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TECHNICAL REPORT FOR KARST MANAGEMENT SERVICES AT THE BALCONES CANYONLANDS PRESERVE – KOTRLA UNIT, TRAVIS COUNTY, TEXAS



Entrance of Cedar Fever Cave (SW-22).

Prepared for
Travis County TNR – Natural Resources and Environmental Quality
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30 September 2022

Abstract

Karst management of the Balcones Canyonlands Preserve Kotrla Unit in 2022 was a continuation of work conducted in 2017 to identify karst features, evaluate features as potential habitat, excavate as necessary to reach sampleable habitat, and document cave fauna with timed biological surveys and/or passive collection by trapping. Eight previously known karst features and nine newly discovered karst features were evaluated for potential karst invertebrate habitat during this investigation. All features met the initial criteria for potential karst invertebrate habitat, and six qualified as caves. All caves were mapped and biologically inventoried. Karst fauna surveys were conducted at nine features, often concurrently with excavation and/or mapping. Seven features were excavated for further evaluation of habitat, and three of these are recommended for continued excavation.

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Introduction

This technical report has been prepared in support of karst management activities at the Balcones Canyonlands Preserve (BCP) Kotrla Unit, located in northwest Travis County, Texas. The Kotrla Unit consists of three preserve tracts (Scott & White Tract, Kotrla Tract, and Endres Tract) owned and managed by Travis County (County), who contracted Zara Environmental LLC (Zara) to provide karst management services including karst invertebrate habitat assessments, excavation of karst features, and collection of karst invertebrates during excavation activities. The karst management services were conducted at eight features previously identified by the County on the Kotrla Unit, and at nine features identified by Zara personnel through a review of aerial imagery and LiDAR data.

Federally Listed Karst Invertebrates

Five invertebrate species known only from caves and karst areas in Travis and Williamson counties were federally listed as endangered species under the Endangered Species Act (ESA) by the U.S. Fish and Wildlife Service (USFWS) on 16 September 1988 (USFWS 1988). These species include the Bee Creek Cave harvestman (*Texella reddelli*), Tooth Cave pseudoscorpion (*Tartarocreagris texana*, formerly *Microcreagris texana*), Tooth Cave spider (*Tayshaneta myopica*, formerly *Neoleptoneta myopica*), Tooth Cave ground beetle (*Rhadine persephone*), and the Kretschmarr Cave mold beetle (*Texamaurops reddelli*). Two additional karst invertebrate species, the Bone Cave harvestman (*Texella reyesi*), and the Coffin Cave mold beetle (*Batrisodes texanus*) from Travis and Williamson counties were federally listed as endangered species due to taxonomic revisions on 18 August 1993 (USFWS 1993).

Balcones Canyonlands Conservation Plan – Species of Concern

A regional habitat conservation plan and incidental take permit, known as the Balcones Canyonlands Conservation Plan (BCCP), was issued in 1996 by the USFWS to the City of Austin and Travis County for the protection of two endangered bird species (including the Golden-cheeked Warbler [*Setophaga chrysoparia*]), six endangered karst invertebrate species (described above, with the exception of the Coffin Cave mold beetle), 25 karst Species of Concern (SOCs), and two plant SOCs (Regional Environmental Consultants [RECON] and USFWS 1996). For the purposes of this report, only the karst SOCs are presented below (Table 1). Since the BCCP was issued in 1996, some of the SOCs have been synonymized with other species based on recent genetic and taxonomic studies. As such, the protected status of these reclassified species may have changed. Additional details are included as footnotes in Table 1.

Table 1. Species of Concern addressed in the Balcones Canyonlands Conservation Plan (RECON and USFWS 1996).

Group	Species
Flatworms	<i>Sphalloplana mohri</i>
Ostracods	<i>Candona</i> sp. nr. <i>stagnalis</i>
Spiders	<i>Cicurina bandida</i> ¹ <i>Cicurina cueva</i> ¹ <i>Cicurina ellioti</i> ² <i>Cicurina reddelli</i> ³ <i>Cicurina reyesi</i> ¹ <i>Cicurina trivisiae</i> ³ <i>Cicurina wartoni</i> ³ <i>Tayshaneta concinna</i> ⁴ <i>Tayshaneta devia</i> ⁴ <i>Eidmannella reclusa</i>
Millipedes	<i>Speodesmus</i> N. S.
Pseudoscorpions	<i>Aphrastochthonius</i> N. S. <i>Tartarocreagris comanche</i> <i>Tartarocreagris reddelli</i> ⁵ <i>Tartarocreagris intermedia</i> <i>Tartarocreagris</i> N. S. 3
Harvestmen	<i>Texella spinoperca</i>
Ground Beetles	<i>Rhadine s. subterranea</i> <i>Rhadine s. mitchelli</i> <i>Rhadine austinica</i>
Isopods	<i>Caecidotea reddelli</i> <i>Miktoniscus</i> N. S. <i>Trichoniscidae</i> N. S.
¹ <i>Cicurina cueva</i> and <i>C. reyesi</i> have been synonymized under <i>C. bandida</i> (Paquin et al. 2008; Paquin and Dup��rr�� 2009; BCP 2016). ² <i>Cicurina ellioti</i> was originally listed as an SOC (RECON and USFWS 1996); however, this species has been synonymized with <i>C. buwata</i> (Cokendolpher 2004), which currently is not listed as an SOC (BCP 2016). ³ <i>Cicurina reddelli</i> and <i>C. wartoni</i> have been synonymized under <i>C. trivisiae</i> (Hedin 2015; BCP 2016) ⁴ <i>Tayshaneta concinna</i> and <i>T. devia</i> were originally listed in the BCCP (RECON and USFWS 1996) under the genus <i>Neoleptoneta</i> ; however, recent studies revised <i>Neoleptoneta</i> , thus placing these species in the genus <i>Tayshaneta</i> (Campbell et al. 2012; BCP 2016). ⁵ <i>Tartarocreagris reddelli</i> was originally listed as an SOC (RECON and USFWS 1996); however, this species has been synonymized with <i>T. infernalis</i> (Muchmore 2001), which currently is not listed as an SOC (BCP 2016).	

Methods

Prioritization of Karst Features

Given the time and personnel allocated for this investigation, the established goal was to evaluate as many karst features as possible by first focusing on those designated as high priority, followed by the secondary priority features. Prioritization of features for excavation, mapping, and biological survey was established using the results of the previously submitted technical report (ZARA 2017) and refined based on the ease of access, estimated time of excavation effort, probability of reaching potential habitat, weather considerations, and input from the County. For example, large features that likely provided karst invertebrate habitat but were estimated to require considerable excavation effort were deprioritized compared to those that could be easily excavated and evaluated for the presence of habitat. Previously known features were given priority over newly discovered features unless their habitat potential was deemed very low.

Karst Invertebrate Habitat Guidelines

Karst features were evaluated by scientists holding a valid USFWS 10(a)(1)(A) permit (TE85077A-1) covering endangered karst invertebrate species to determine the features' potential to contain suitable habitat for karst invertebrate species. Where necessary, scientists performed reconnaissance excavation to remove loose fill from each evaluated feature and subsequently characterized the feature based on recommendations contained in USFWS (2015) and paraphrased below. If any of the following criteria were met, then the feature was considered potential habitat, subjected to reconnaissance excavation (where applicable), and evaluated for potential to lead to a void:

- Feature contains leaf litter, loose modern soils, and a few rocks;
- Feature exhibits airflow;
- Feature displays channelized recharge of water;
- Feature exhibits collapse development;
- Feature contains loose fill to a depth of at least 30 cm (1 ft);
- Feature contains clean-washed rocks at its base; or
- Feature contains *Ceuthophilus cunicularis* cave crickets, *Cicurina varians* spiders, or other cave-adapted species.

The USFWS (2015) provides additional criteria for features that do not meet the above characteristics. If the evaluated karst features did not meet any of the above criteria but met at least two of the following, then the feature was considered potential habitat:

- Feature developed along a fracture;
- Feature extends at least 1 m (3.3 ft) beyond the original surface expression;
- Feature similar in appearance to nearby caves in similar geologic setting; or
- A potentially humanly enterable void is visible.

Additional factors indicating potential habitat include: proximity to known endangered species caves; formation in karst zones 1 or 2; physical characteristics indicative of a cave; presence of artificial fill material; presence of roots/soil in the feature; proximity to fault, photolineament, or an area with high fracture density; or vegetation known to preferentially grow in cave entrances or karst features.

In cases where excavation was not recommended based on the criteria for potential habitat listed above and the consideration of additional factors indicating the potential for habitat, five characteristics of features not likely to contain suitable habitat were considered. These characteristics provided by USFWS (2015) are paraphrased here:

- All or nearly all of the interior surfaces covered with calcite speleothems;
- Absence of cave-adapted species;
- Features are dry or do not have evidence of modern water flow;
- Absence of airflow; and
- Feature not formed by a collapse or related to a collapse.

In some cases, evaluation of potential habitat via excavation is recommended. All excavations were performed by or under the direct supervision of a scientist holding a valid USFWS 10(a)(1)(A) permit. Features were excavated until one of the following was encountered:

- Suitable habitat (i.e., cave passage) for sampling karst invertebrate species;
- A distinct terminus (i.e., bedrock) with no conduits;
- Packed clay with no airflow present;
- Potential archaeological or paleontological materials; or
- Continued excavation would be dangerous (due to large overhanging rocks, high levels of carbon dioxide, etc.)

Karst Invertebrate Specimen Collection

Scientists holding a valid 10(a)(1)(A) permit for karst invertebrates collected karst invertebrate specimens during excavations. Visible surfaces and the undersides of rocks were examined for the presence of karst invertebrates. Observed fauna encountered was noted on field sheets, and notable specimens were collected for accessioning, further identification, and/or to create a museum record of notable fauna from each site. Collected specimens were retained by the County for further taxonomic studies.

Results

Reconnaissance of twenty-four depressions identified using LiDAR-derived imaging and GIS analysis occurred on 6 January 2022. A majority of these were determined to be disturbed ground, either from animal or human activity (burrows, mounds, ditches, etc), but nine were karst features and all of these were determined to be potential habitat. Subsequent excavation activities and/or fauna surveys occurred on 27 January; 1, 8, 10, and 15 February; and 13, 15, and 22 September 2022. Habitat assessments, excavations, and specimen collections were conducted by a crew of two to four of the following scientists under USFWS 10(a)(1)(A) permit TE85077A-1: Peter Sprouse, Aubri Jenson, Jimmy MacMillan, Krista McDermid, Kara Posso, and Liza Colucci, with technical field assistance from Ethan Perrine and Rich Zarria.

Seven features were further evaluated for habitat during excavation activities: SW-11, SW-16 (Puncture Pit), SW-17, SW-18, SW-21 (Travis Pit), SW-23, and SW-24 (Natural Intelligence Cave). Of seven features excavated, three are recommended for additional excavation. Two features that had been previously identified but not evaluated (SW-9 and SW-10) were assessed and determined to be potential karst habitat but remained a low priority for excavation due to heavy soil cover. Biological surveys and/or sampling were conducted at the following nine features, often concurrent with excavation or cave mapping: SW Cave 3 (Poison Ivy Pit), SW Cave 4 (McMac Cave), SW-11, SW-16 (Puncture Pit), SW-17, SW-18, SW-21 (Travis Pit), SW-22, and SW-27 (Artificial Intelligence Cave). A summary of work by feature is presented Table 2. Potential habitat parameters indicating the need for additional assessment via excavation and/or karst fauna surveys are described in Table 3. Provided below are detailed descriptions of the evaluated features, activities performed, and recommendations for future work for each feature.

Table 2. Summary table of evaluated features.

Feature Name	Feature Type	Excavated in 2022	Cave Adapted Species [Specimen ID, if collected]
KO-4 ²	Solution cavity	N	none observed
SW Cave 3 ¹ (Poison Ivy Pit)	Cave	N	<i>Ceuthophilus secretus</i> , <i>Collembola</i> , <i>Leiobunum townsendii</i>
SW Cave 4 ¹ (McMac Cave)	Cave	N	<i>Speodesmus</i> [ZARA14165], <i>Collembola</i> , <i>Leptonetid</i> , <i>Agyneta</i> , <i>Texoreddelia</i> [ZARA14353], <i>Ceuthophilus cunicularis</i> , <i>Ceuthophilus secretus</i> , <i>Cicurina</i> sp. {ZARA14152/3} <i>Tartarocreagis</i> sp [ZARA14156/7/8 & 14163], <i>Rhadine</i> sp. [ZARA14159 & 14352]
SW-9 ¹	Solution cavity	N	none observed
SW-10 ¹	Solution cavity	N	none observed
SW-11 ¹	Enlarged fracture	Y	<i>Ceuthophilus secretus</i> , <i>Cicurina</i> sp. (eyed) [ZARA14350]
SW-16 ¹ (Puncture Pit)	Cave	Y	<i>Collembola</i> , <i>Ceuthophilus cunicularis</i> , <i>Ceuthophilus secretus</i> , <i>Batrissodes</i> [14179], <i>Cicurina varians</i> [ZARA14186], <i>agyneta</i> sp. [14188], <i>eidmanella</i> sp. [ZARA 14187]
SW-17 ¹	Solution cavity	Y	<i>Collembola</i> , <i>Ceuthophilus cunicularis</i> , <i>Ceuthophilus secretus</i>
SW-18 ¹	Sinkhole	Y	<i>Leiobunum townsendii</i>
SW-21 ² (Travis Pit)	Solution cavity	Y	<i>Collembola</i> , <i>Leiobunum townsendii</i> , <i>eidmanella</i> [ZARA14150], <i>Cicurina</i> sp. (eyeless) [ZARA14146], <i>Cicurina</i> sp. (eyed) [ZARA14147], <i>Cicurina varians</i> [ZARA14148], <i>Ceuthophilus secretus</i> , <i>Ceuthophilus cunicularis</i>
SW-22 ² (Cedar Fever)	Cave	N	<i>Collembola</i> , <i>Leiobunum townsendii</i> , <i>eidmanella</i> sp., <i>agyneta</i> sp., <i>cicurina</i> sp., <i>Ceuthophilus secretus</i> , <i>Ceuthophilus cunicularis</i> ,
SW-23 ²	Enlarged fracture	Y	<i>Ceuthophilus secretus</i>
SW-24 ² (Natural Intelligence)	Cave	N	<i>Collembola</i> , <i>Ceuthophilus secretus</i> [ZARA14173], <i>Ceuthophilus cunicularis</i> [ZARA14174],
SW-25 ²	Sinkhole	N	none observed
SW-26 ²	Enlarged fracture	N	none observed
SW-27 ² (Artificial Intelligence)	Cave	N	<i>Collembola</i> , <i>Cicurina</i> sp., <i>Leptonetid</i> <i>townsendii</i> , <i>Ceuthophilus secretus</i> , <i>pseudoscorpion</i> [ZARA14356], <i>Batrissodes</i> [ZARA14357], <i>Cicurina varians</i> [ZARA14168] <i>eidmanella</i> sp. [ZARA14172]
SW-28 ²	Sinkhole	N	none observed

¹ Priority karst feature according to ZARA 2017, ² Previously undiscovered karst feature

Table 3. Summary table of USFWS (2015) conditions indicating potential habitat for features discovered during karst surveys at this project.

