Horizon™
Environmental Services, Inc.

22 September 2021

Brett Denton
Ardent Residential
5453 Burnet Road, Suite 203
Austin, Texas 78746

RE: Phase III Karst Invertebrate Survey of Luby's Cave
Steck Avenue and MoPac Expressway (Loop 1)
Austin, Travis County, Texas
HJN 21048.003KS

Dear Mr. Denton:

Horizon Environmental Services, Inc. (Horizon) has conducted a karst invertebrate survey (Phase III Karst Survey) for federally listed endangered terrestrial karst invertebrates (TKIs) that occur within Travis County at the above-referenced site (subject site) (Figure 1, attached). The subject site is located at 8176 MoPac Expressway in Austin, Travis County, Texas.

Additionally, the entire subject site is located within the Edwards Aquifer Recharge Zone (EARZ), and a Phase II Karst Survey (KS) was previously conducted by Horizon in May 2021. Based on the results of the karst survey, one feature (F-1) was identified that met the requirements to be classified as a cave based on it being a natural underground open space formed by the dissolution of limestone that is large enough for an average-sized person to enter. Horizon staff surveyed/mapped the feature, which has been named **Luby's Cave** for identification purposes (Figure 2, attached). The total footprint of the cave extends 21 feet from southeast to northwest and 14 feet from east to west, with a total depth of approximately 15 feet. The surveyed plan and profile (section) map of Luby's Cave is attached to this report.

The Phase III karst invertebrate survey was conducted according to US Fish and Wildlife Service (USFWS) requirements and the terms of Horizon's USFWS endangered species Permit Number TE798998-3, issued 28 March 2011. The karst invertebrate survey was conducted from late August to mid-September 2021 by Horizon staff under the supervision of senior geologist James Killian, PG[1], who is currently permitted by the USFWS to sample and collect federally listed karst invertebrate species within Bexar, Travis, and Williamson counties, Texas, for scientific and species recovery purposes. Horizon staff members Greg Sherrod, Zach Blackburn, and Cherman Hall assisted with this survey

[1] Registered Professional Geoscientist, State of Texas

ENDANGERED SPECIES INVESTIGATIONS

The subject site lies within a known karst zone area (Veni Karst Zone 1) that was previously documented to provide suitable habitat for federally listed TKI species that occur within Travis County (Veni, 1991). Preparation of a project-specific Environmental Assessment (EA), Habitat Conservation Plan (HCP), and other necessary documentation in support of a 10(a)(1)(B) permit from the USFWS would be required should endangered karst invertebrate species be found and verified by a certified taxonomist.

KARST INVERTEBRATE SURVEY METHODOLOGY

The karst invertebrate survey of Luby's Cave was conducted according to USFWS Section 10(a)(1)(A) Scientific Permit Requirements for Conducting Presence/Absence Surveys for Endangered Karst Invertebrates in Central Texas, dated 21 May 2015. Salient highlights of the USFWS methodology include the following scope of work:

Number and timing of surveys: To assess the presence/absence of endangered karst invertebrates, survey each cave and/or significant feature at least 14 times. Each survey should occur at least 48 hours apart during suitable surveying conditions. USFWS encourages permittees to bait every survey unless red imported fire ants (RIFA) are being observed. However, if no endangered species are detected by the 11th survey, then baits must be used in addition to surveying. Data loggers must be installed in caves and features (as far back into the cave or feature as possible) prior to the beginning of surveys and remain in place until all surveys are completed. USFWS encourages permittees to conduct at least 3 surveys at night and at least 3 during daylight hours to account for possible daily variation in behavior.

Suitable surveying conditions: The entire cave should be searched when conditions in the cave are appropriate for finding the endangered karst invertebrates, generally avoiding temperature extremes and low humidity. Surveys may be conducted any time of year as long as suitable weather conditions are met. Suitable weather conditions include average weather (temperature and rainfall) for time of year and the absence of recent, extensive, local flooding.

Surveying diligence and thoroughness: Before any endangered species are considered absent after completion of survey, the void/cave should be searched thoroughly; search times should be proportional to the size of the void/cave. A system of transects should be used to ensure the entire cave is thoroughly searched. The surveyor should search under all loose and easily moveable rocks. Rocks should be returned to their original positions immediately after examination. The surveyor should also search under clumps of dried, cracked sediment, which should be returned to their original positions after examination. The search should include crevices, ceilings, and walls. Samples of loose sediment are to be hand-sifted, and scat and dead animals are to be examined. The surveyor should search for all habitat types, not only those that are believed to be the preferred habitat of the endangered karst invertebrates. Species

abundance for listed and non-listed species and the microhabitat that they were found on/in should be recorded.

