features. Whatever the case may be, there is a high probability that significantly more sensitive features are present very near the surface at the Vulcan Site. A thorough review of the Vulcan Geologic Assessment by the TCEQ is warranted.

Wells Drilled on the Vulcan Site

Wells are categorized by the TCEQ as *manmade features in bedrock*, and are given a high sensitivity rating equal to cave openings. It is therefore important that the location of all wells be correctly identified prior to the development of a site in the EARZ.

Six test wells were drilled in 2007 to a depth of around 1000 ft on the proposed Vulcan Site, formerly known as the White Ranch (Table 2). Because the results were not successful in finding sufficient groundwater to support a planned residential housing development, the wells were plugged and abandoned following the procedures in place at that time. The abandonment procedure consisted of filling the wells with gravel up to the top of the water level in each wellbore, and then capping them with a 10-foot cement plug. Above the cement plug, each wellbore was left open to the surface, where another cement plug was installed. These abandoned wells are potential pathways for pollutants to enter the aquifer that must be protected during quarrying operations according to the TCEQ. If any wells are disturbed by quarry operations, they must be plugged according to current plugging procedures enforced by the Comal Trinity Groundwater Conservation District (CTGCD).

In 2017, a water well was drilled by Blue Pine Holdings, LLC to a total depth of 983 ft. It tested water flow at an estimated rate of 150 gallons per minute from the Middle Trinity Aquifer in the Cow Creek

Limestone. During drilling, the well encountered a highly porous and permeable zone (63–143 ft) in the Glen Rose Formation. This 80-ft interval corresponds to the Cave-Prone Zone seen in the caves to the south (Figure 1). As mentioned previously, this lost circulation zone is a strong indication that quarrying at the Vulcan Site could encounter large caves that are hydrologically connected to Edwards and Trinity Aquifers.

Nitrate Pollution of Groundwater

Quarry operations pose a special risk of groundwater pollution because the predominant explosive used is ANFO, a combination of ammonium nitrate and fuel oil. Ammonium nitrate is used in large quantities and it is highly soluble in water. Per industry sources, up to 28% of the explosive is not consumed by blasting (Alberts, N., 2016, Mining News Digest, August issue). Exposure to nitrate can be particularly threatening to aquatic organisms (Isaza, D.F., Cramp, R.L., and Franklin, C.E., 2020, Environmental Pollution, Vol. 26).

Large quarry pits located over the EARZ act as funnels for pollutants including nitrate into the Edwards Aquifer. At the Vulcan Site, the Edwards Aquifer is interconnected with the Trinity Aquifer as explained previously. This topic was also addressed by hydrogeologist Douglas A. Wierman, P.G. #4062, in his report submitted in 2023 to the TCEQ regarding the WPAP for the Needmore Ranch quarry in Hays County, TX (EA Permits 11003759 and 11003760).

The Edwards Aquifer Authority (EAA) is the agency most responsible for protecting the quantity and quality in the Edwards Aquifer. Prior to the commencement of any quarrying activities at the Vulcan site, a representative number of water samples should be collected and tested to determine background concentrations for various parameters including nitrate levels.

Groundwater Flowpaths & Dye Tracing

In the vicinity of the Vulcan Site, groundwater in the Edwards Aquifer generally flows from west to the east (Figure 2). A portion of it makes its way to the Hueco and Comal Springs in New Braunfels, Texas. Some lesser components of the flow would bypass those springs and flow further downgradient towards San Marcos Springs (Smith, 2024).