Feature Name	Potential habitat if feature meets any one criterion							Potential habitat if feature meets at least two criteria				Not Habitat if all conditions are met				
	Leaf litter, modern soil, rocks	Airflow	Channelized recharge	Collapse development	Loose fill ≥30 cm	Clean washed rocks	Cave fauna	Developed along fracture	Extends ≥ 1 m	Similar to nearby caves	Enterable void	All surfaces calcite	No cave fauna	No evidence of water flow	No airflow	Not related to collapse
KO-4 ³	X														X	X
SW Cave 3 ¹ (Poison Ivy Pit)	X						X		X	X	X				X	
SW Cave 4 ¹ (McMac Cave)	X					X	X		X	X	X				X	
SW-09 ¹	X							X					X		X	X
SW-10 ¹	X				X								X		X	X
SW-11 ¹	X	X						X					X			X
SW-16 ¹ (Puncture Pit)	X			X		X	X		X		X				X	X
SW-17 ¹	X						X	X	X		X					
SW-18 ¹	X		X	X	X	X			X		X		X		X	
SW-21 ³ (Travis Pit)	X	X							X	X	X					X
SW-22 ³ (Cedar Fever)	X							X	X	X	X				X	X
SW-23 ³	X							X							X	X
SW-24 ³ (Natural Intelligence)	X	X							X	X	X					X
SW-25 ³	X				X										X	X
SW-26 ³	X				X			X							X	X
SW-27 ³ (Artificial Intelligence)	X							X	X	X	X				X	X
SW-28 ³	X				X										X	X

Feature Descriptions

Feature KO-4; Sinkhole

Feature KO-4 is a sinkhole located in the west central area of the Kotrla Tract (Table 4; Figure 1 – Figure 3). The feature was discovered through visual review of a LiDAR-derived hillshade map but was also previously flagged by the county for evaluation. The sinkhole was approximately 8 m wide by 15 m long and 0.4 m deep, and had a general orientation of 195°. A soil drain that measured approximately 0.4 m wide by 0.3 m long and 0.3 m deep was observed at the base of a tree on the north side of the sinkhole. The interior substrate of the feature consisted of loose limestone fragments, modern organic soil, and leaf litter. Minor hand excavation of the soil drain revealed a compact soil floor. Feature KO-4 met the initial criteria for potential habitat due to the presence of nutrient-rich soil and leaf litter (Table 3). Excavation could be done but remains a low priority due to thin soil cover and the lack of downward trending voids. Karst fauna surveys are not recommended until sampleable habitat is accessible.

Table 4. Feature KO-4 assessment.

Assessment date	Dimensions meters (feet)			Airflow	Sediment	Fauna Observed/ Comments
	X	Y	Z			
6 January 2022	8.0 (26.0)	15.0 (49.2)	0.4 (1.6)	N	modern, dark, fine-grained soil, leaf litter, and rocks	None observed



Figure 1. Feature KO-4 is a sinkhole with a soil drain.



Figure 2. Hand excavation of feature KO-4 revealed a compact soil floor.

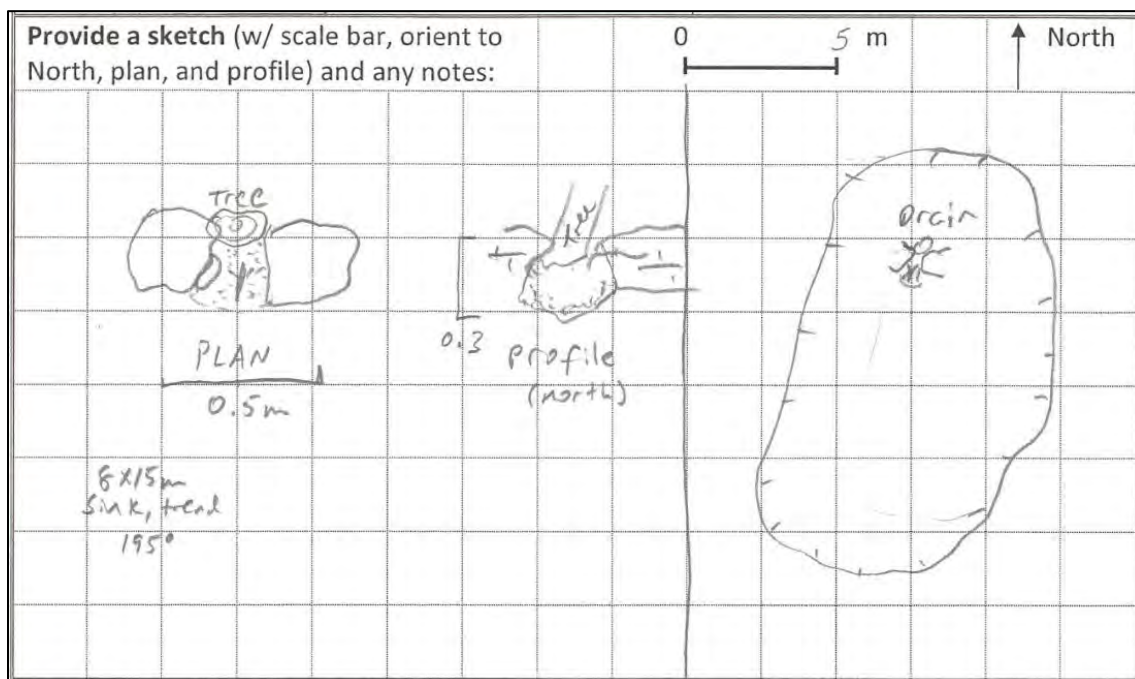


Figure 3. Field sketch of feature KO-4.

SW Cave 3 (Poison Ivy Pit); Cave

Feature SW Cave 3 (Poison Ivy Pit) is located in the north-central area of the Scott & White Tract (Table 5; Figure 4 - Figure 9). The original cave entrance measured approximately 0.75 m in diameter, and a constriction in the limestone walls was recorded at approximately 4 m deep. The constriction was widened for further access on 12 September 2017. Due to bad air, no further work was attempted in 2017. On 10 February 2022, cool conditions permitted entry for biological survey. The cave was mapped on 22 September 2022 using a DistoX2 and Topodroid mobile phone application (Figure 9). Cave fauna observed in SW Cave 3 are listed below in Table 5.

The cave interior consisted of highly scalloped bedrock walls and floor and contained breakdown and some loose soil and leaf litter. The cave appeared to be controlled by fracture development oriented east-west. A small drain was observed trending downward into bedrock below the entrance. Additional excavation is not necessary to conduct routine biological sampling, and due to the small size of the drain and restricted room for excavation, no further excavation is recommended. Karst fauna surveys are recommended to continue.

Table 5. Feature SW Cave 3 assessment.

Assessment date	Dimensions meters (feet)			Airflow	Sediment	Fauna Observed/ Comments
	X	Y	Z			
10 February 2022 22 September 2022	1.5 (4.9)	4.4 (14.4)	7.2 (23.6)	N	Modern, dark, fine-grained soil and leaf litter and breakdown; bedrock floor	<i>Helicodiscus</i> (snail); <i>Leiobunum townsendii</i> (harvestman); Collembola (springtails); <i>Texoreddellia</i> sp. (silverfish); <i>Scolopendra Hero</i> (Texas Redheaded centipede); Scarabaeidae (<i>dung beetle</i>); <i>Ceuthophilus cunicularis</i> and <i>C. secretus</i> (cave crickets); <i>Thamnopsis marcianus</i> (Checkered garter snake); <i>Plethodon albagula</i> (salamander)



Figure 4. Overview of feature SW Cave 3.



Figure 5. Entrance of feature SW Cave 3, enlarged in 2017.



Figure 6. Entrance of feature SW Cave 3 from interior.



Figure 7. Drain at the bottom of feature SW Cave 3.

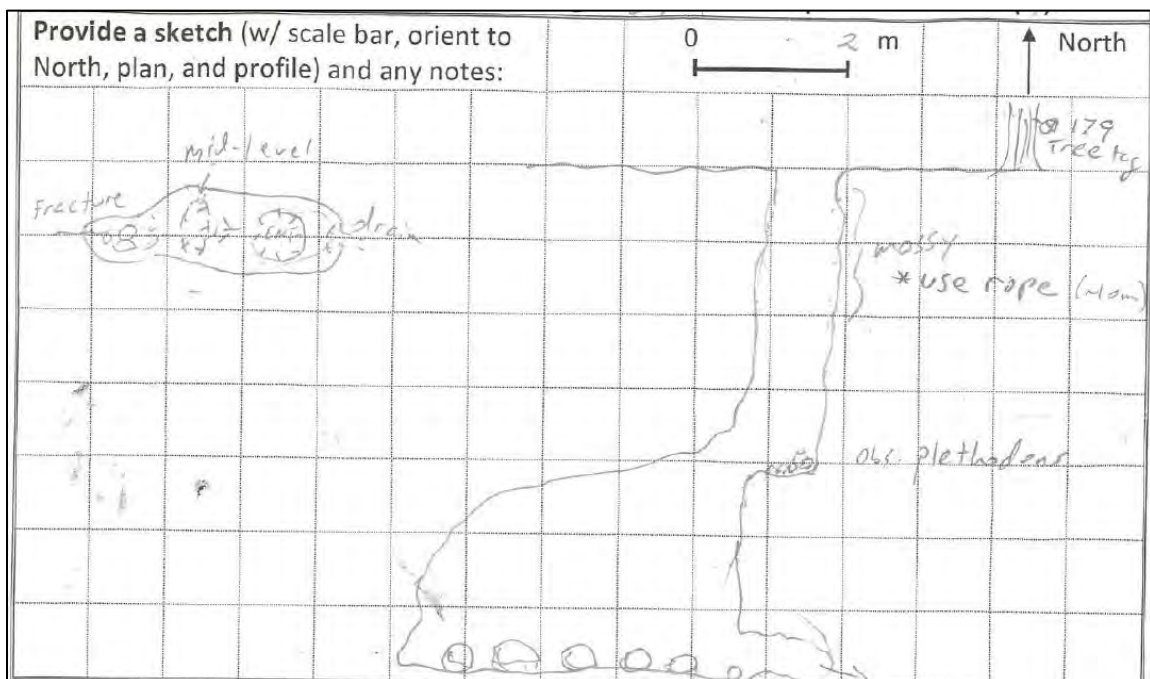
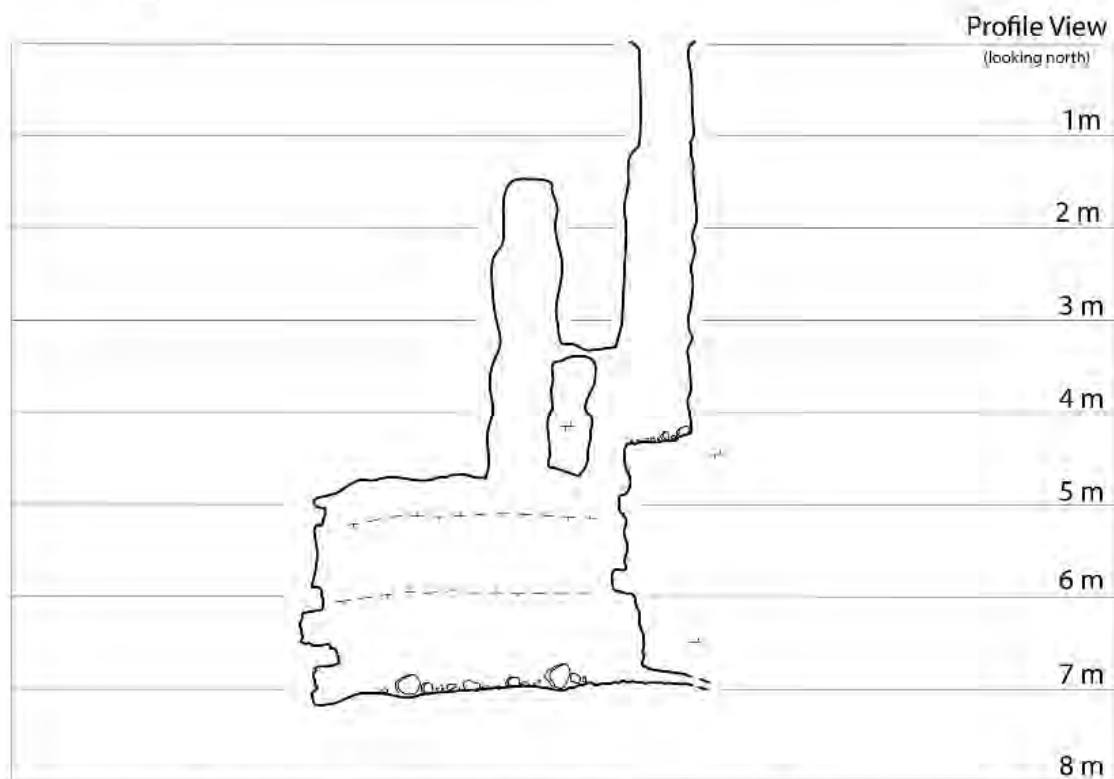
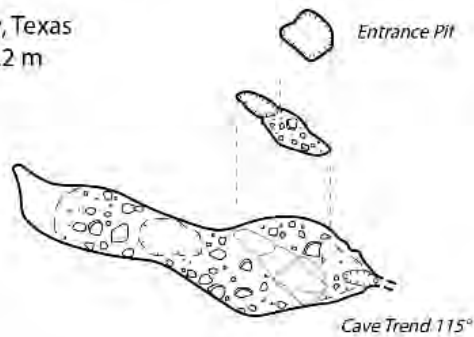


Figure 8. Field sketch of feature SW Cave 3.

Posion Ivy Pit

Feature SW-Cave3
Kotrola Tract, Travis County, Texas
Length: 4.4 m Depth: 7.2 m



September 22nd, 2022. DistoX2 and Topodroid Survey. Kara Posso (Sketch and Cartography), Aubri Jenson (Instruments & Biosurvey)

Figure 9. Map of feature SW Cave 3 (Poison Ivy Pit).

SW Cave 4 (McMac Cave); Cave

Feature SW Cave 4 (McMac Cave), is located in the southeast central area of the Scott & White Tract (Table 6; Figure 10 - Figure 13). The entrance dimensions were estimated to be 1 m wide by 2 m long, and the entrance drop was measured at 8 m deep. The cave trended east and west along a low crawl, terminating approximately 3.2 m to the east and extending west roughly 10 m before trending slightly upwards and branching into a low crawl. The cave was discovered in 2017 and met initial criteria as karst habitat due to infilling of nutrient-rich soil and leaf litter, its enterable size, and development along a fracture. Excavation was recommended in 2017 to clear out a low crawlway below the entrance, but upon re-inspection it was decided to prioritize biological survey of the already accessible portions of the cave. The cave was mapped on 10 February 2022 using a DistoX2, Suunto instruments, and tape (Figure 13). Timed biological surveys were conducted on 10 February and 22 September 2022. A wide variety of cave adapted fauna was observed in McMac Cave (Table 6). Of note, three pseudoscorpions were collected on 10 February for taxonomic identification. Karst fauna surveys are strongly recommended to continue the evaluation for protected species at this feature.

Table 6. SW Cave 4 (McMac Cave) assessment.

Assessment date	Dimensions meters (feet)			Airflow	Sediment	Fauna Observed/ Comments
	X	Y	Z			
10 February 2022 22 September 2022	26 (85.3)	2 (6.6)	8 (26.2)	N	Modern, dark, fine-grained soil and breakdown	<i>Helicodiscus</i> (snail); <i>Leiobunum townsendii</i> (harvestman); Acari (tick); Pseudoscorpions und; Collembola (springtails); <i>Agynetta</i> sp. (spider); <i>Cicurina</i> sp. (cave meshweaver spider); <i>Eidmanella</i> sp. (spider); <i>Leptonetid</i> (spider); <i>Texoreddellia</i> sp. (silverfish); <i>Speodesmus</i> (millipede); <i>Geophylomorpha</i> (soil centipede); <i>Scolopendra Hero</i> (Texas Redheaded centipede); <i>Rhadine</i> sp. (cave beetle); Scarabaeidae (<i>dung beetle</i>); Staphylinidae (rove beetle); <i>Ceuthophilus cunicularis</i> and <i>C.</i> <i>secretus</i> (cave crickets); Lepidoptera (moth); <i>Plethodon albagula</i> (salamander) <i>Eleutherodactylus marnocki</i> (cliff chirping frog); <i>Dryophytes versicolor</i> (gray treefrog); <i>Microhylidae</i> (narrow-mouth frog); <i>Lithobates</i> (Leopard frog)



Figure 10. Entrance of feature SW Cave 4.