Specimen collection and preservation: Since the endangered karst invertebrates may not be possible to distinguish in the field from closely related species, specimens should be collected for identification by a qualified taxonomist. All specimens should be preserved in 100% non-denatured ethanol because they may be used in future genetic studies. Specimens collected should be immediately placed in a cooler and kept there until transferred to a freezer. Before transfer to a freezer, the preservative should be discarded and replaced with new ethanol. All preserved specimens should be stored in a freezer at -20ºC (-4ºF). All specimens should be stored in separate vials to prevent misidentification if appendages become separated from the body.

Baiting: Baits may attract RIFA into the cave; therefore, they should be used with caution as an invertebrate survey technique. Baits should be used in leads that are inaccessible for visual examination. When baiting is used, baits should consist of both sticky traps and bottle traps. Baits should be placed as far back in a void/cave as possible to reduce the chance of attracting surface species, but the baits must be retrievable. Data loggers must be installed in features prior to the beginning of baiting and remain in place until all baiting is completed.

TKI SURVEY RESULTS

At the time of Horizon's survey efforts, the subject site was a commercially developed tract of land that is used as a restaurant (Luby's) located at 8176 MoPac Expressway. Most of the subject site is paved, with a large building (the restaurant) located near the center of the tract. Vegetation near the cave's entrance consists of sparse live oak (*Quercus virginiana*), landscaped scrub species, and/or maintained grasses. The subject site is situated on gently to steeply sloping terrain that is located within the Shoal Creek watershed. Adjacent land use at the time of the survey consisted of predominantly residential and/or commercial retail use.

In order to identify any previously documented karst features that contain federally or state-protected species or species of concern in the vicinity of the subject site, Horizon reviewed information maintained by the Texas Parks and Wildlife Department (TPWD) through the National Diversity Database (NDD), dated 17 September 2021. According to the NDD database, no apparent karst features were found within 0.5 miles of the subject site that were documented to contain a federally protected karst invertebrate species.

Luby's Cave (F-1) is a phreatic-formed subsurface void (30.367989 and -97.743356) that has been covered with a storm sewer steel lid, located along the eastern property boundary of Luby's next to the southbound service road for the MoPac Expressway (Loop 1). Inside the void and below the steel lid, there is no associated City of Austin stormwater infrastructure, such as a manhole and/or stormwater line. The feature was likely interstitial with no connection to the

surface prior to the utility (wastewater line) construction in the unpaved right-of-way (ROW) area. Inside the cave along the upper east side is a concrete vertical wall for a city sanitary sewer line located immediately east of the cave. On behalf of Ardent Residential, Horizon was contracted to conduct a survey of Luby's Cave for federally listed endangered karst invertebrates.

Fourteen separate karst invertebrate survey events were conducted on 23, 25, 27, 29, and 31 August 2021 and 2, 4, 6, 8, 10, 12, 14, 16, and 18 September 2021 to determine if Luby's Cave contains any federally listed endangered karst invertebrates known to occur within Travis County.

According to the USFWS, there are a total of 6 federally listed karst invertebrate species found within Travis County, Texas: Bone Cave harvestman (*Texella reyesi*), Tooth Cave ground beetle (*Rhadine persephone*), Bee Creek Cave harvestman (*Texella reddelli*), Kretschmarr Cave mold beetle (*Texamaurops reddelli*), Tooth Cave pseudoscorpion (*Tartarocreagris texana*), and Tooth Cave spider (*Neoleptoneta myopica*). Each of these invertebrates is troglobitic and spends its entire life underground in karst terrain containing voids/caves with suitable habitat conditions.

Table 1 (below) presents recorded hand surface and interior (data logger) conditions for each collection date of the Luby's Cave survey.