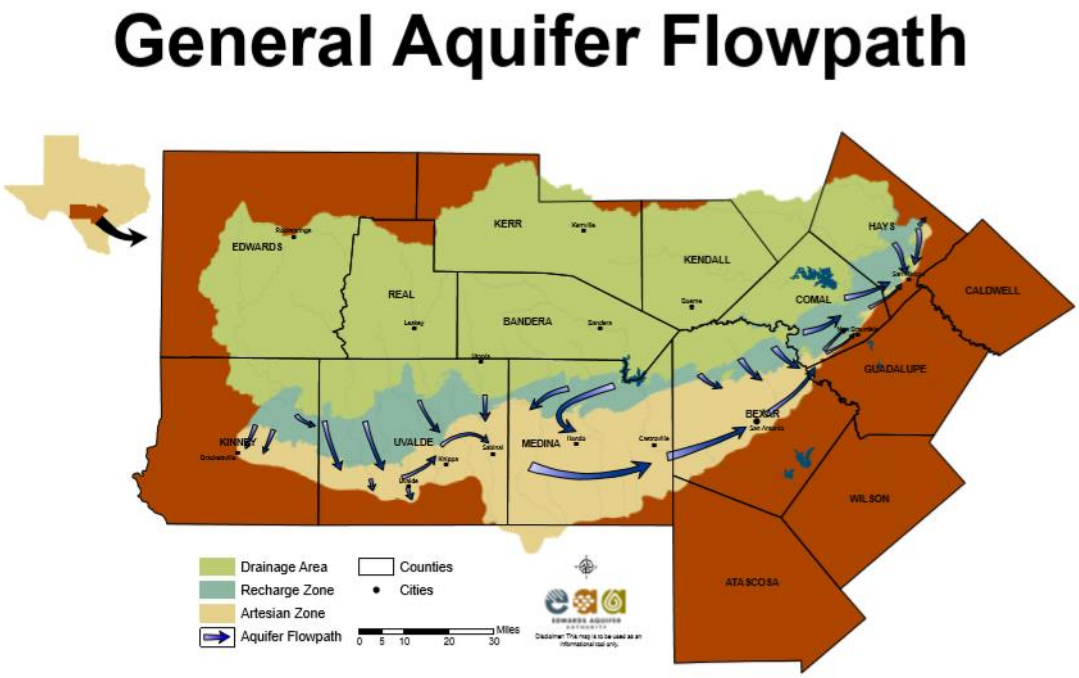

Figure 2. General Aquifer Flowpath in the Edwards Aquifer (Source: EAA website).

The most direct method for determining groundwater flowpaths is known as dye tracing. Nontoxic dyes are injected usually in cave opening and then traced to nearby wells and springs. The closest example of such a study in the EARZ was conducted in 2010 by the EAA at Panther Springs Creek Basin, located in northern Bexar County (Johnson, Schindel, & Veni, 2010). Non-toxic organic dyes were injected into 6 caves, and 32 public and private wells completed in the Edwards or Trinity Aquifers, and then closely monitored. Flow rates as high as 3-miles per day were observed. The tracer tests demonstrated excellent interconnection between the Edwards Aquifer and Upper Trinity Aquifers. Dye traveled across several faults in which permeable members of the Edwards and Glen Rose Formations are juxtaposed. One trace was initiated in a shallow pit dug in an area with no observable karst features, and yet the dye was subsequently detected in 2 wells. This study proves that the EARZ is highly sensitive to groundwater pollution, and that its vulnerability for contamination is not limited to recognizable karst landforms. This calls into question the effectiveness of TCEQ's sensitivity-rating system.

A diesel spill in January 2000 provided valuable groundwater flowpath information (San Antonio ExpressNews, 1/21/2000, Officials hopeful diesel spill in recharge zone contained). The spill occurred at the Dyno Noble explosives plant that was located in the EARZ near the city of New Braunfels (Figure 2). On or about January 17, two-thousand gallons of diesel fuel leaked into the ground from an approved, above-ground-storage tank (Dames & Moore, 2000, Hydrogeology of Dyno Nobel ANFO Manufacturing Facility, Comal Co., TX). Diesel was detected 3 to 4 days later at the Comal Springs and Hueco Springs, a distance of 4.5 miles and 6.5 miles, respectively (G. Schindel, CCCA presentation, 2019). Although the diesel concentrations detected at the springs were minimal, the leak confirmed two important points: 1) the groundwater flow rate in the EARZ is very rapid – well in excess of 1-mile per day, and 2) observable karst landforms are not necessary for groundwater contamination to occur.