Figure 11. Crawlway below entrance that was recommended for excavation in 2017.



Figure 12. Looking west into the lower cave passage.

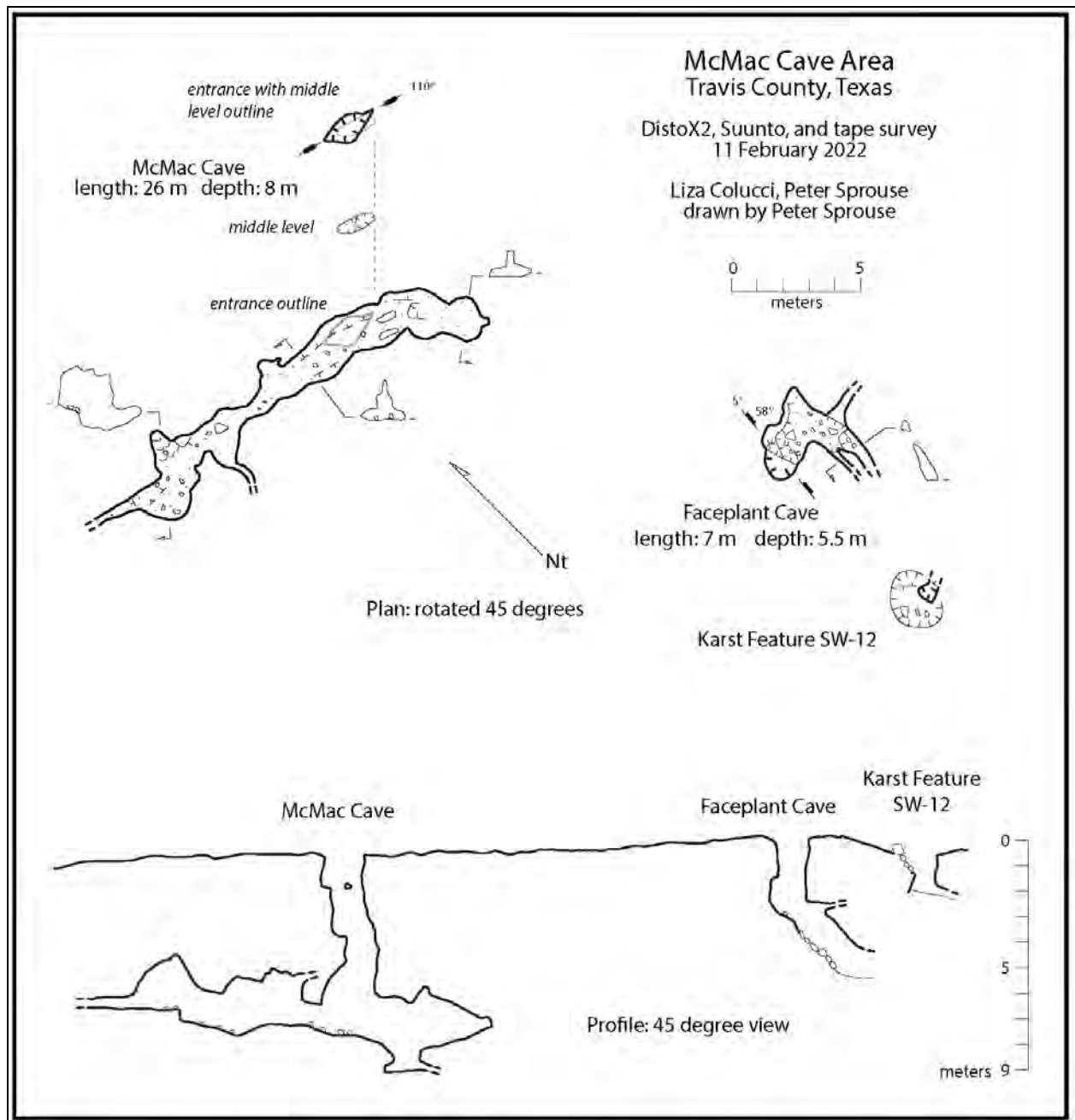


Figure 13. Map of SW Cave 4 (McMac Cave) showing nearby features, SW-13 (Faceplant Cave) and SW-12.

Feature SW-9; Solution Cavity

Feature SW-9 is a solution cavity located in the north central area of the Scott & White Tract (Table 7; Figure 14 - Figure 16). Feature SW-9 was identified as a low-priority feature by the County in 2017, and the feature was evaluated upon request on 6 January 2022. A fracture with a bearing of 265° guided the feature, which measured approximately 0.3 m high and 0.4 m wide, and extended up to 0.8 m along a bedding plane. The interior substrate consisted of loose limestone fragments, modern organic soil, and leaf litter. Minor hand excavation revealed a compact soil floor. No airflow or moisture was noted. Feature SW-9 meets the initial criteria for potential habitat due to modern soil and development along a fracture (Table 3). Additional excavation could be done, but since this is a small feature with thick soil cover, the priority remains low. Karst fauna surveys are not recommended until sampleable habitat is reached.

Table 7. Feature SW-9 assessment.

Assessment date	Dimensions meters (feet)			Airflow	Sediment	Fauna Observed/ Comments
	X	Y	Z			
6 January 2022	0.4 (1.3)	0.8 (2.6)	0.3 (1)	N	modern, dark, fine-grained soil, leaf litter, and rocks	None observed



Figure 14. Overview of feature SW-9.



Figure 15. Feature SW-9 is developed along a fracture.

Provide a sketch (w/ scale bar, orient to North, plan, and profile) and any notes:

0 1 m

North

PLAN

PROFILE

Figure 16. Field sketch of feature SW-9.

Feature SW-10; Solution Cavity

Feature SW-10 is a solution cavity located in the north central area of the Scott & White Tract (Table 8; Figure 17- Figure 19). Feature SW-10 was identified as a low-priority feature by the County in 2017, and the feature was evaluated upon request on 6 January 2022. The feature dimensions were approximately 0.5 m long by 0.2 m wide, with a depth of up to 0.5 m. The interior substrate consisted of loose limestone fragments, modern organic soil, and leaf litter. Minor hand excavation revealed a soil floor. No airflow or moisture was noted. Feature SW-10 meets the initial criteria for potential habitat due to modern soil and leaf litter (Table 3). Additional excavation could be done, but since this is a small feature with thick soil cover, the priority remains low. Karst fauna surveys are not recommended until sampleable habitat is reached.

Table 8. Feature SW-10 assessment.

Assessment date	Dimensions meters (feet)			Airflow	Sediment	Fauna Observed/ Comments
	X	Y	Z			
6 January 2022	0.2 (0.7)	0.5 (1.6)	0.5 (1.6)	N	modern, dark, fine-grained soil, leaf litter, and rocks	None observed



Figure 17. Overview of feature SW-10.



Figure 18. The floor of feature SW-10 contains loose soil and leaf litter.

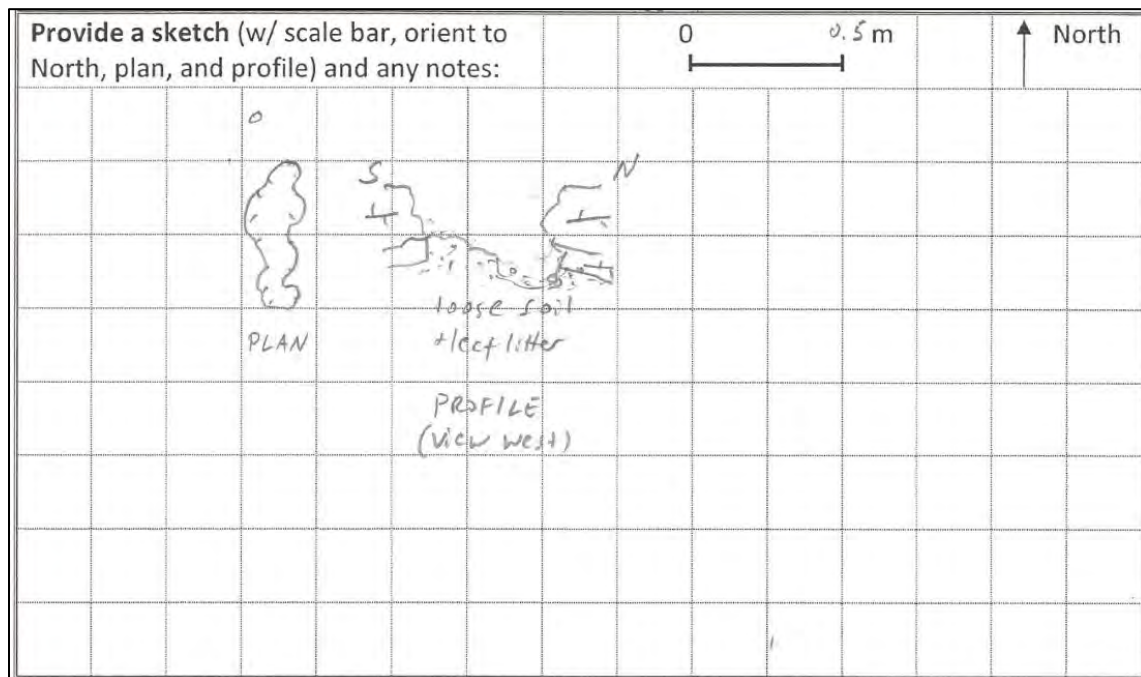


Figure 19. Field sketch of feature SW-10.

Feature SW-11; Enlarged Fracture

Feature SW-11 is an enlarged fracture located in the north central area of the Scott & White Tract (Table 9; Figure 20 – Figure 24). The feature was evaluated in 2017 and determined to meet the initial criteria for potential habitat due to modern soil, airflow, and development along a fracture (Table 3). A fracture with a bearing of 176° guided the feature, which originally measured 5 m long by 1 m wide by 0.7 m deep. Prior to excavation, the substrate consisted of rocks, modern soil, and leaf litter. The feature was excavated on 21 June 2017 using hand tools to remove loose rocks, soil, and roots. Excavation revealed mesocavernous voids, but digging was stopped due to time constraints. Excavation resumed on 22 September 2022 to remove several large boulders and approximately 1.8 m³ of loose soil and rocks during a total of 10.5 person-hours of effort. The final depth of the feature was approximately 1.5 m, excluding a small drain observed to continue downward along a fracture for another 1 m. No airflow was noted. Biological survey during excavation and passive collection with glue traps detected several cave adapted species (Table 9). No further excavation is necessary to reach sampleable habitat. Karst fauna surveys are recommended to continue.

Table 9. Feature SW-11 assessment.

Assessment date	Dimensions meters (feet)			Airflow	Sediment	Fauna Observed/ Comments
	X	Y	Z			
22 September 2022	5 (16)	1 (3.3)	1.5 (5)	Y	modern, dark, fine-grained soil, leaf litter, and rocks	Blattaria (wood roach); <i>Cambala</i> (millipede); <i>Geophilidae</i> (Soil centipede); <i>Cicurina</i> sp. (Cave meshweaver spider); <i>Ceuthophilus secretus</i> (cave cricket); <i>Staphylinidae</i> (rove beetle)



Figure 20. Feature SW-11 prior to excavation in 2022.



Figure 21. Feature SW-11 after excavation in 2022.



Figure 22. Floor drain following a fracture exposed after excavation.

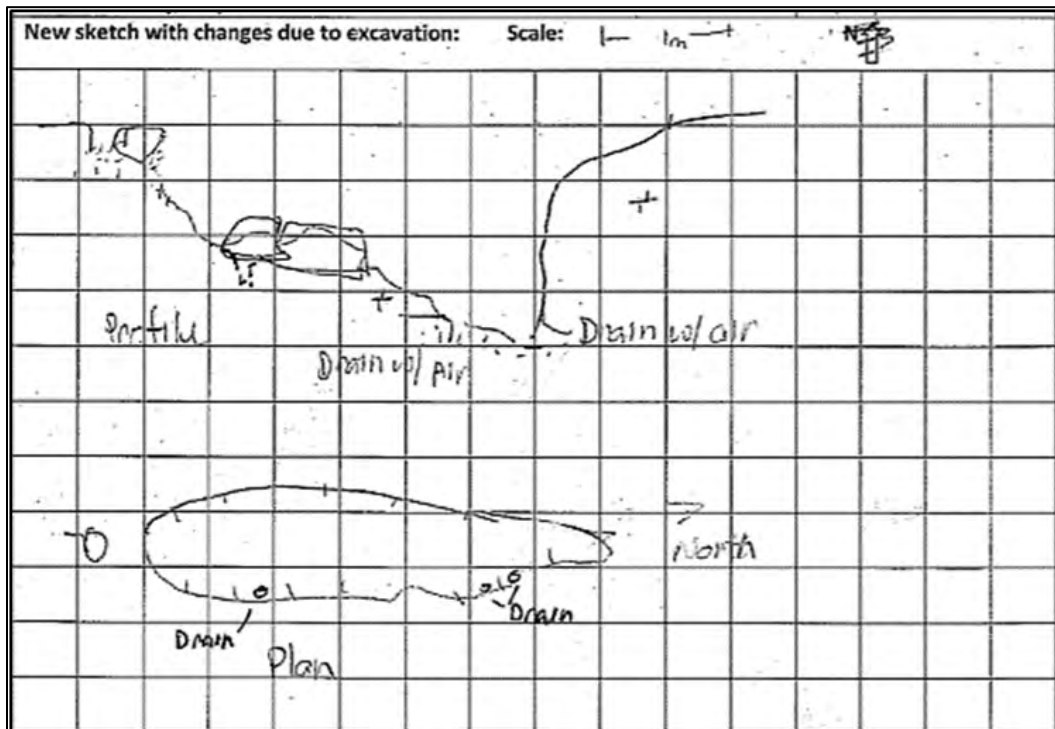


Figure 23. Field sketch of feature SW-11 after excavation in 2017.

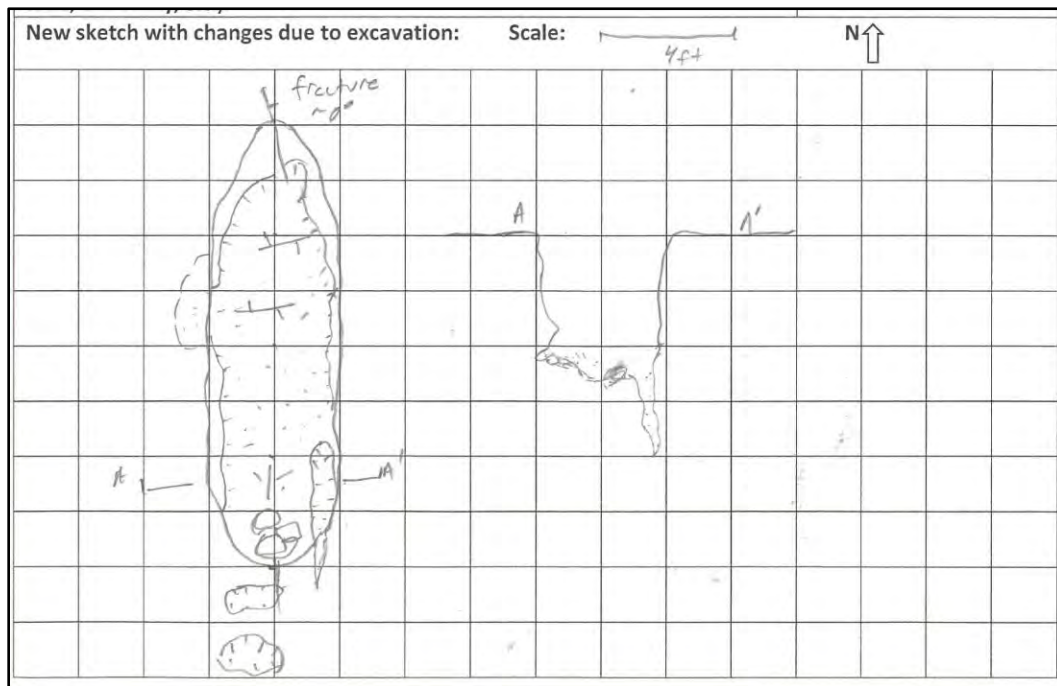


Figure 24. Field sketch of feature SW-11 after excavation in 2022.