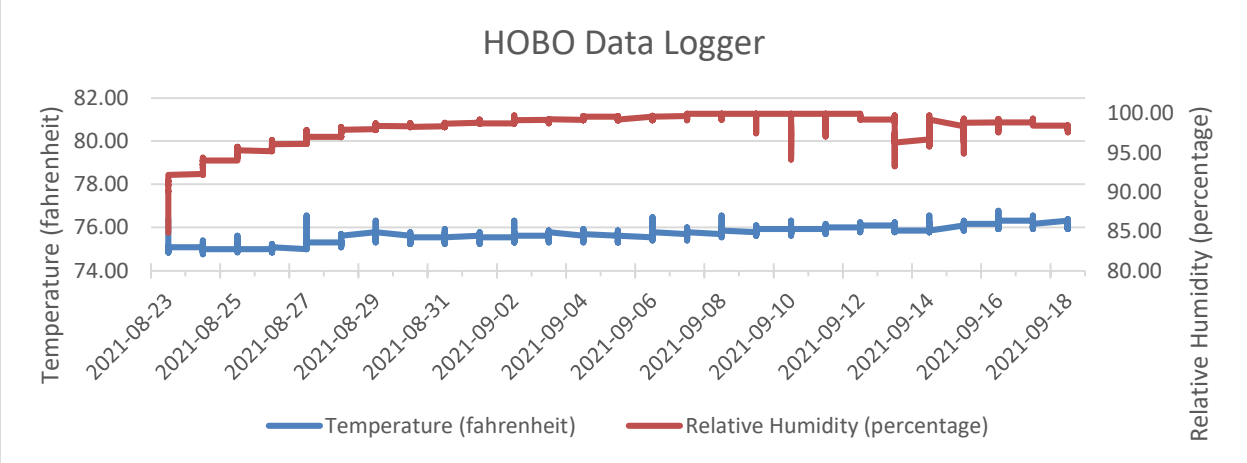
Table 1 – Luby's Cave

Date/Time	Surface Conditions	Interior Conditions	Endangered Cave Fauna Observed/Collected
08/23/21 9:00am	79°F 79% relative humidly	81.49°F 69.06% relative humidity	No
08/25/21 9:00am	79°F 80% relative humidity	75.88°F 94.88% relative humidity	No
08/27/21 9:00am	77°F 100% relative humidity	75.24°F 96.98% relative humidity	No
08/29/21 9:00am	77°F 90% relative humidity	75.78°F 98.42% relative humidity	No
08/31/21 9:00am	79°F 79% relative humidity	75.55°F 98.79% relative humidity	No
09/02/21 9:00am	81°F 84% relative humidity	75.62°F 98.76% relative humidity	No
09/04/21 9:00am	80°F 79% relative humidity	76°F 99% relative humidity	No
09/06/21 9:00am	83°F 69% relative humidity	75.62°F 99.66% relative humidity	No
09/08/21 9:00am	75°F 84% relative humidity	75.78°F 99.98% relative humidity	No
09/10/21 9:00am	73°F 57% relative humidity	75.7°F 98.31% relative humidity	No

Date/Time	Surface Conditions	Interior Conditions	Endangered Cave Fauna Observed/Collected
09/12/21 9:00am	73°F 77% relative humidity	75.93°F 99.98% relative humidity	No
09/14/21 9:00pm	77°F 74% relative humidity	75.93°F 99.24% relative humidity	No
09/16/21 9:00pm	81°F 60% relative humidity	76.09°F 99.24% relative humidity	No
09/18/21 9:00pm	76°F 76% relative humidity	76.17°F 97.97% relative humidity	No

Table 2 presents the recorded data logger (Onset HOBO® MX2302 Humidity and Temperature Data Logger with External Sensor) interior conditions for Luby's Cave. The data logger was mounted on the northern interior wall of Luby's Cave. Ambient temperature and relative humidity measurements were recorded every 30 minutes from the beginning to the end of the invertebrate survey.

Table 2
Luby's Cave – HOBO Data Logger



During the invertebrate survey, 2 (glass) pitfall traps were placed on either side of the cave floor and baited with blue cheese crumbles in the time periods between the latter survey events (after 12 September). However, due to large populations of (non-native) tawny crazy ants (*Nylanderia fulva*) throughout the cave, sticky traps were not used. In addition, plastic (removable) baby bottle traps were not used because most of the cave was accessible for the survey collection events. The existing steel manhole lid was securely placed over the cave entrance after each survey visit to maintain cool, moist, dark conditions to the extent practicable.

Based on the invertebrate survey results of Luby's Cave, no federally listed endangered karst invertebrates were observed, collected, and/or captured in any of the specified (pitfall) traps. All

the collected specimens (including surface accidentals and [non-endangered] trogloxene and/or troglophile species) were hand-delivered to Dr. James Reddell at the University of Texas (UT) Brackenridge Field Laboratory for proper taxonomic identification.