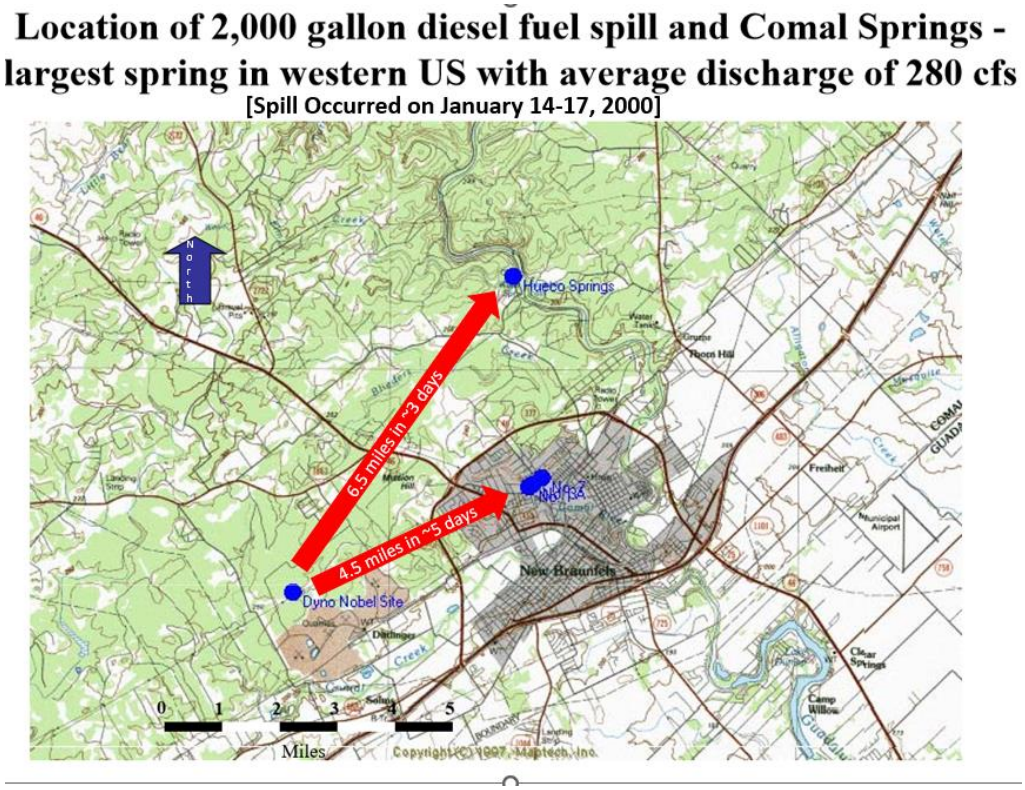

Figure 2. Diesel Spill in New Braunfels, TX (Source: G. Schindel, 2019)

A dye trace study is needed around the Vulcan Site to precisely determine the groundwater flowpaths. There are numerous domestic water wells along FM 3009 and points farther east that potentially would be at risk of contamination with nitrate and other hazardous substances if quarry operations are permitted. Nearby wells could experience nitrate levels above the EPA's maximum concentration limit safe for human consumption of 10 mg/L (N). Some of this water with elevated nitrate could make its way to Hueco and Comal Springs (Smith, 2024). Several protected, aquatic, endangered species live in Comal Springs. New Braunfels is heavily dependent on its water-based tourist industry that requires clean and plentiful groundwater from the Edwards Aquifer.

TCEQ Best Management Practices for Quarry Operations

TCEQ's Best Management Practices (BMPs) for Quarry Operations currently allows for the removal of caves. The Regulatory Guidelines (RG-500) were published in 2010 before agencies like the EAA and the Southwest Research Institute conducted studies showing the Edwards Aquifer recharge zone and contributing zones are much more sensitive than originally thought.

Quarry operators are given too much discretion when determining the need to permanently seal off sensitive features that cannot be totally removed. Sensitive features discovered during quarrying are supposed to be reported to the TCEQ and addressed on a case-by-case basis. A minimum separation of 25 ft is recommended between the floor of the quarry pit and the groundwater level to protect from blasting into the aquifer. In the Balcones Fault Zone, however, natural fractures are already present. Furthermore, the Vulcan WPAP does not make clear which wells will be used in determining the mining depth necessary to protect the aquifer. Quarry berms used to prevent surface drainage and stormwater

from entering the quarry pits are required to be inspected quarterly to ensure continued effectiveness for the active life of the quarry. Unfortunately, there are no provisions in the BMPs for inspection and maintenance of required quarry berms after quarry abandonment, nor is there any requirement for land reclamation.

These are all major oversights in the current BMPs for Quarry Operations, especially for quarries located in the EARZ where the pits qualify as highly sensitive *manmade features in bedrock (MB)*. The BMPs need to be updated to account for modern scientific understanding of aquifer recharge and groundwater flow.

Groundwater Availability

The large amount of water necessary to control dust that would be produced at the Vulcan Site is another major concern. An estimate based on the amount of material to be quarried shows that the proposed Vulcan quarry would use approximately 385 acre-ft (125,000,000 gallons) of groundwater per year (D. Everingham, personal communication, 4/12/2024, assumes one 800 ton per hour portable crusher consumes 40,000 gallons of water/hour). Surrounding domestic water wells completed in the Trinity Aquifer can be expected to suffer depletion.