Feature SW-16 (Puncture Pit); Cave

Feature SW-16 (Puncture Pit) is a cave located in in the northeast corner of the Scott & White Tract panhandle (Table 10; Figure 25 – Figure 31). Feature SW-16 was originally described as a sinkhole that was 2 m wide by 9 m long by 1 m deep with a substrate of loose modern soil, rocks, leaf litter, and roots. The feature met initial criteria for potential habitat due to evidence of nutrient and water flow into the feature, enterable size, depth of greater than 1 m, and similarity to nearby caves known to contain karst invertebrates. Excavation with hand tools occurred in July 2017, revealing a pit approximately 5 m deep. However, bad air was detected in the bottom of the pit, and excavation was discontinued.

Excavation resumed on 8 February 2022, when cooler weather allowed safe entry into the pit. Approximately 1.5 m³ of soil, loose rocks, and roots were removed with hand tools during 12 person-hours of effort. The cave was mapped on 8 February using a Disto X2 with hand sketching (Figure 31). Timed biological surveys were completed during excavation, and glue traps were left for passive sampling. Timed surveys were conducted again on 10 and 15 February 2022. A variety of cave adapted fauna was observed (Table 10). No further excavation is necessary to reach sampleable habitat. Karst fauna surveys are recommended to continue.

Table 10. Feature SW-16 assessment.

Assessment date	Dimensions meters (feet)			Airflow	Sediment	Fauna Observed/ Comments
	X	Y	Z			
8, 10, and 15 February 2022	1.0 (3.2)	1.5 (4.9)	6 (20)	N	modern, dark, fine-grained soil, rocks, roots	Annelidae (segmented worm); Collembola (springtail); <i>Armadillidae</i> (isopod); Araneae (surface spider); Blattaria (roach); Diplopoda (millipede); Lithobiomorpha (centipede); Reduviidae (assassin bug); <i>Solenopsis invicta</i> (RIFA); <i>Ceuthophilus secretus</i> ; <i>Ceuthophilus cunicularis</i> ; <i>Ceuthophilus</i> sp. nymphs (cave cricket); Lepidoptera (moth); <i>Mus musculus</i> (mouse)



Figure 25. Entrance of feature SW-16 before excavation in 2022.



Figure 26. Entrance to feature SW-16 after excavation in 2022.

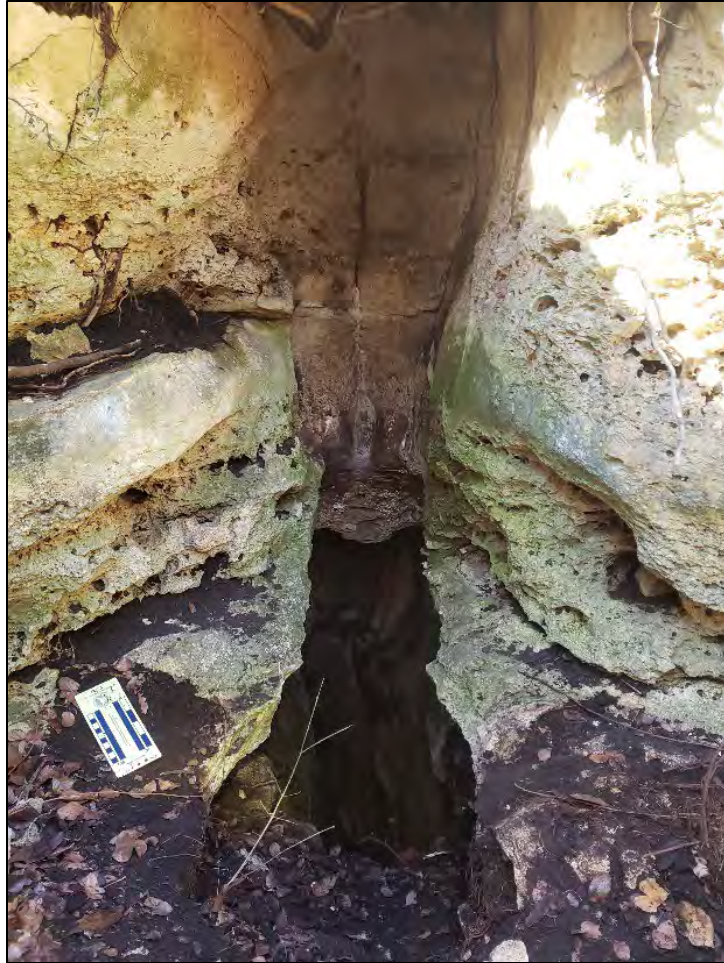


Figure 27. Looking into the "keyhole" above the pit.



Figure 28. Floor of feature SW-16 after excavation in 2022.

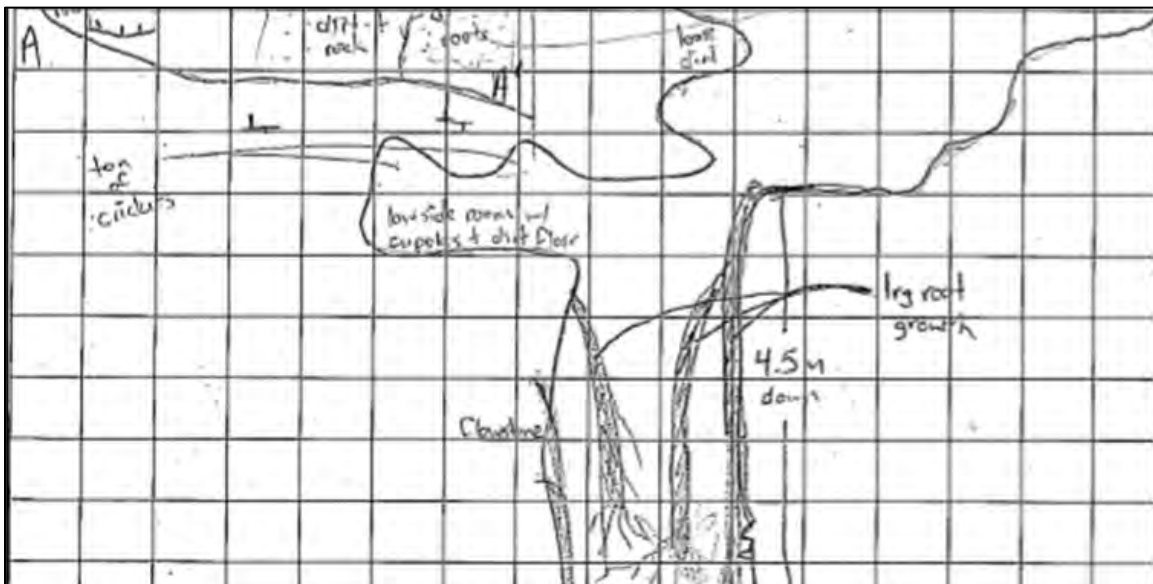


Figure 29. Field sketch of feature SW-16 after excavation in 2017.

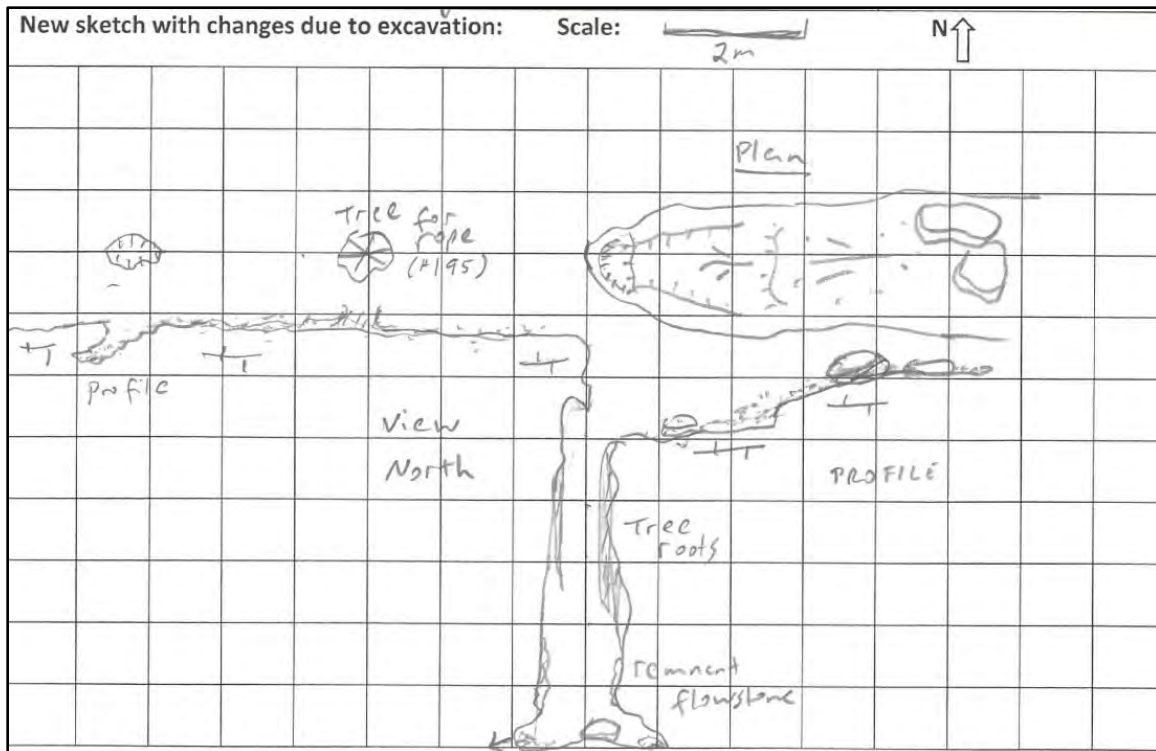


Figure 30. Field sketch of feature SW-16 after excavation in 2022.

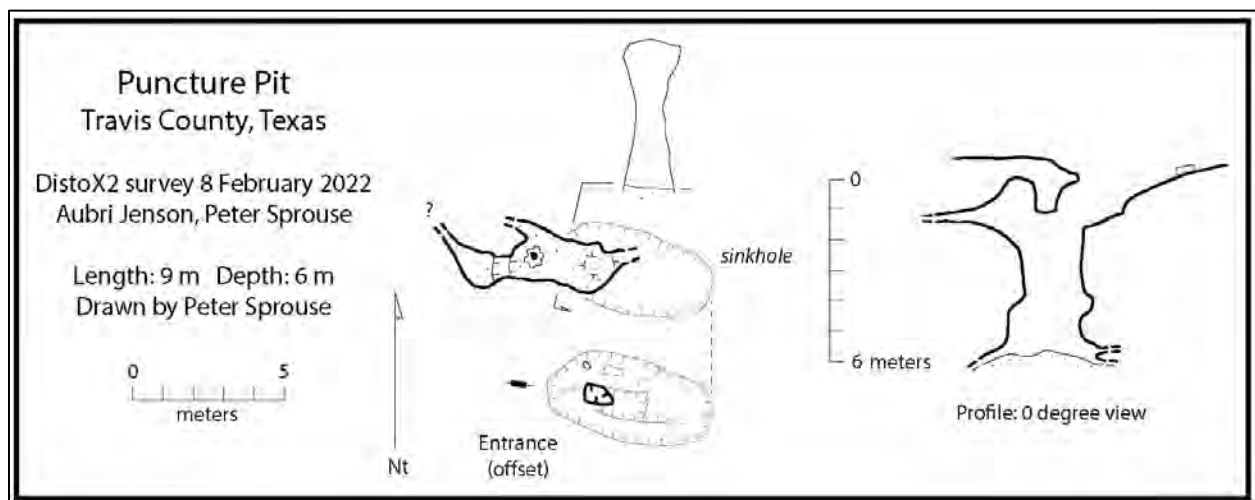


Figure 31. Map of SW-16 (Puncture Pit).

Feature SW-17; Solution Cavity

Feature SW-17 is a solution cavity located in the eastern area of the Scott & White panhandle and near feature SW-18, a large sinkhole (Table 11; Figure 32 – Figure 37). This feature was originally described in 2017 as a solution-formed sinkhole that measured 2.5 m long by 0.75 m wide by 3 m deep, and was guided by a fracture with a bearing of 236°. The feature was hand excavated in September 2017, and revealed downward trending mesocaverns, but excavation ceased due to time constraints. Prior to excavation, the substrate consisted of loose modern soil, leaf litter, roots, and rocks. Feature SW-17 met the initial criteria for potential habitat due to the presence of cave-adapted species, evidence of nutrient and water flow into the feature, development along a fracture, a depth of greater than 1 m, and its enterable size (Table 3).

Excavation resumed in September 2022, removing approximately 1.6 m³ of loose soil, roots, and rocks with hand tools during 9.3 person-hours of effort. Excavation was considered complete when bedrock walls were exposed in the lower room and only a small drain continued into bedrock. Cave-adapted fauna was observed during excavation and detected by passive sampling with glue traps (Table 11). Karst fauna surveys are recommended to continue.

Table 11. Feature SW 17 assessment.

Assessment date	Dimensions meters (feet)			Airflow	Sediment	Fauna Observed/ Comments
	X	Y	Z			
13 September 2022	2.5 (8.2)	0.75 (2.5)	4.3 (14.0)	N	Modern, dark, fine-grained soil, leaf litter, and rocks	Annelida (segmented worm); <i>Armadillidae</i> (isopod); <i>Collembola</i> (springtail); Symphylan (garden centipede); <i>Geophilidae</i> (soil centipede); Aranea (surface spider); <i>Solenopsis invicta</i> (RIFA); Coleoptera (beetle, larval); <i>Ceuthophilus secretus</i> (cave crickets); <i>Eleutherodactylus marnocki</i> (cliff chirping frog);



Figure 32. Overgrown entrance to feature SW-17 prior to excavation.



Figure 33. Entrance of feature SW-17 after excavation.



Figure 34. Bedrock floor exposed in feature SW-17 after excavation.

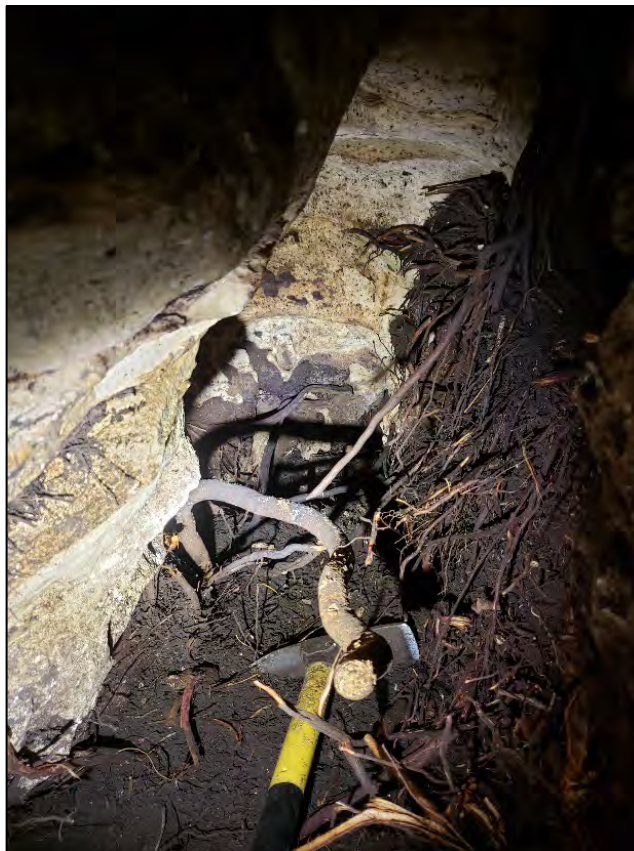


Figure 35. A small drain continues downward in feature SW-17.