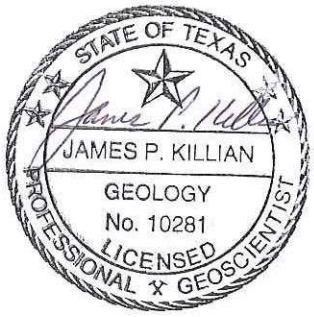
Based on Dr. Reddell's taxonomic review of the karst invertebrate survey collection, at least 2 cave-adapted species (troglobites) were found in Luby's Cave. One is the millipede *Cambala speobia*, which is abundant in caves throughout Central Texas and the Edwards Plateau. The second troglobite is the eyeless meshweaver spider, *Cicurina (Cicurella)* sp. Of note, no species of the genus *Cicurina* within Travis County are considered endangered. In addition, 4 specimens of a (not-federally listed and/or endangered) short-tailed whipscorpion belonging to the order *Schizomida* were found in Luby's Cave. The entire taxonomic list for identification of specimens collected from Luby's Cave by Dr. Reddell is attached to this report.

Based on the results of this survey, no federally listed endangered karst invertebrates were collected from the 14 karst invertebrate survey events (23 August 2021 to 18 September 2021). However, due to the documented presence of short-tailed whipscorpions (*Schizomida*), Luby's Cave should be kept accessible for further scientific research.

It is Horizon's opinion that proposed development of the subject site would have "no effect" on any of the 6 federally listed endangered karst invertebrate species that occur in Travis County. If you have any future questions, please feel free to contact me or Scott Flesher.

Sincerely,
For Horizon Environmental Services, Inc.
Registered TBPG Firm No. 50488

James Killian, PG
Principal Geoscientist



REFERENCES:

(Nearmap) Nearmap US, Inc. Nearmap Vertical™ digital orthographic photograph, <https://go.nearmap.com>. Imagery date 7 May 2021.

(OSM) OpenStreetMap contributors. Open Street Map, <http://www.openstreetmap.org>. Available under the Open Database License (www.opendatacommons.org/licenses/odbl). Accessed 28 April 2021.

(TCEQ) Texas Commission on Environmental Quality, Edwards Aquifer Protection Program. Edwards Aquifer Viewer, <http://gis.tceq.state.tx.us/website/iredwards1/viewer.htm>. Accessed 17 September 2021.

(TPWD) Texas Parks and Wildlife Department. Natural Diversity Database, T/E and Rare Species Elemental Occurrences. Wildlife Division, Habitat Assessment Program, Austin, Texas. Data downloaded 17 September 2021.

(USFWS) US Fish and Wildlife Service. Section 10(a)(1)(A) Scientific Permit Requirements for Conducting Presence/Absence Surveys for Endangered Karst Invertebrates in Central Texas. 2015.

(UT-BEG) The University of Texas at Austin Bureau of Economic Geology; C.V. Proctor, Jr., T.E. Brown, J.H. McGowen, N.B. Waechter, and V.E. Barnes. Geologic Atlas of Texas, Austin Sheet. Francis Luther Whitney Memorial Edition. 1974; reprinted 1995.

Veni, George, and Associates. *Geologic controls on cave development and the distribution of cave fauna in the Austin, Texas, region*. Prepared for the US Fish and Wildlife Service, Austin, Texas. 1991.

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ATTACHMENTS

FIGURES
CAVE MAP
TAXONOMY INVERTEBRATE REPORT

Date:	04/28/2021
Drawn:	KRS
HJN NO:	21048.001 GA
Source:	OSM, 2021

Horizon Environmental Services, Inc.