A special concern is for the future sustainability of water contained in a permanent spring-fed pond (S1, Plate 2) located just 500 ft from Vulcan's southern boundary. It is currently a critical water source for wildlife during the current drought conditions. The pond is at high risk of drying up if quarrying upstream is allow to proceed.

The Comal Trinity Groundwater Conservation District (CTGCD) was formed in 2015 to monitor Trinity groundwater levels. Unlike the Edwards Aquifer Authority (EAA), the CTGCD lacks the authority to regulate water production, so Trinity wells and natural springs are at risk of depletion.

Summary

- The Edwards Aquifer Recharge Zone (EARZ) is the primary source of water for over 2.5 million people in South Central Texas, and therefore requires strict protection by the TCEQ and EAA.
- An extensive system of caves and caverns in the EARZ are important to groundwater transmission which is known to be rapid.
- The Edwards and Trinity Aquifers in the EARZ are known to be interconnected across faults in the Balcones Fault Zone.
- A Cave-Prone Zone extends across the Vulcan Site indicating a high probability that quarry pits will encounter large caves that are hydrologically connected to the underlying aquifers.
- Dye trace studies show that the EARZ is much more sensitive to groundwater pollution than previously understood.
- Quarries introduce pollutants such as ammonium nitrate and diesel fuel (ANFO) used as the primary explosive.
- Groundwater in Comal County generally flows from west to east towards the Comal Springs in New Braunfels, home to several endangered aquatic species in the Comal Springs.
- The Vulcan Site is located in a suburban location surrounded by numerous by domestic water wells; whereas the majority of large limestone quarries in Comal County are located in the commercial zone paralleling Interstate Highway 35.

Recommendations:

- The WPAP application should take into consideration all available cave information within a minimum distance of 2-miles of the proposed quarry site, including data maintained by the Texas Speleological Survey, data submitted to the TCEQ in Geological Assessments, and information provided by local property owners.
- The EAA should be consulted during the water-permit review process to help ensure that the destruction of caves and other sensitive karst features does not cause serious damage to the Edwards Aquifer, surrounding water wells, and natural springs.
- Prior to the issuance of a water permit for the proposed quarry, a dye-tracing study is needed to accurately determine the risk of pollution reaching nearby domestic water wells from the Vulcan Site.
- TCEQ's Geologic Assessment and sensitivity scoring system should be applied more stringently in light of the evidence that groundwater pollution is possible even where no observable karst features are present. Sinkholes are not being sufficiently protected considering that they commonly occur just above cave chambers. The relative water infiltration scoring method is too arbitrary.
- The Best Management Practices (BMPs) for Quarry Operations should specifically address the risk of encountering large caves, or a series of smaller caves, that are hydrologically well connected to the underlying aquifers. Large quarry pits are sensitive *manmade features in bedrock* that deserve to be reclaimed.

Conclusions

The Vulcan WPAP application does not provide sufficient scientific evidence for the TCEQ to adequately determine if the development plan is protective of the Edwards Aquifer both during and after construction. Domestic water wells completed in the Trinity Aquifer near the site are at risk of nitrate pollution and depletion. The Vulcan Site's proximity to the Comal Springs poses a special concern for the long-term health effects on the aquatic endangered species living in spring water sourced by the Edwards Aquifer.

On April 16, 2024, Texas Lieutenant Governor Dan Patrick publicly expressed his serious environmental concerns about a proposed cement production plant in Grayson County (kxii.com, Sherman, TX). This plant has an associated quarry and covers 600 acres. In a letter sent to the TCEQ's Chairman, he asked for an immediate pause in the permitting processes for all permanent cement production plants until the legislature can consider what is best for Texas communities. I strongly believe that a pause in permitting should also apply to the proposed Vulcan Comal Quarry. The Vulcan project has a projected life of over 80 years and will leave permanent pits over a highly-sensitive portion of the EARZ - the source of drinking water for over 2.5 million Texans.

Public Meeting Request

A Public Meeting is requested so that all water-related concerns involved with the proposed quarry can be openly and more-fully discussed with the TCEQ-EAPP's and Vulcan's experts. I believe there is sufficient scientific evidence showing that the Vulcan Site is located in a extremely sensitive portion of the EARZ. The TCEQ's BMPs giving guidance and suggestions are not adequate to protect the special environmental conditions present there.