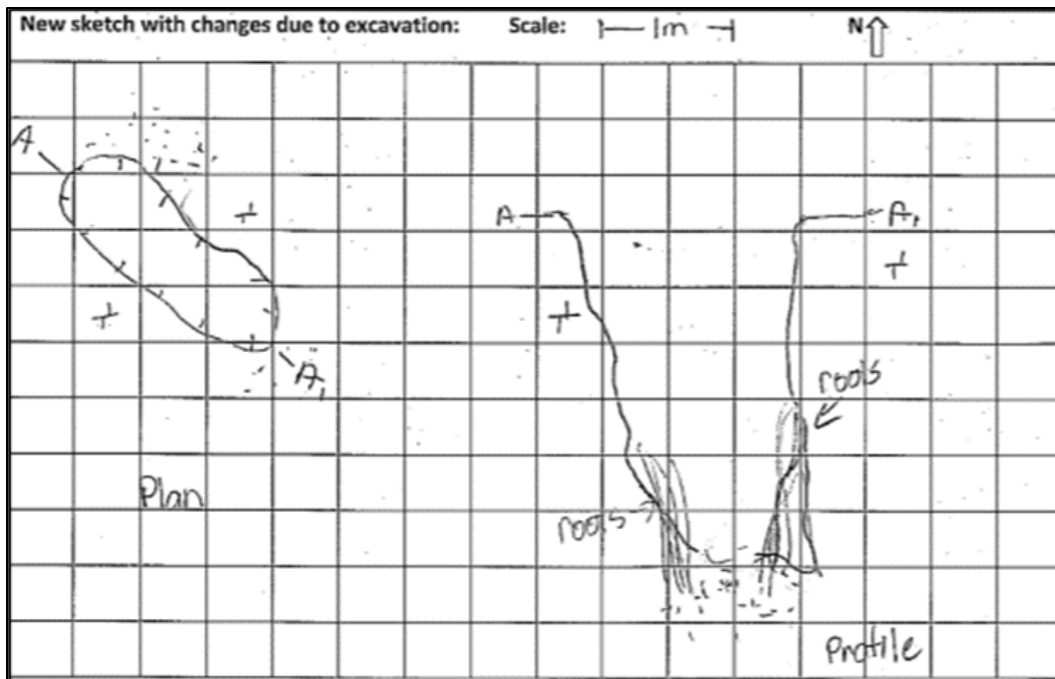


Figure 36. Field sketch of feature SW-17 after excavation in 2017.

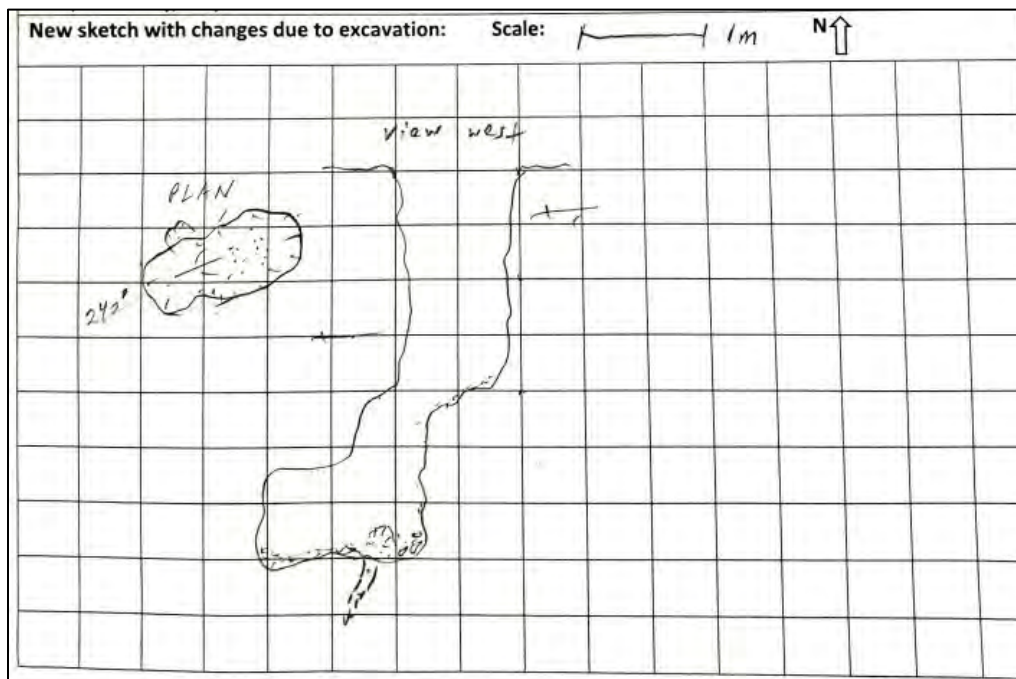


Figure 37. Field sketch of feature SW-17 after excavation in 2022.

Feature SW-18; Sinkhole

SW-18 is a large collapse-related sinkhole located in in the southeast area of the Scott & White Tract panhandle near SW-17 (Table 12; Figure 38 – Figure 41). This feature was originally described in 2017 as a sinkhole that measured 10 m wide by 8 m long by 4 m deep. Substrate consisted of very loose modern soil, leaf litter, vegetation, and rocks. The feature met the initial criteria for karst invertebrate habitat due to the presence of modern soil and leaf litter and formation by collapse (Table 3). SW-18 was recommended for excavation in 2017.

On 13 September 2022, excavation began with hand tools, a hammer drill, and bull pins to remove three large boulders and an estimated 1.8 m³ of soil and rocks during 9.3 person-hours of effort. Excavation ended when it became clear that an extensive effort would be required to reach potential karst habitat. Downward trending voids were visible but appeared to be created by spaces between breakdown boulders. Cave-adapted fauna was observed during excavation (Table 11). Additional excavation is recommended; however, this feature remains a low priority due to the amount of effort required for completion. Karst fauna surveys are not recommended at this time.

Table 12. Feature SW 18 assessment.

Assessment date	Dimensions meters (feet)			Airflow	Sediment	Fauna Observed/ Comments
	X	Y	Z			
13 September 2022	10 (8.2)	8 (2.5)	5 (16)	N	Loose, modern, dark, fine-grained soil, leaf litter, rocks, breakdown, and boulders	<i>Leiobunum townsendii</i> (harvestman); <i>Armadillidae</i> (isopod); Annelida (segmented worm); <i>Geophilidae</i> (soil centipede)



Figure 38. Feature SW-18 prior to excavation.



Figure 39. Feature SW-18 after excavation.

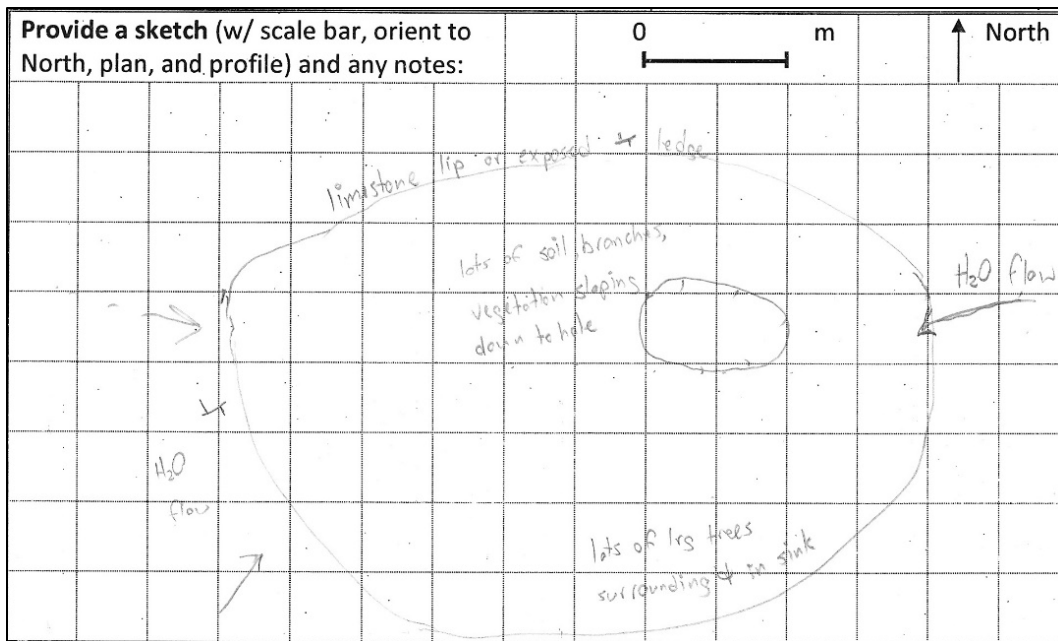


Figure 40. Field sketch of feature SW-18 in plan view from 2017.

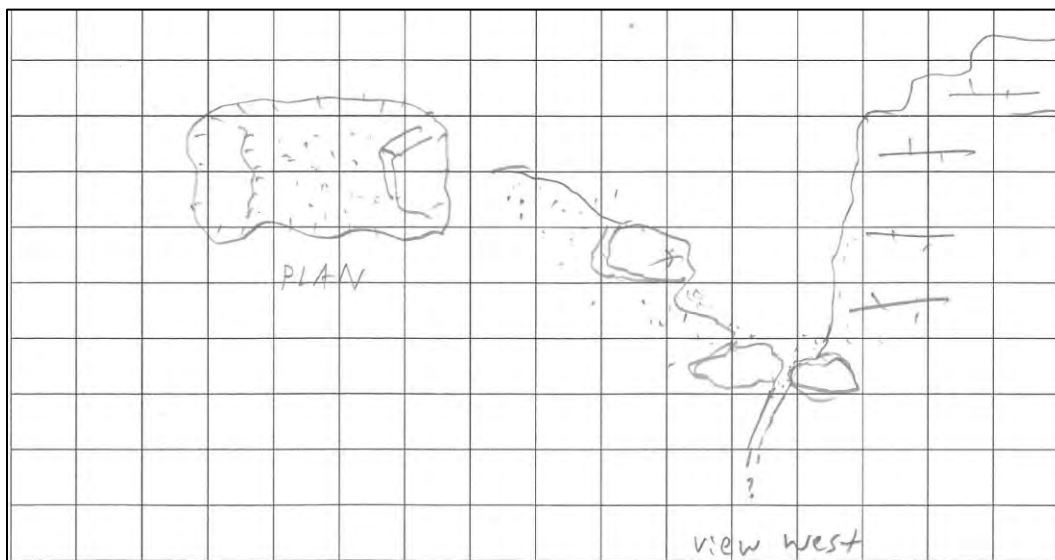


Figure 41. Field sketch of feature SW-18 after excavation.

Feature SW-21 (Travis Pit); Solution cavity

SW-21 is a solution cavity located in the north-central portion of the Scott & White Tract (Table 13; Figure 42 – Figure 46). This feature was flagged by the County for evaluation in 2022. Prior to excavation, SW-21 had an approximately circular entrance with a diameter of 0.7 m and a maximum depth of 3.2 m. Substrate consisted of very loose modern soil, leaf litter, vegetation, and rocks. This feature met the initial criteria for karst invertebrate habitat due to the presence of loose, modern soil, its depth of greater than 1 m, and the enterable size of the feature (Table 3). The feature was first excavated with hand tools on 27 January 2022, removing an estimated 0.73 m³ of soil and rock during 3.5 person-hours of effort. Mesocavernous voids were uncovered and appeared to continue downward along an east-west trend, but excavation was stopped due to time constraints. Excavation by hand resumed on 22 September 2022, removing another 0.5 m³ of soil and rock, and one large boulder. Cave-adapted fauna was observed during each excavation (Table 11). Excavation is recommended as a medium priority due to its apparent continuation and ease of digging, despite its relatively small size. Karst fauna surveys are not recommended until more sampleable habitat is encountered.

Table 13. Feature SW 21 assessment after excavation.

Assessment date	Dimensions meters (feet)			Airflow	Sediment	Fauna Observed/ Comments
	X	Y	Z			
27 January 2022	0.7 (2.3)	0.7 (2.3)	4 (13.1)	N	Loose, modern, dark, fine-grained soil, leaf litter, rocks	<i>helicodiscus</i> (snail); <i>Collembola</i> (springtail); Armadillidae (isopod); <i>analidae</i> (segmented worms); <i>Cicurina</i> sp. (cave meshweaver spider); <i>Eidmanella</i> (spider); Coleoptera (surface beetles); <i>Ceuthophilus secretus</i> , (cave cricket); <i>Plethodon albagula</i> (salamander); <i>Microhylidae</i> (narrow mouth frog); <i>Lithobates</i> (leopard frog)



Figure 42. Entrance of feature SW-21 at evaluation.



Figure 43. Bottom of feature SW-21 prior to excavation.



Figure 44. Interior of feature SW-21 near the end of excavation efforts.

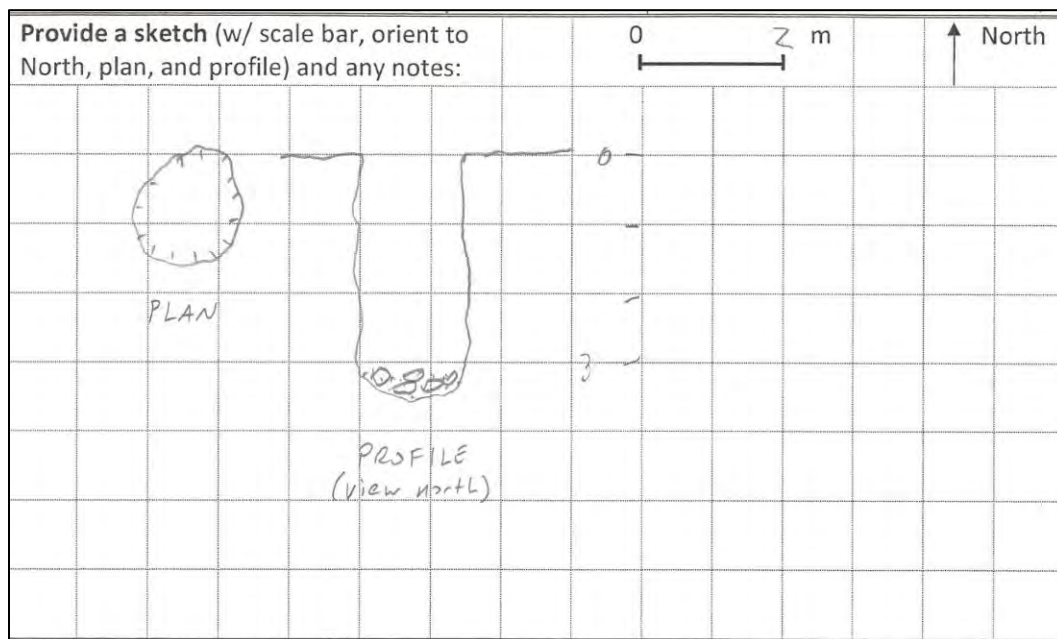


Figure 45. Field sketch of feature SW-21 prior to excavation.