Figure 1

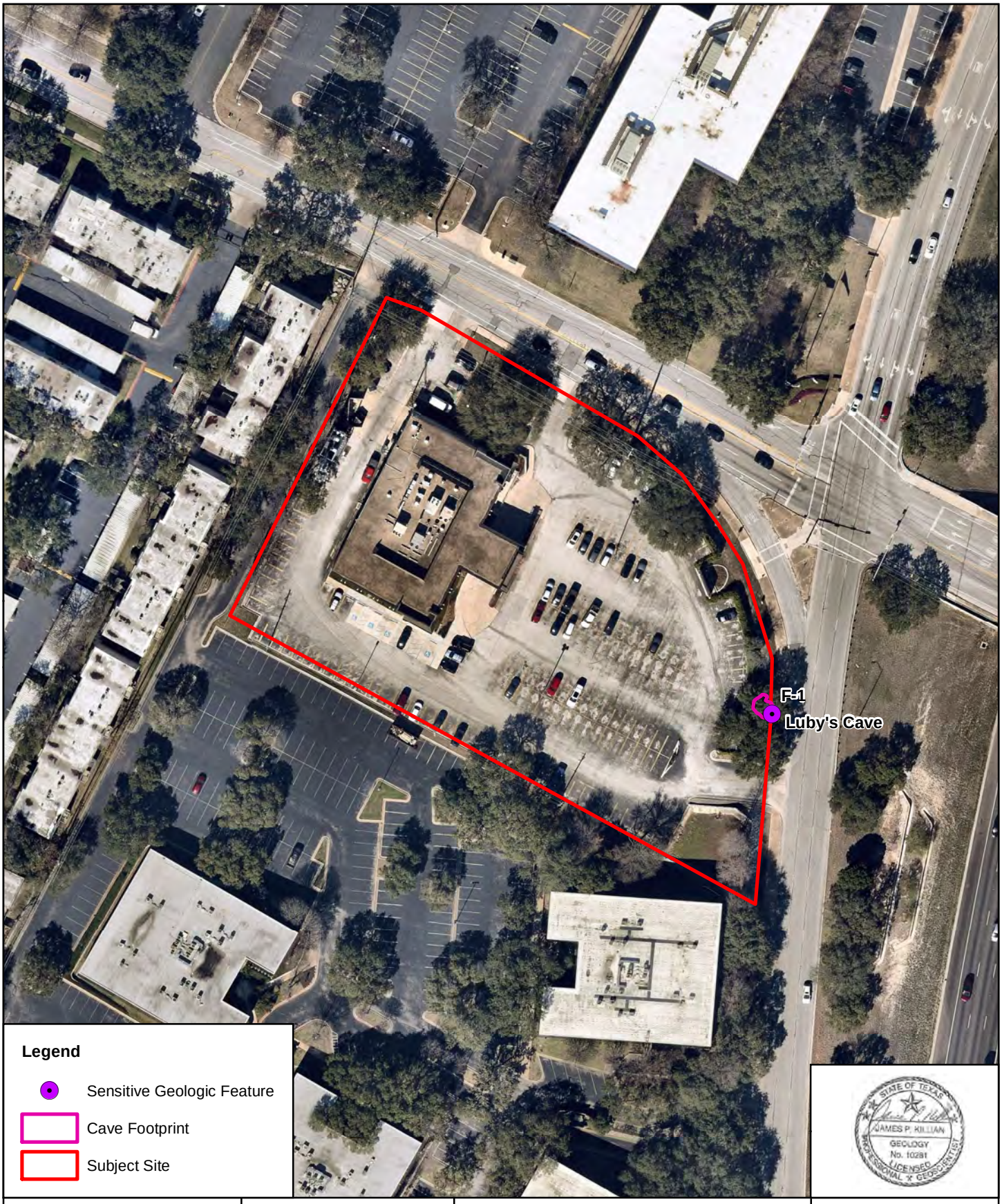
Vicinity Map
Luby's Site at Steck and MoPac
8176 North Mopac Expressway
Austin, Travis County, Texas

STATE OF TEXAS
JAMES P. KILLIAN
GEOLOGY
No. 10281
LICENSED
PROFESSIONAL GEOSCIENTIST

N

0 1,000 2,000
Feet

21048--Lubys_Site_at_Steck_and_MoPac\Graphics\21048-001KS_01A_Vicinity_F1.mxd



Legend

- Sensitive Geologic Feature
- Cave Footprint
- Subject Site

STATE OF TEXAS
JAMES P. KILLIAN
GEOLOGY
No. 10281
LICENSED
PROFESSIONAL GEOSCIENTIST

Horizon Environmental Services, Inc.