Respectfully,

Jack Olivier
1509 Cabernet
New Braunfels, Texas 78132

REFERENCES

Alberts, N., 2016, Mining News Digest, August issue). Exposure to nitrate can be particularly threatening to aquatic organisms (Isaza, D.F., Cramp, R.L., and Franklin, C.E., 2020, Environmental Pollution, Vol. 26).

Clark, A. K., Golab, J.A., and Morris, R.R., 2016, Geologic Framework and Hydrostratigraphy of the Edwards and Trinity Aquifers within Northern Bexar and Comal Counties, Texas: U.S. Geological Survey Scientific Investigation Map 3366, scale 1:24,000, and accompanying Pamphlet, 20 p.

Dames & Moore, 2000, Hydrogeology of Dyno Nobel ANFO Manufacturing Facility, Comal County, Texas.

Frost GeoSciences, 2021, Bigbee Tract Geologic Assessment, WPAP, April 21, 2021.

Gary, M.O., Veni, G., Shade, B., and Gary, R.H., 2011, Spatial and temporal recharge variability related to ground-water interconnection of the Edwards and Trinity aquifers, Camp Bullis, Bexar and Comal Counties, Texas, in Interconnection of the Trinity (Glen Rose) and Edwards aquifers along the Balcones fault zone and related topics— Karst Conservation Initiative meeting, Austin, Tex., February 17, 2011, [Proceedings]: Austin, Tex., Karst Conservation Initiative, 46 p.

Isaza, D.F., Cramp, R.L., and Franklin, C.E., 2020, Environmental Pollution, Vol. 26).

Johnson, S., Schindel, G., and Veni, George, 2010, Tracing Groundwater Flowpaths in the Edwards Aquifer Recharge Zone, Panther Springs Creek Basin, Northern Bexar County, Texas: Edwards Aquifer Authority Report No. 10-01, 112 p.

Kastning, Ernst, 2015, Geomorphology and Hydrogeology of the Edwards Plateau Karst, Central Texas: Texas Speleological Survey (reformatted version of the complete PhD dissertation done at the University of Texas at Austin in 1983), 274 p.

Pape-Dawson Engineers, 2024, Water Pollution Abatement Plan for proposed Vulcan Comal Quarry, February 2024.

Schindel, Geary, 2019, Groundwater Resources in Comal County, Texas, presented at the May meeting of the Comal County Conservation Alliance (CCCA).

Schindel, Geary, 2021, Geological Evaluation of the Froboese Ranch Comal County, Texas Prepared by: Edwards Aquifer Authority Geary M. Schindel, P.G. for the City of San Antonio, October 19, 2021).

Smith, Brian A., 2024, Hydrogeology of the Edwards and Trinity Aquifers in the Vicinity of the Proposed Vulcan Quarry, Comal County, Texas.

TCEQ Publication RG-500, 2010, Best Management Practices for Quarry Operations, 26 p.

TCEQ Report F-0585, 2004, Instructions to geologists for Geologic Assessments on the Edwards Aquifer Recharge/Transition Zones, 34 p.

Texas Speleological Survey, 2016, Texas County Karst Totals, TSS website, list updated on 11/22/2016.

Veni, George, 2005, Lithology as a Predictive Tool of Conduit Morphology and Hydrology in Environmental Impact Assessments: Sinkholes and the Engineering and Environmental Impacts of Karst, Geotechnical Special Publication No. 144, American Society of Civil Engineers, pp. 46-56.

Wierman, Douglas A., 2023, Technical Comments – TCEQ Water Pollution Abatement Plan (WPAP) for Needmore Quarry Ranch, Hays, Co. TX, Far South Mining LLC.

TABLES

Table 1 – Will be provided to the TCEQ upon request.