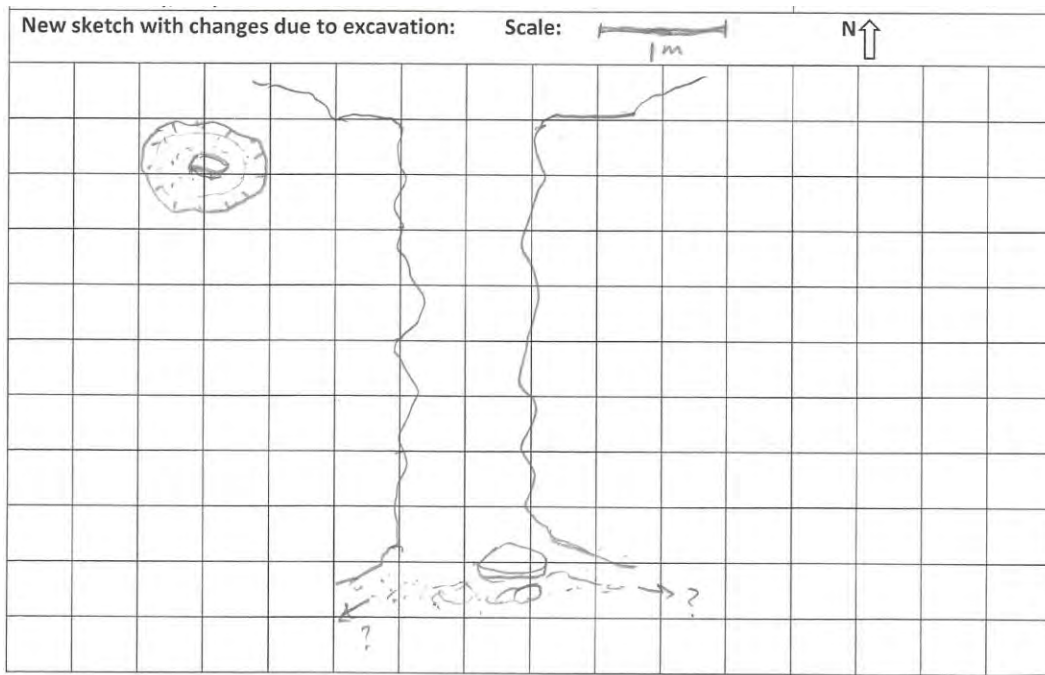


Figure 46. Field sketch of feature SW-21 after excavation

Feature SW-22 (Cedar Fever Cave); Cave

Feature SW-22 (Cedar Fever Cave), is located in the north-central portion of the Scott & White Tract, within 20 m of SW-21 (Table 14; Figure 47 – Figure 51). The feature was discovered through visual review of a LiDAR-derived hillshade map. The entrance dimensions were estimated to be 1.8 m wide by 2.5 m long, and the entrance drop was measured at 4 m deep. A fracture was exposed in the entrance pit walls with a trend of 80°. The cave had a second level dropping another 3 m and a room intersecting a low bedding plane. No airflow was noted. The feature met initial criteria as potential karst habitat due to its enterable size, development along a fracture, depth greater than one meter, presence of nutrient-rich soil and leaf litter, and similarity to nearby caves known to contain karst fauna. Excavation was not necessary to reach suitable karst habitat. The cave was mapped on 10 February 2022 using a DistoX2 and hand sketch (Figure 51). Timed biological surveys were conducted on 27 January and 22 September 2022. A wide variety of cave adapted fauna was observed in Cedar Fever Cave (Table 14). Karst fauna surveys are recommended to continue.

Table 14. Feature SW-21 (Cedar Fever Cave) assessment.

Assessment date	Dimensions meters (feet)			Airflow	Sediment	Fauna Observed/ Comments
	X	Y	Z			
6 January 2022, 22 September 2022	1.8 (5.9)	2.5 (8.2)	7 (23)	N	modern, dark, fine- grained soil, leaf litter, and rocks	<i>Helicodiscus</i> (snail); <i>Leiobunum townsendii</i> (harvestman); Acari (tick); <i>Porcellio</i> (isopod); <i>Armadillidae</i> (isopod); Aranea (surface spider); Annalida (segmented worm); Cicadellidae (leaf hopper); Blattaria (wood roach); Collembola (springtail); Scolopendra hero (Texas redheaded centipede); <i>Agynetta sp.</i> (spider); <i>Eidmanella sp.</i> (spider); <i>Leptonetid</i> (spider); Cicurina varians (cave meshweaver spider); <i>Staphylinidae</i> (rove beetle); <i>Ceuthophilus cunicularis</i> and <i>C.</i> <i>secretus</i> (cave crickets); Plethodon albagula (salamander); <i>Eleutherodactylus marnocki</i> (cliff chirping frog); <i>Lithobates</i> (Leopard frog)



Figure 47. Entrance of feature SW-22.



Figure 48. Opening to lower level of feature SW-22.

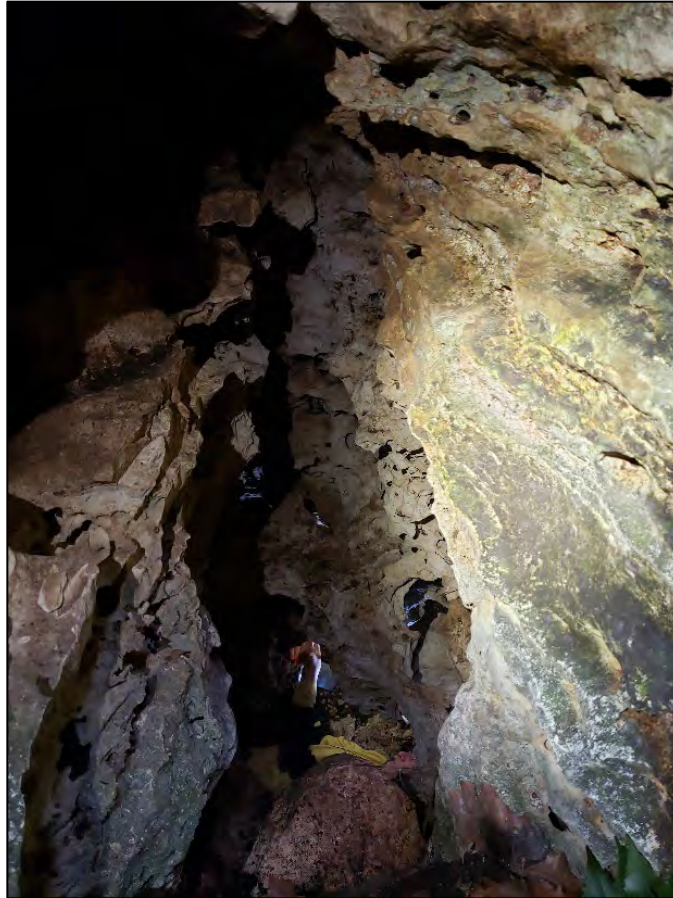


Figure 49. Interior of feature SW-22.

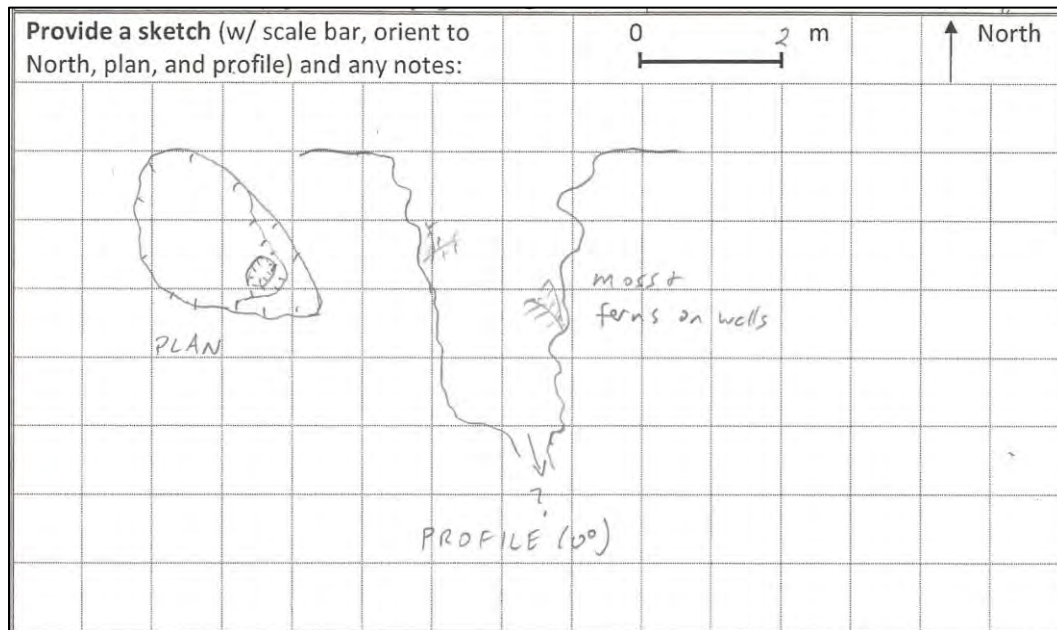


Figure 50. Field sketch of feature SW-22 at evaluation.

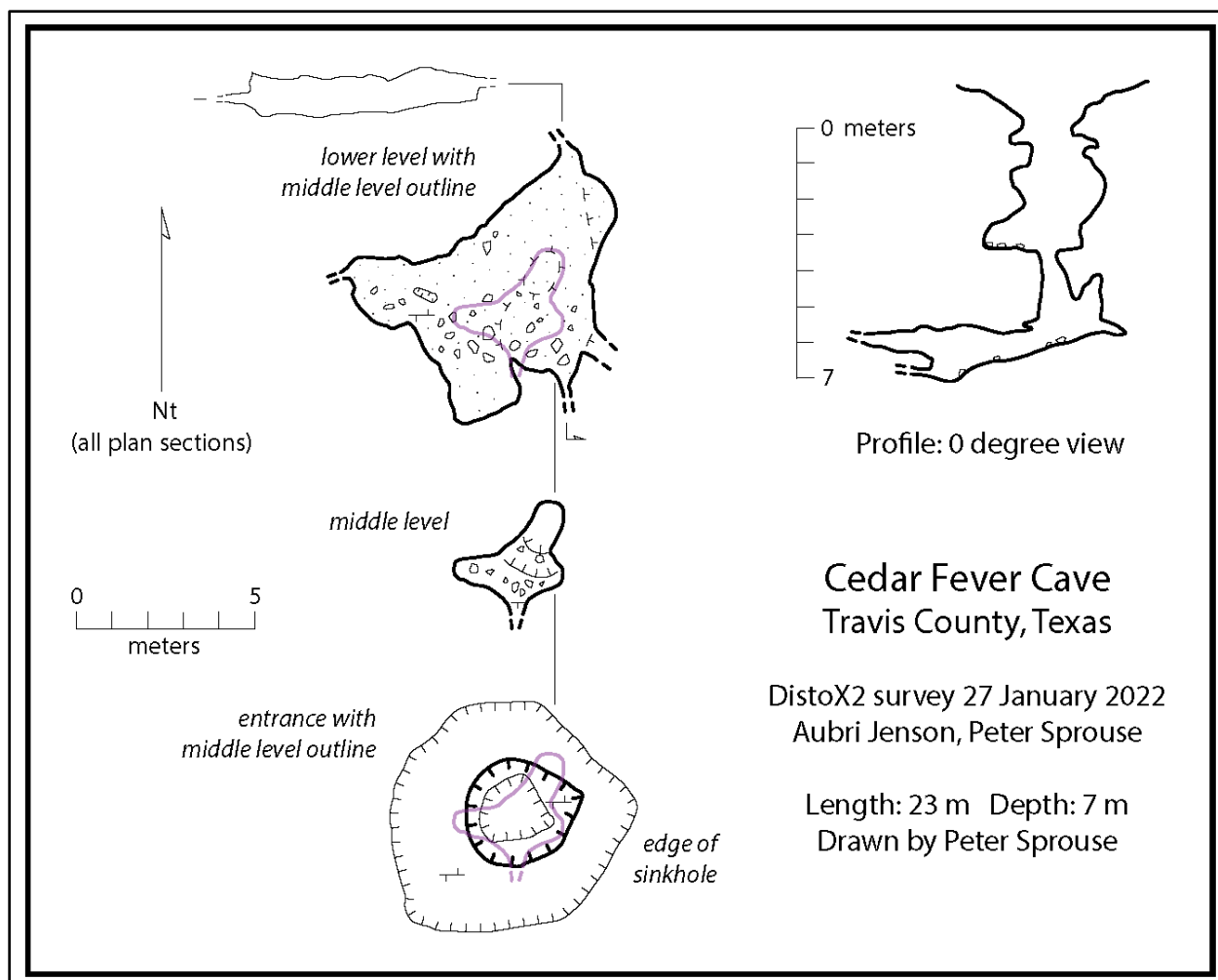


Figure 51. Map of feature SW-22 (Cedar Fever Cave).

Feature SW-23; Enlarged Fracture

SW-23 is an enlarged fracture located in the northern panhandle of the Scott & White Tract (Table 15; Figure 52 – Figure 55). The feature was discovered through visual review of a LiDAR-derived hillshade map. Prior to excavation, SW-23 consisted of two intersecting fractures at trends of 80° and 160°, with overall dimensions of 0.8 m long, 0.5 m wide, and 0.4 m deep. Substrate consisted of very loose modern soil, leaf litter, vegetation, and rocks. This feature met the initial criteria for karst invertebrate habitat due to the presence of nutrient-rich soils and leaf litter, and development along a fracture (Table 3). The feature was excavated with hand tools and a hammer drill on 1 February 2022, removing an estimated 1.0 m³ of soil and rock during 8.25 person-hours of effort. Excavation stopped when sampleable habitat was reached. Cave-adapted fauna was observed during excavation and glue traps were left for passive collection (Table 11). Additional excavation could be done but remains a low priority due to the small size of the feature and lack of downward trending voids. Karst fauna surveys are not recommended until more sampleable habitat is encountered.

Table 15. Feature SW-23 assessment after excavation.

Assessment date	Dimensions meters (feet)			Airflow	Sediment	Fauna Observed/ Comments
	X	Y	Z			
6 January 2022, 1 February 2022	1.0 (3.3)	1.5 (4.9)	1.0 (3.3)	N	Loose, modern, dark, fine-grained soil, leaf litter, rocks	Symphylan (garden centipede); <i>Geophylomorpha</i> (soil centipede); Diplopoda (millipede); <i>Ceuthophilus secretus</i> , (cave cricket);



Figure 52. Feature SW-23 prior to excavation.



Figure 53. Feature SW-23 after excavation.

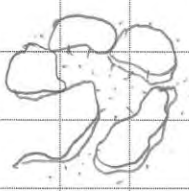
Void size (m): width: 0.5 length: 0.8 height: 0.4				Floor Depth Below Surface (m):			
Provide a sketch (w/ scale bar, orient to North, plan, and profile) and any notes:				0 1 m		 North	
							
PLAN				PROFILE (north)			

Figure 54. Field sketch of feature SW-23 prior to excavation.

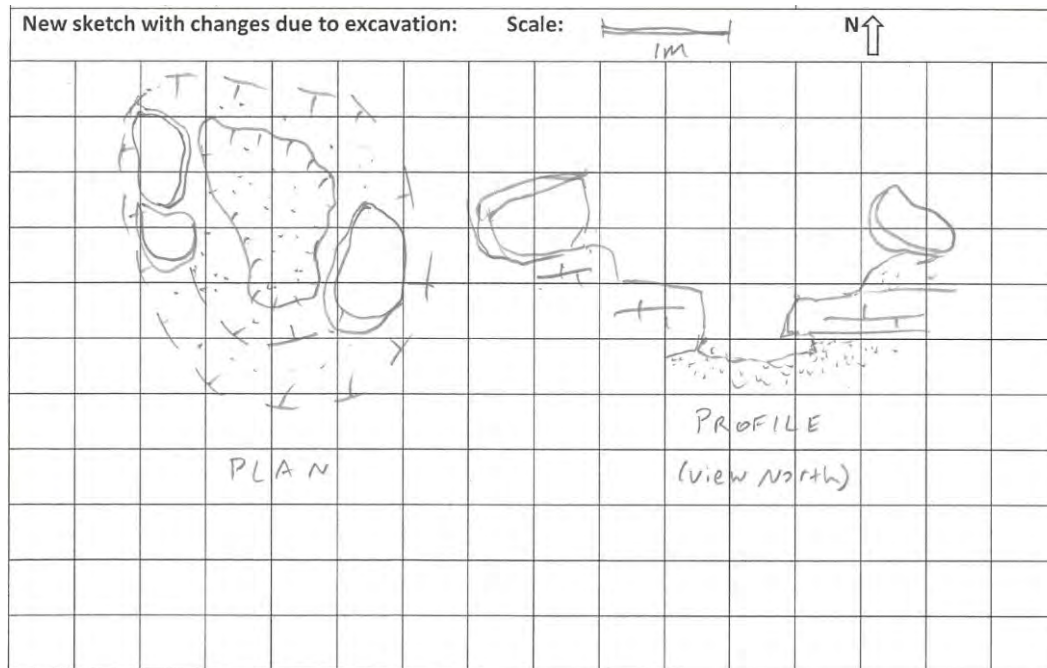


Figure 55. Field sketch of feature SW-23 after excavation

Feature SW-24 (Natural Intelligence Cave); Cave

Feature SW-24 (Natural Intelligence Cave), is located in the northern panhandle of the Scott & White Tract, approximately 40 m southwest of SW-23 (Table 16; Figure 56 – Figure 61). The feature was discovered through visual review of a LiDAR-derived hillshade map. The feature was situated in a sinkhole approximately 4 m in diameter. The original entrance was 0.4 m in diameter, restricting entry to a pit 4.9 m deep. No airflow was noted. The feature met initial criteria as potential karst habitat due to its depth greater than one meter, presence of nutrient-rich soil and leaf litter, and similarity to nearby caves known to contain karst fauna. The feature was excavated with hand tools and a hammer drill on 1 February 2022, removing an estimated 0.45 m³ of rock around the entrance and 0.51 m³ from the pit floor during 10.5 person-hours of effort. Excavation stopped when a compact red clay floor was encountered. The cave was mapped on 1 February 2022 using a DistoX2 and hand sketch (Figure 61). Cave-adapted fauna was observed during excavation. Additional excavation is not recommended due to the lack of downward trending voids and compact clay. Karst fauna surveys are recommended to continue.