Date:	04/28/2021
Drawn:	KRS
HJN NO:	21048.001 GA
Source:	Nearmap, 2021

Figure 2

Geologic Feature Map
Luby's Site at Steck and MoPac
8176 North Mopac Expressway
Austin, Travis County, Texas

N

0 50 100
Feet

21048--Lubys_Site_at_Steck_and_MoPac\Graphics\21048-001KS_02A_Feature_F1.mxd

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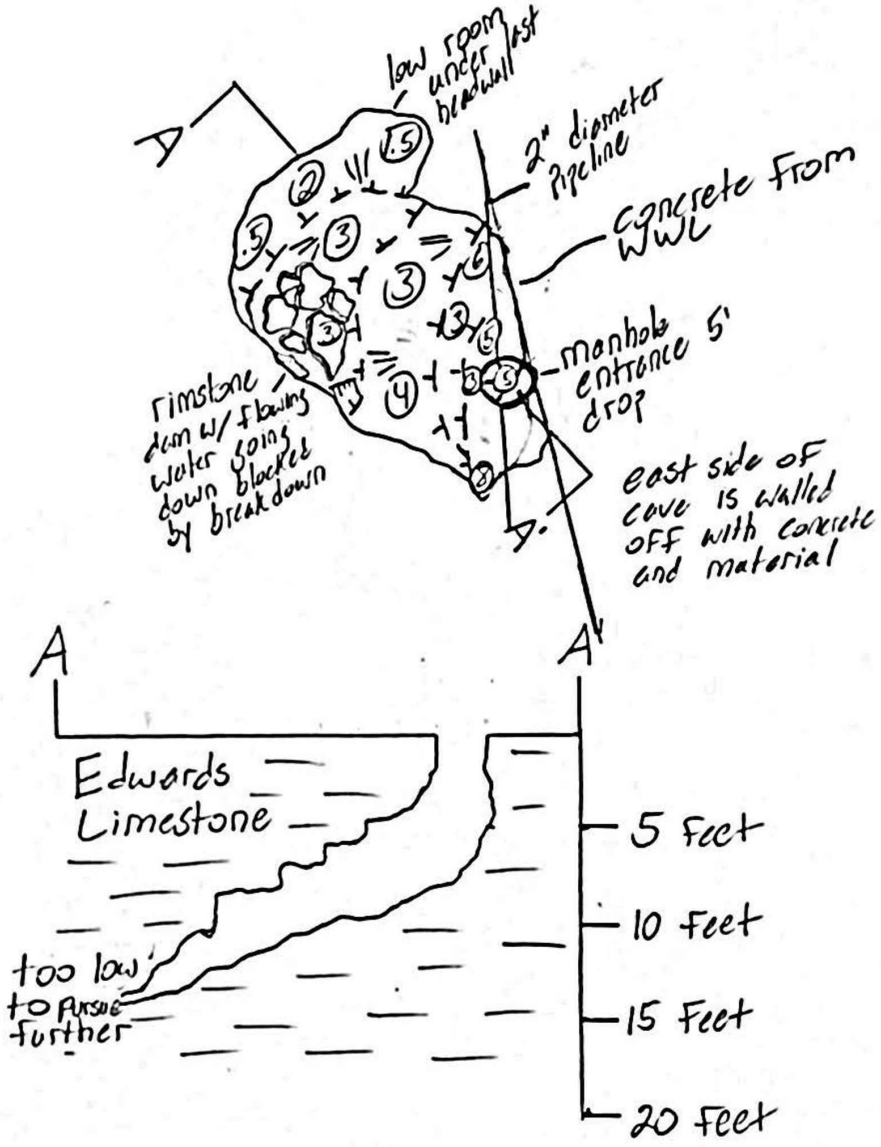

Horizon Environmental Services, Inc.	Date: 04/28/2021 Drawn: KRS HJN NO: 21048.001KS	Luby's Cave (F-1) Luby's Site at Steck and Mopac Austin, Travis County, Texas Suuntos & Tape Survey, 26 April 2021 Personnel: J. Killian, J. Yarbrough, C. Hall Lenght: 21' Width 14' Depth: 15' Drafted By: J. Yarbrough	② Ceiling Height (ft) △ Survey Station 1" = 10'	N	

"Do Not Scale This Drawing"

GEO-REF

Identification of Specimens from Luby's Cave, Travis County, Texas

James R. Reddell

21 September 2021

Fourteen collections were made in Luby's Cave by James Killian, Greg Sherrod, Cherman Hall, and Zach Blackburn of Horizon Environmental. Most of the material collected is common surface species found in urban areas. Others are soil dwellers. Two cave-adapted species (troglobites) were found. One is the millipede *Cambala speobia* which is extremely abundant in caves throughout Central Texas and the Edwards Plateau. The second troglobite is the eyeless meshweaver spider *Cicurina* (*Cicurella*) sp. The specimens cannot be identified except by a taxonomic specialist. No species of the genus *Cicurina* in Travis County are endangered. The most remarkable species found were four specimens taken on three separate dates of a short-tailed whipscorpion belonging to the order Schizomida. The only other record of the order in Travis County is of *Stenochrus portoricensis* from Millipede Cave at McNeil. This species id doubtless introduced and can reproduce without the presence of males. The only other U.S. record of the species is in southern Florida.