Table 2

Wells on Vulcan Site (former White Ranch)

TWDB Tracking No.	Well Name	Total Depth (ft) Driller/Logger	Date Drilled	Location (Degrees/Minutes/Seconds) Latitude	Longitude	Status
520687	White Ranch #1	980/962	Oct-07	29*, 44', 26.2"	98*, 19', 31.1"	Plugged & Abandoned
520688	White Ranch #2	1000/970	Nov-07	29*, 44', 56.2"	98*, 19', 30.5 '	Plugged & Abandoned
520689	White Ranch #3	1020/976	Nov-07	29*, 45', 5.4"	98*, 19', 13.6"	Plugged & Abandoned
520690	White Ranch #4	1060/1054	Dec-07	29*, 45', 6.3"	98*, 19', 31.1"	Plugged & Abandoned
520691	White Ranch #5	940/931	Oct-07	29*, 44', 56.6"	98*, 18', 42.9"	Plugged & Abandoned
520692	White Ranch #6	980/968	Nov-07	29*, 44', 29.2"	98*, 19', 18.2"	Plugged & Abandoned
439830	Blue Pine #1 aka VULCAN WELL	983/NA	Jan-17	29*, 46', 12.8"	98*, 18', 43.5"	Water Well-Uncompleted

Information Sources:
Texas Water Development Board (TWDB) website
Wells Logs provided upon request from Edwards Aquifer Authority (EAA)

PLATES

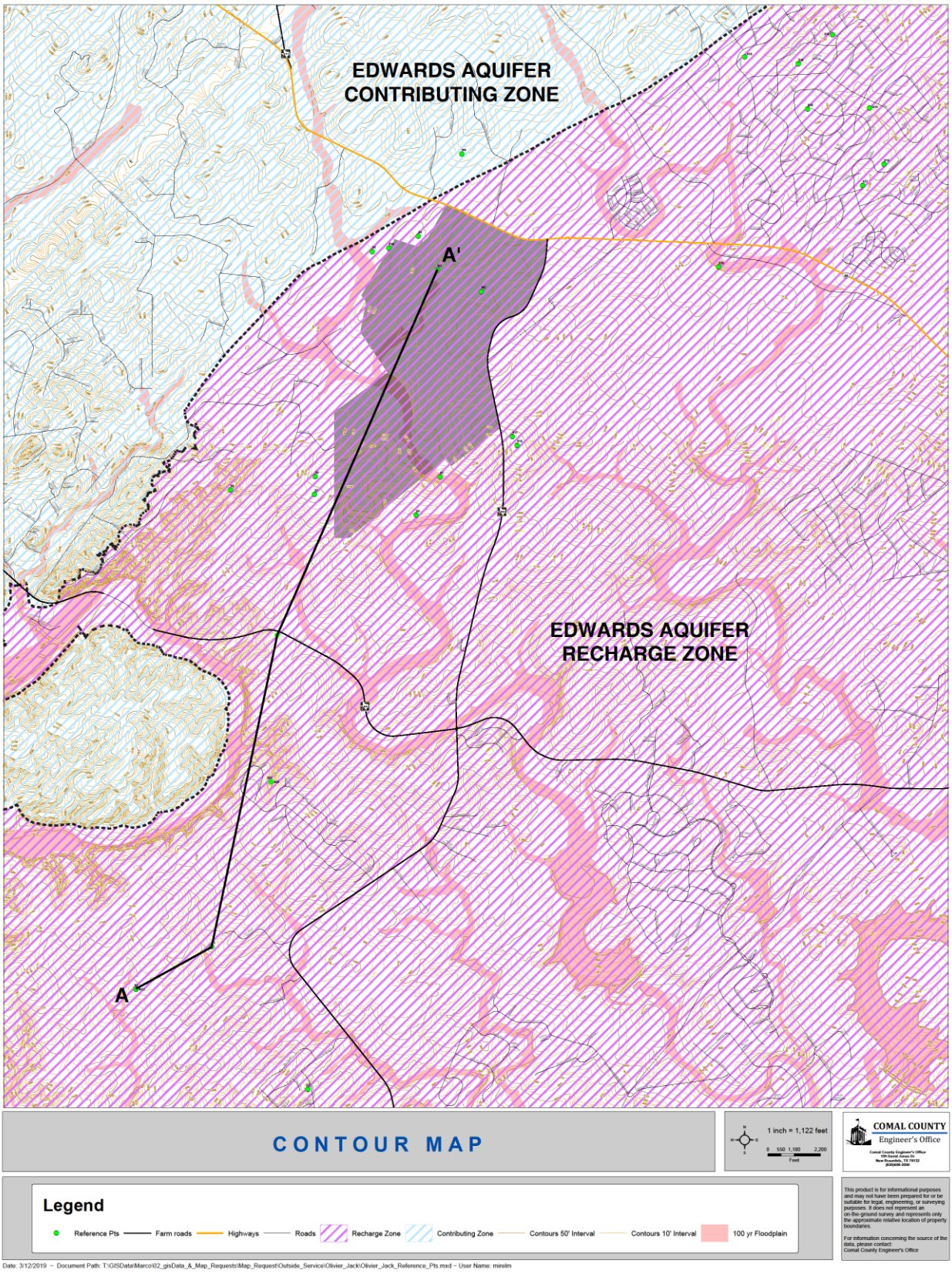

Plate 1. Location of the proposed Vulcan quarry in the Edwards Aquifer Recharge Zone.