Table 16. Feature SW-24 (Natural Intelligence Cave) assessment after excavation.

Assessment date	Dimensions meters (feet)			Airflow	Sediment	Fauna Observed/ Comments
	X	Y	Z			
6 January 2022, 1 February 2022	1.0 (3.3)	1.0 (3.3)	5.3 (17.4)	N	modern, dark, fine-grained soil, leaf litter, red clay, and rocks	Aranea (surface spider); Annalida (segmented worm); Collembola (springtail); <i>Staphylinidae</i> (rove beetle);



Figure 56. Feature SW-24 prior to excavation.



Figure 57. Feature SW-24 after excavation.



Figure 58. Red clay was encountered in the floor of SW-24.

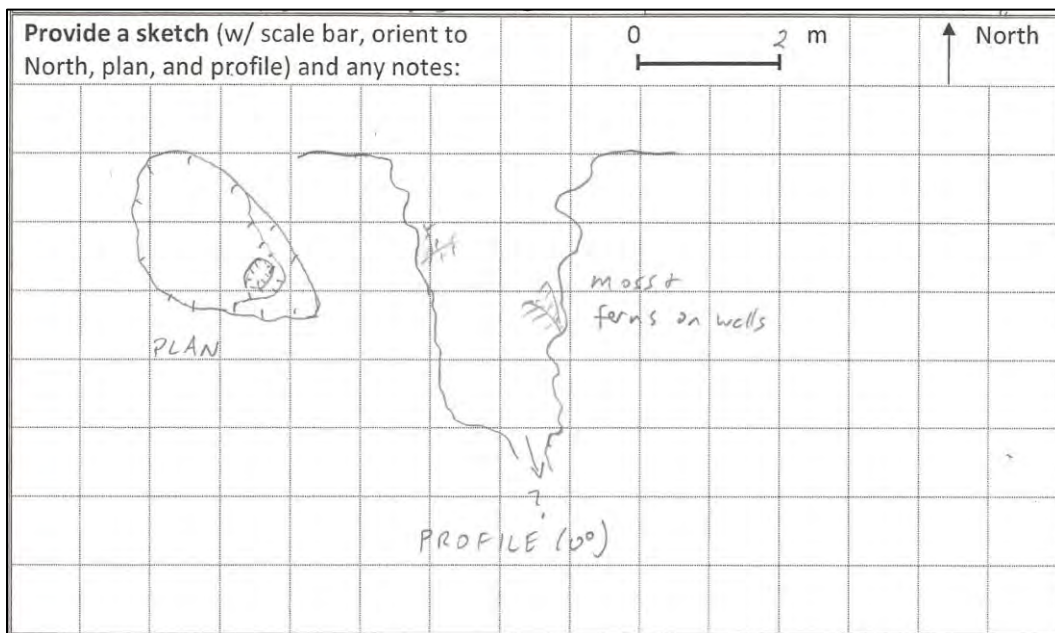


Figure 59. Field sketch of feature SW-24 prior to excavation.

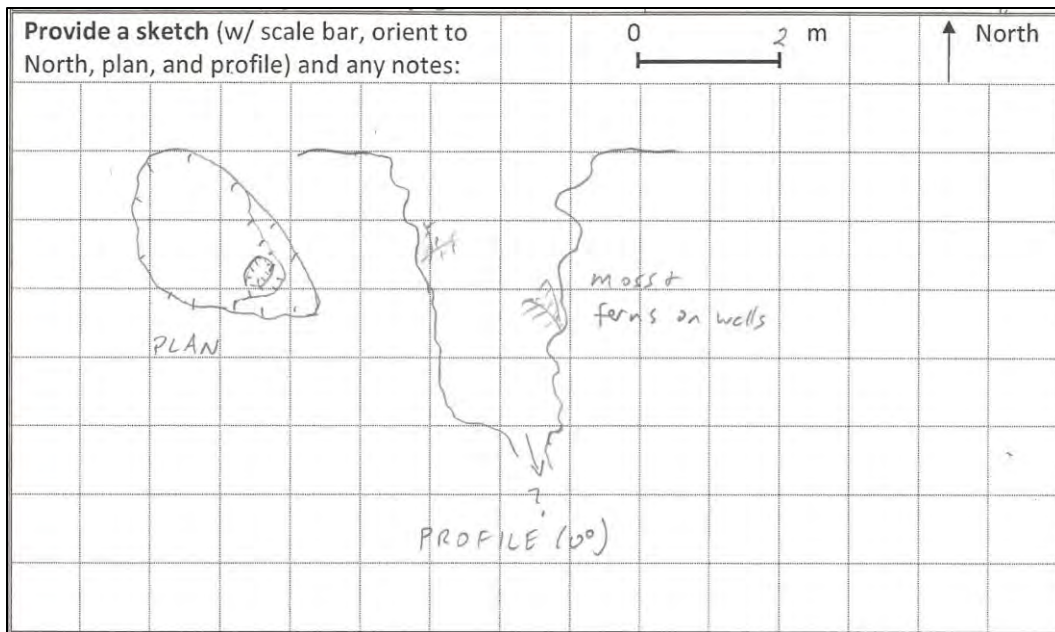


Figure 60. Field sketch of feature SW-24 after excavation.

Natural Intelligence Cave Travis County, Texas

DistoX2 survey 1 February 2022
Aubri Jenson, Peter Sprouse

Length: 5 m Depth: 5 m
Drawn by Peter Sprouse

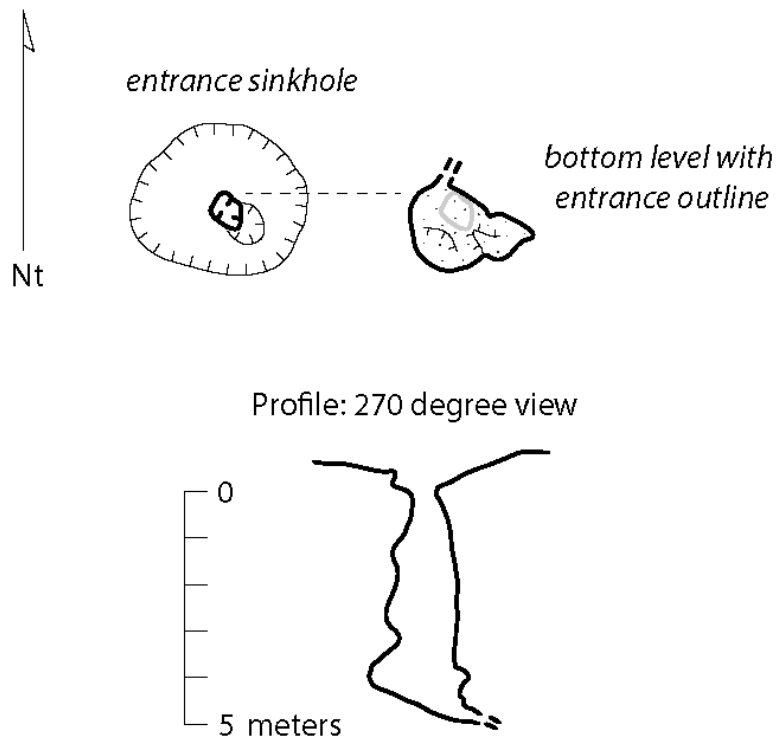


Figure 61. Map of feature SW-24 (Natural Intelligence Cave).

Feature SW-25; Sinkhole

Feature SW-25 is a sinkhole with a visible drain located in the north central area of the Scott & White Tract approximately 40 m southeast of SW-11 (Table 17; Figure 62 – Figure 64). The feature was discovered using GIS tools to identify closed depressions from a LiDAR-derived Digital Elevation Model. The sinkhole measured approximately 7 m wide, 10 m long and 0.5 m deep. On the north side of the sinkhole, a soil drain was observed that measured 0.5 m long by 0.2 m wide and 0.3 m deep. The interior substrate of the feature consisted of loose limestone fragments, modern organic soil, and leaf litter. Minor hand excavation of the soil drain revealed a compact floor. No airflow or moisture was noted. Feature SW-25 met the initial criteria for potential habitat due to the presence of nutrient-rich soil and leaf litter (Table 3). Additional excavation could be done, but since this is a small feature with thick soil cover, the priority remains low. Karst fauna surveys are not recommended at this time.

Table 17. Feature SW-25 assessment.

Assessment date	Dimensions meters (feet)			Airflow	Sediment	Fauna Observed/ Comments
	X	Y	Z			
6 January 2022	7 (22.9)	10 (32.8)	0.5 (1.6)	N	modern, dark, fine-grained soil, leaf litter, and rocks	None observed



Figure 62. A soil drain was situated in feature SW-25.



Figure 63. Interior of feature SW-25.

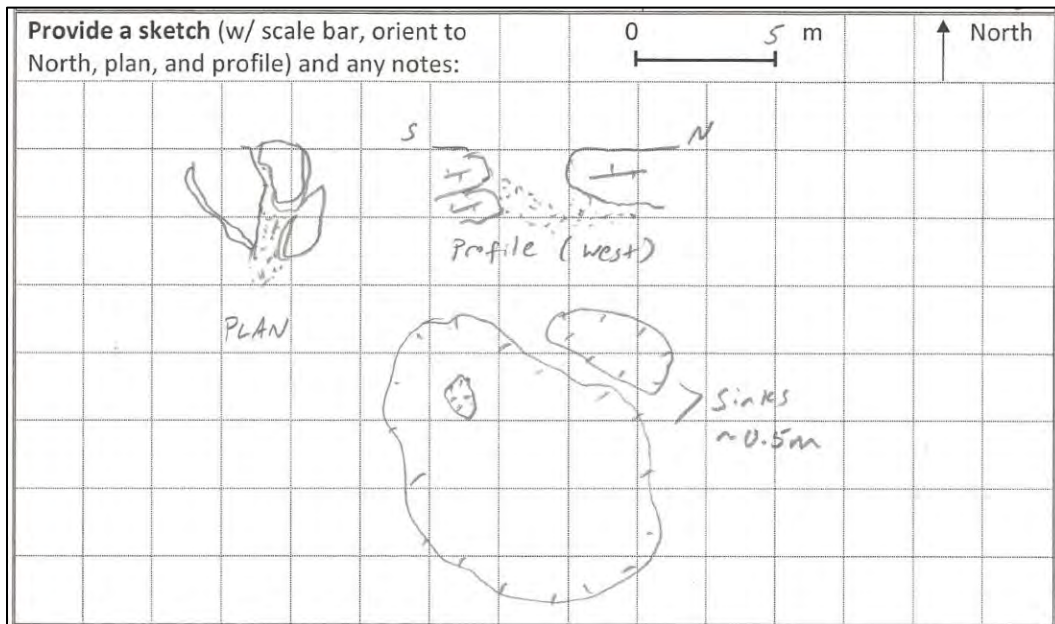


Figure 64. Field sketch of feature SW-25.

Feature SW-26; Enlarged Fracture

Feature SW-26 is a solution-enlarged fracture located in the north central area of the Scott & White unit (Table 18; Figure 65 – Figure 67). The feature was discovered using GIS tools to identify closed depressions from a LiDAR-derived Digital Elevation Model. The feature was developed along a fracture with a bearing of 30° and measured 0.7 m long by 0.2 m wide and 0.3 m deep. The interior substrate of the feature consisted of loose limestone fragments, modern organic soil, and leaf litter. Minor hand excavation revealed a soil floor. No airflow or moisture was noted. Feature SW-25 met the initial criteria for potential habitat due to the presence of nutrient-rich soil and leaf litter and development along a fracture (Table 3). Additional excavation could be done, but since this is a small feature with thick soil cover, the priority remains low. Karst fauna surveys are not recommended at this time.

Table 18. Feature SW-26 assessment.

Assessment date	Dimensions meters (feet)			Airflow	Sediment	Fauna Observed/ Comments
	X	Y	Z			
6 January 2022	0.2 (0.7)	0.7 (2.6)	0.3 (1.0)	N	modern, dark, fine-grained soil, leaf litter, and rocks	None observed



Figure 65. Overview of feature SW-26.



Figure 66. The floor of feature SW-26 contained loose soil and leaf litter.

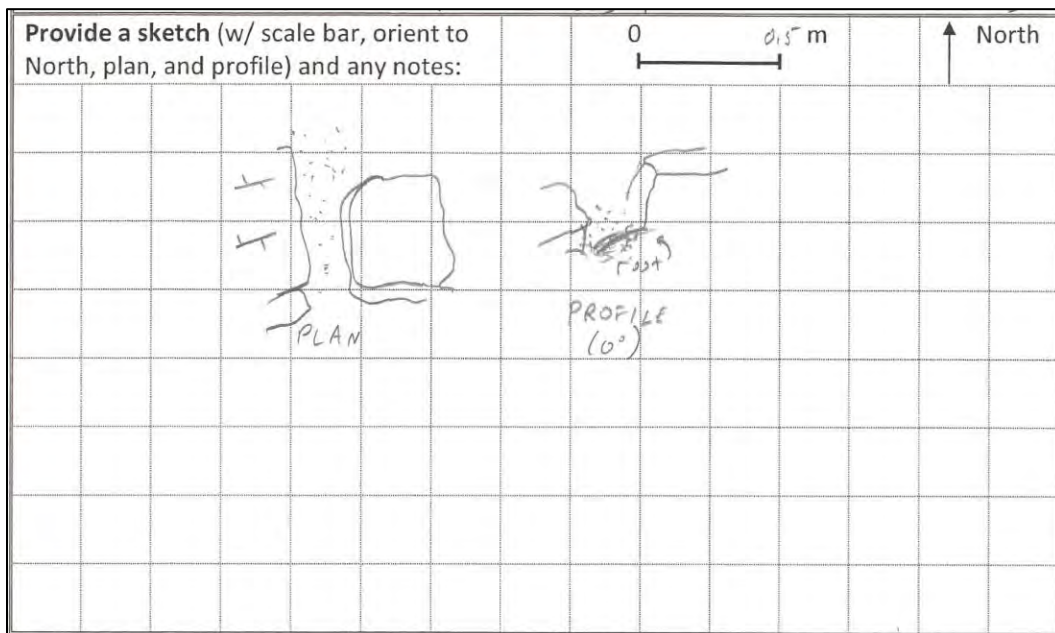


Figure 67. Field sketch of feature SW-26.