There were no endangered species found nor are any likely to occur in the cave due to its small size and shallow habitat. The cave, nevertheless, is of significance due to the presence of the Schizomida and should be kept open and made available for scientific research.

Results

23 August 2021
- Soil centipedes: Geophilomorpha undetermined (1)
- Hot house millipedes: *Oxidus gracilis* (1)

25 August 2021
- Millipedes: *Cambala speobia* (troglobite) (2)
- Hot house millipedes: *Oxidus gracilis* (1)
- Wasps: Hymenoptera undetermined no. 3 (1)

27 August 2021
- Hot house millipedes: *Oxidus gracilis* (1)
- Wasps: Hymenoptera undetermined no. 2 (1)

29 August 2021
- Pillbugs: *Armadillidium vulgare* (2)
- Meshweaver spiders: *Cicurina* (*Cicurella*) sp. (eyeless) (troglobite) (1 female)
- Hot house millipedes: *Oxidus gracilis* (2)

31 August 2021
- Snails: *Helicodiscus* sp. (troglophile) (1)
- Pillbugs: *Armadillidium vulgare* (1)
- Short-tailed whipscorpion: Hubbardiidae genus and species (1)
- Spiders: Araneae undetermined (1)
- Hot house millipede: *Oxidus gracilis* (1)
- Cockroaches: Blattaria undetermined (1)

2 September 2021
- Spiders: Araneae (2)
- Meshweaver spiders: *Cicurina* sp. (1 juvenile)
- Rock centipedes: Lithobiidae genus and species (1)
- Earwigs: Dermaptera undetermined (1)

4 September 2021

Earthworm: Haplotaxida undetermined (1)\
Pillbugs: *Armadillidium vulgare* (2)
Earwigs: Dermaptera undetermined (3)

6 September 2021

Pillbugs: *Armadillidium vulgare* (2)
Short-tailed whipscorpion: Hubbardiidae genus and species (2)
Hot house millipedes: *Oxidus gracilis* (1)
Garden centipedes: Symphyla undetermined (1)
Insect: Insecta undetermined (1)
Cockroaches: Blattaria undetermined (1)

8 September 2021

Snail**:** *Helicodiscus* sp. (troglophile) (1)
Meshweaver spiders: *Cicurina* (*Cicurella*) sp. (eyeless) (troglobite) (1 juvenile)
Insect: Insecta undetermined (1)
Wasps: Hymenoptera undetermined no. 2 (2)

10 September 2021

Millipedes: *Cambala speobia* (troglobite) (1)
Insect: Insecta undetermined (1)
Cockroaches: Blattaria undetermined (1)
Earwigs: Dermaptera undetermined (1)
Wasps: Hymenoptera undetermined no. 2 (7)

12 September 2021

Pillbugs: *Armadillidium vulgare* (1)
Short-tailed whipscorpion: Hubbardiidae genus and species (1)
Meshweaver spiders: *Cicurina* (*Cicurella*) sp. (eyeless) (troglobite) (1 juvenile)
Cockroaches: Blattaria undetermined (1)

14 September 2021

Pillbugs: *Armadillidium vulgare* (3)
Sow bugs: *Porcellio* sp. (2)
Hot house millipedes: *Oxidus gracilis* (1)
Cockroaches: Blattaria undetermined (4)
Earwigs: Dermaptera undetermined (3)

16 September 2021

Earthworm: Haplotaxida undetermined (1)
House centipedes: Scutigeridae genus and species (1)
Hot house millipedes: *Oxidus gracilis* (1)
Cockroaches: Blattaria (1)
Earwigs: Dermaptera undetermined (1)
Wasps: Hymenoptera undetermined no. 1 (1)
Hymenoptera undetermined no. 2 (3)

18 September 2021

Pillbugs: *Armadillidium vulgare* (1)
Millipedes: *Cambala speobia* (troglobite) (1)
Hot house millipedes: *Oxidus gracilis* (2)
Earwigs: Dermaptera undetermined (2)