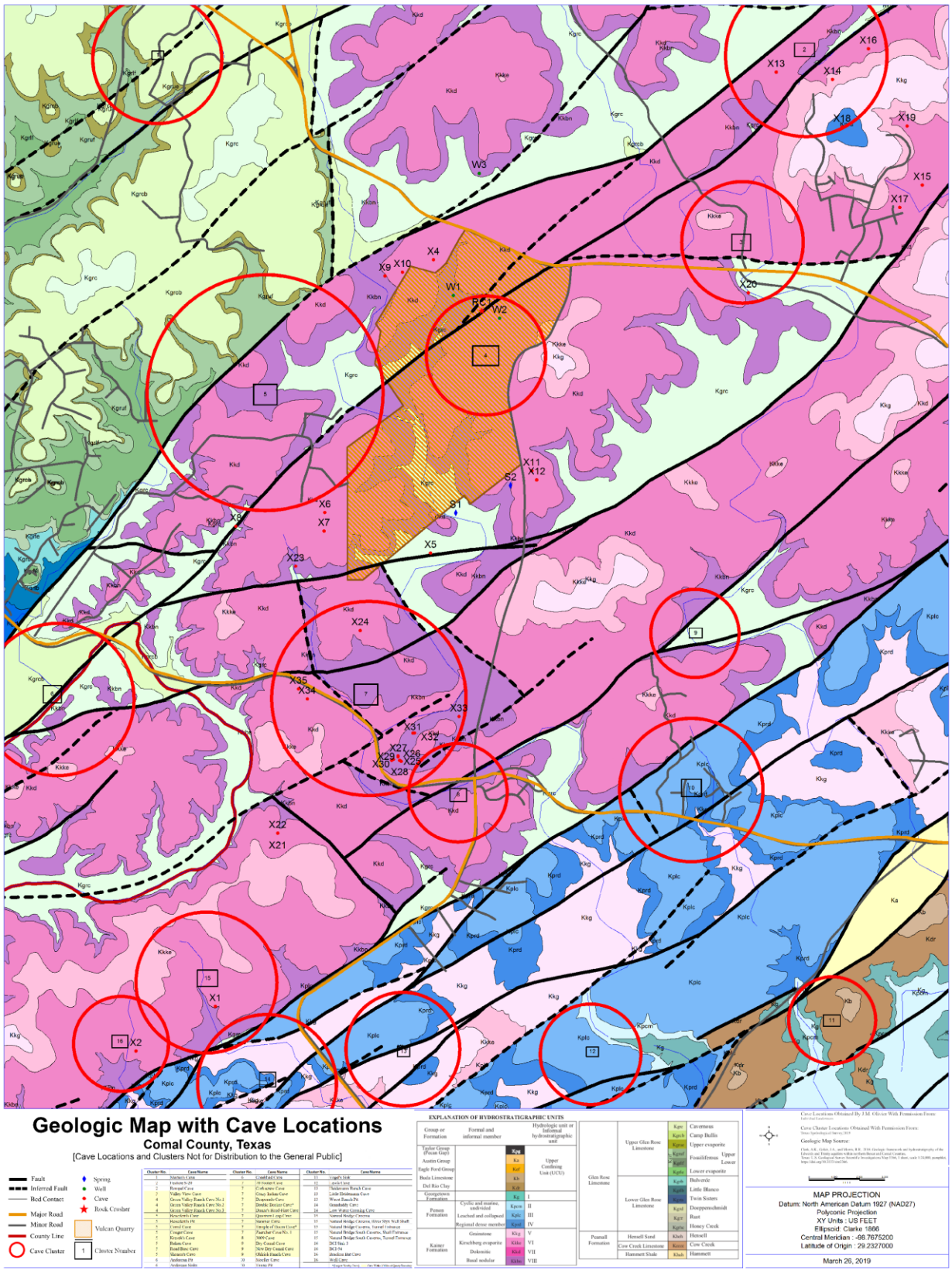

Plate 2. Geologic map of Study Area.