Feature SW-27 (Artificial Intelligence Cave); Cave

Feature SW-27 (Artificial Intelligence Cave) is located in the north-central portion of the Scott & White unit, approximately 40 m south of SW-26 (Table 19; Figure 68 – Figure 73). The feature was discovered using GIS tools to identify closed depressions from a LiDAR-derived Digital Elevation Model. The cave was situated in a sinkhole approximately 15 m long by 9 m wide. The cave entrance was approximately 2 m wide by 3.5 m long, and the maximum cave depth was 6 m. The entrance was developed along a fracture oriented near 0°, and the overall trend of the cave is NE-SW. No airflow was noted. The feature met initial criteria as potential karst habitat due to its enterable size, development along a fracture, depth greater than one meter, presence of nutrient-rich soil and leaf litter, and similarity to nearby caves known to contain karst fauna. Excavation was not necessary to reach suitable karst habitat. The cave was mapped on 15 February 2022 using a DistoX2 and hand sketch (Figure 73). Timed biological surveys were conducted on 15 February and 22 September 2022. A wide variety of cave adapted fauna was observed in Artificial Intelligence Cave, and it appeared to have frequent mammal use. Of note, a pseudoscorpion and a mold beetle were collected on 22 September 2022 for taxonomic identification. Karst fauna surveys are recommended to continue.

Table 19. Feature SW-27 (Artificial Intelligence Cave) assessment.

Assessment date	Dimensions meters (feet)			Airflow	Sediment	Fauna Observed/ Comments
	X	Y	Z			
6 January 2022, 15 February 2022, 15 September 2022	2.0 (6.5)	3.5 (11.5)	6.0 (19.7)	N	modern, dark, fine-grained soil, leaf litter, and rocks	<i>Helicodiscus</i> (snail); <i>Leiobunum townsendii</i> (harvestman); Dipluran (pronged bristle tail); Acari (tick); Psuedoscorpion (no common name); <i>Armadillidae</i> (isopod); Collembola (springtail); Speodesmus (milipede); <i>Eidmanella</i> sp. (spider); <i>Leptonetid</i> (spider); Cicurina varians (cave meshweaver spider); <i>Batrisodes</i> sp. (mold beetle); <i>Staphylinidae</i> (rove beetle); Tenebrionidae (darkling beetle); Scarabaeidae (dung beetle); <i>Solenopsis invicta</i> (RIFA); <i>Ceuthophilus cunicularis</i> and <i>C.</i> <i>secretus</i> (cave crickets); Tineidae (fungus moth); <i>Plethodon albagula</i> (salamander)



Figure 68. Entrance of feature SW-27.



Figure 69. Opening to lower level of feature SW-27.



Figure 70. Interior of feature SW-27.



Figure 71. *Plethodon albagula* observed in feature SW-27.

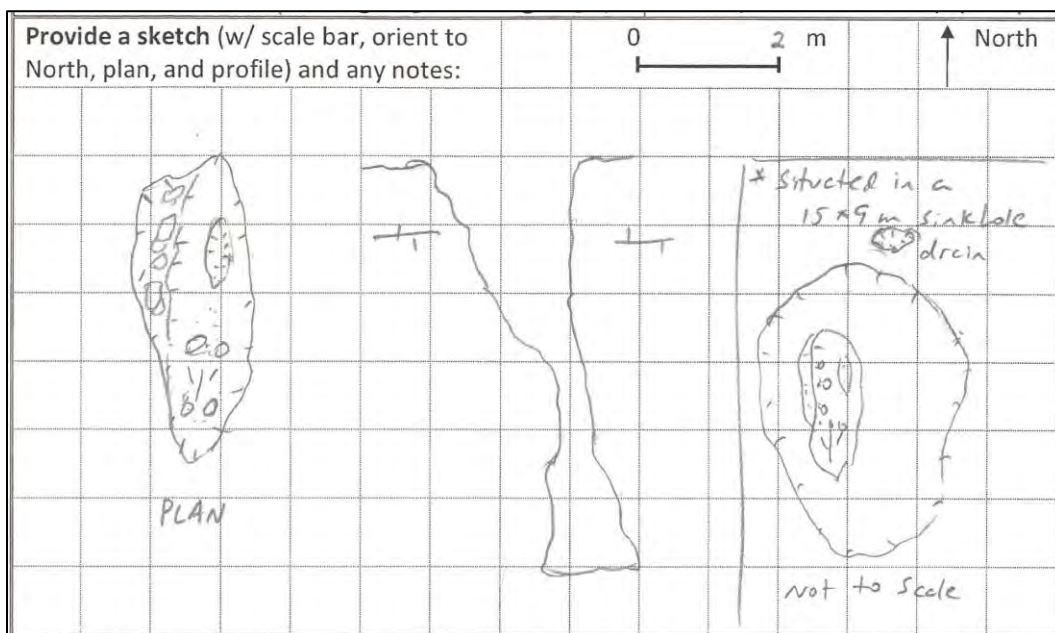


Figure 72. Field sketch of feature SW-27.

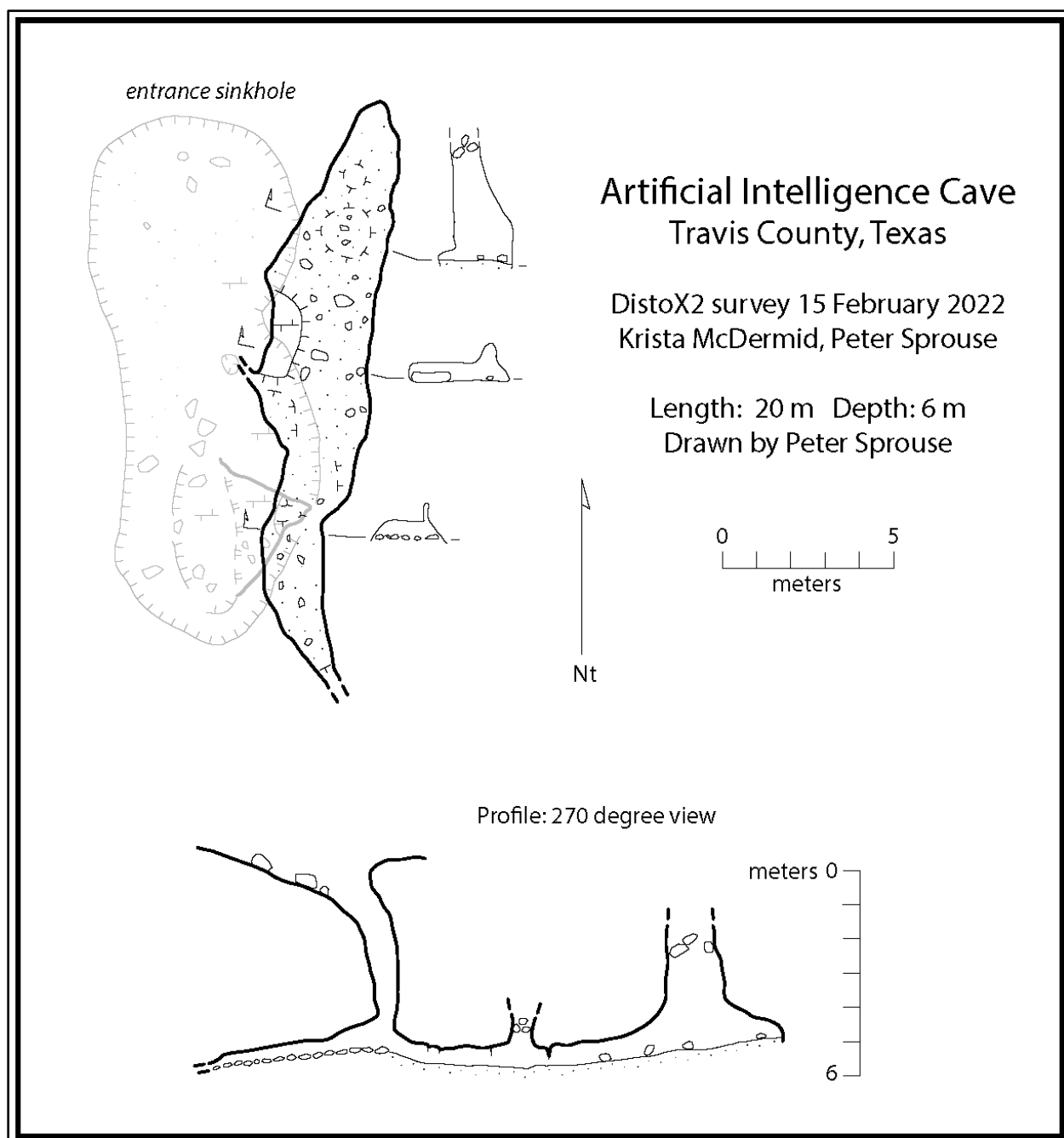


Figure 73. Map of feature SW-27 (Artificial Intelligence Cave).

Feature SW-28; Sinkhole

Feature SW-28 is a sinkhole located in the northwestern area of the Scott & White unit (Table 20; Figure 74 – Figure 75). The feature was discovered using GIS tools to identify closed depressions from a LiDAR-derived Digital Elevation Model. The sinkhole was approximately 2 m in diameter and 0.5 m deep. No soil drains or downward trending voids were visible. The interior substrate of the feature consisted of loose limestone fragments, modern organic soil, and leaf litter. Minor hand excavation revealed a soil floor. Feature SW-28 met the initial criteria for potential habitat due to the presence of nutrient-rich soil and leaf litter (Table 3). Excavation could be done but remains a low priority due to thick soil cover and the lack of downward trending voids. Karst fauna surveys are not recommended until suitable habitat is accessible.

Table 20. Feature SW-28 assessment.

Assessment date	Dimensions meters (feet)			Airflow	Sediment	Fauna Observed/ Comments
	X	Y	Z			
6 January 2022	2.0 (6.6)	2.0 (6.6)	0.5 (1.6)	N	modern, dark, fine-grained soil, leaf litter, and rocks	None observed



Figure 74. Overview of feature SW-28.

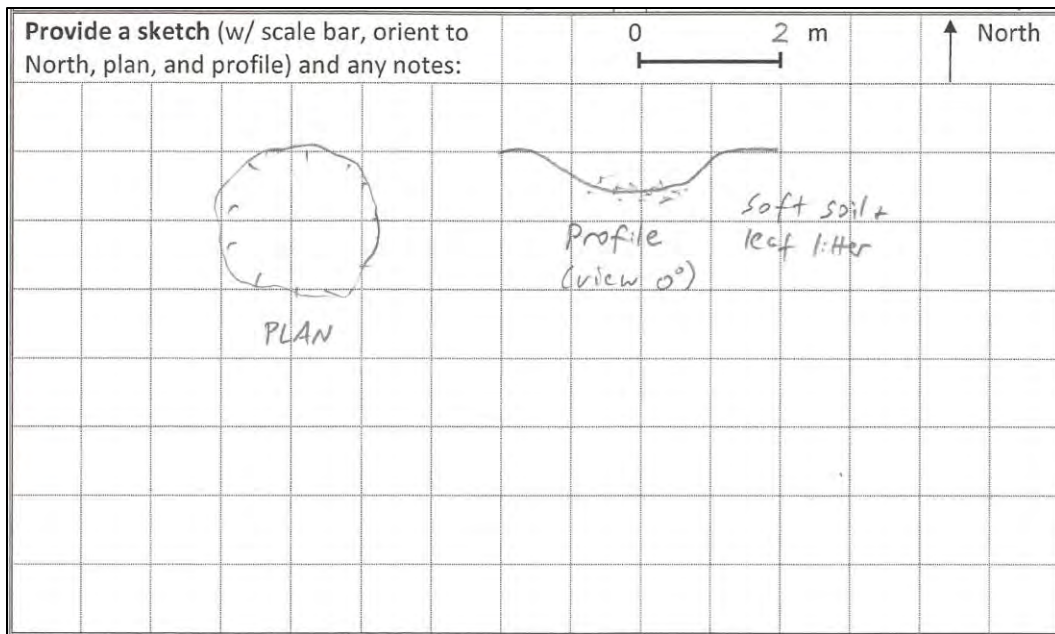


Figure 75. Field sketch of feature SW-28.

Recommendations

Eight previously recorded karst features and nine previously undiscovered features were evaluated for potential karst invertebrate habitat during this investigation on the Kotrla Unit. All features met the initial criteria for potential karst invertebrate habitat as provided by USFWS (2015). Seven features were further evaluated for habitat during excavation activities: SW-11, SW-16 (Puncture Pit), SW-17, SW-18, SW-21 (Travis Pit), SW-23, and SW-24 (Natural Intelligence Cave). Of the excavated features, three are recommended for continued excavation: SW-18, SW-21 (Travis Pit), and SW-23. The highest priority should go to completion of excavation at SW-21 (Travis Pit), due to the ease of digging and potential to expand existing habitat. The lowest priority feature is SW-18, a collapsed sinkhole, because of the extensive effort required to remove large amounts of material. Other features of low to moderate priority for excavation include KO-4, SW-9, SW-10, SW-25, SW-26, and SW-28. These features consist of smaller, solutional sinkholes, and soil drains or fractures that are likely to require 1 to 2 days of digging to determine if they contain suitable karst habitat.

Biological surveys and/or sampling were conducted at the following nine features, often concurrent with excavation or cave mapping: SW Cave 3 (Poison Ivy Pit), SW Cave 4 (McMac Cave), SW-11, SW-16 (Puncture Pit), SW-17, SW-18, SW-21 (Travis Pit), SW-22, and SW-27 (Artificial Intelligence Cave). Of these, the most species rich features were SW Cave 4 (McMac Cave), SW-22 (Cedar Fever Cave), and SW-27 (Artificial Intelligence Cave). Black plastic should be placed over the entrance of these features to stabilize the temperature and humidity prior to future fauna surveys.

In order to establish zones for repeated sampling, cave mapping was completed at all features with a depth greater than 5 m. These include SW Cave 3 (Poison Ivy Pit), SW Cave 4 (McMac Cave), SW-16 (Puncture Pit), SW-22 (Cedar Fever Cave), SW-24 (Natural Intelligence Cave), and SW-27 (Artificial Intelligence Cave). Additional work could include hydrogeological studies, beginning with surface and subsurface basin characterization, to better delineate protection areas.

Slightly bad air was noted during excavation of SW-21 (Travis Pit) and when conducting timed biological surveys in SW Cave 3 (Poison Ivy Pit). Due to the poor quality of air in these two caves, future work in these features should be performed during cooler weather and/or using a blower to provide adequate ventilation.

A summary of the above results and recommendations is provided in Table 21. The table includes a breakdown of excavated features, whether features met the initial criteria for potential karst invertebrate habitat (USFWS 2015), recommendations for future excavation and karst fauna surveys, and other details as provided in the footnotes.

Table 21. Summary table of results and recommendations.

Feature Name	Excavated?	Fauna Surveyed?	Future Excavation Recommended? (Estimated Minimum Effort)	Future Karst Fauna Surveys Recommended at This Time?
KO-4	N	N	Y (1 to 2 days)	N
SW Cave 3 (Poison Ivy Pit)	N	Y	N	Y
SW Cave 4 (McMac Cave)	N	Y	N	Y
SW-9	N	N	Y (1 day)	N
SW-10	N	N	Y (1 day)	N
SW-11	Y	Y	N	Y
SW-16 (Puncture Pit)	Y	Y	N	Y
SW-17	Y	Y	N	Y
SW-18 ¹	Y	N	Y (1 week)	N
SW-21 (Travis Pit)	Y	Y	Y (1 day)	N
SW-22 (Cedar Fever Cave)	N	Y	N	Y
SW-23	Y	Y	Y (1 day)	N
SW-24 (Natural Intelligence Cave)	Y	Y	N	Y
SW-25 ¹	N	N	Y (1-2 days)	N
SW-26 ¹	N	N	Y (1-2 days)	N
SW-27 (Artificial Intelligence Cave)	N	Y	N	Y
SW-28 ¹	N	N	Y (1-2 days)	N
¹ Feature should be deprioritized for other features recommended for future excavation.				

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