

**Balcones Canyonlands Preserve
Karst Monitoring and Management
FY 2022 Annual Report**



New Room discovered in Lady Bird Lounge, photo by Drew Thompson

**Travis County
Department of Transportation and Natural Resources
Natural Resources and Environmental Quality Division
and
City of Austin Balcones Canyonlands Preserve – Austin Water (AW)**



October 1, 2021 – September 30, 2022

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1.0 REGIONAL PERMIT

There are six species of endangered karst invertebrates (ES; Table 1) and 25 karst species of concern (SOC; Table 2) covered by the Balcones Canyonlands Conservation Plan (BCCP), a regional 10(a)1(B) permit issued by the U.S. Fish and Wildlife Service (USFWS) to the City of Austin (COA) and Travis County (TC) in May 1996 (USFWS 1996a). If these 25 species of concern become listed as endangered in the future, no additional mitigation will be necessary to protect them, provided that all karst protection requirements outlined in the BCCP are fully implemented.

The Regional Permit requires protection of 36 endangered species caves and 26 additional caves that support SOC, for a total of 62 karst features (60 caves, one mine and one karst spring). Several of these karst features occur in clusters, identified in the Regional Permit's associated Habitat Conservation Plan/Environmental Impact Statement (HCP/EIS) as the Four Points, McNeil, and Northwood cave clusters (USFWS 1996b). As of Fiscal Year 2022 (FY22), 52 of the 62 BCCP karst features have some form of formal protection on properties owned and managed by COA, TC, and BCCP partners, Texas Cave Management Association (TCMA), as well as private mitigation lands.

Table 1. Federally Listed Karst Species Covered by the BCCP

Footnotes follow table

Common Name	Scientific Name
Tooth Cave pseudoscorpion	<i>Tartarocreagris texana</i>
Tooth Cave spider	<i>Tayshaneta myopica</i> ¹
Tooth Cave ground beetle	<i>Rhadine persephone</i>
Kretschmarr Cave mold beetle	<i>Texamaurops reddelli</i>
Bee Creek Cave harvestman	<i>Texella reddelli</i>
Bone Cave harvestman	<i>Texella reyesi</i>

¹ *Tayshaneta myopica* is listed in the regional permit as *Neoleptoneta myopica*, but a 2012 study revised the genus *Neoleptoneta*, thus identifying this species in the genus *Tayshaneta* (Campbell et al. 2012).

Table 2. Karst Species of Concern Covered by the BCCP*Footnotes follow table*

Common Name	Scientific Name
Flatworm	<i>Sphalloplana mohri</i>
Ostracod	<i>Candona</i> sp. nr. <i>stagnalis</i>
Isopod	<i>Caecidotea reddelli</i>
Isopod	<i>Trichoniscinae</i> N. S.
Isopod	<i>Miktoniscus</i> N. S.
Spider	<i>Cicurina bandida</i>
Spider	<i>Cicurina cueva</i>
Spider	<i>Cicurina ellioti</i>
Spider	<i>Cicurina reddelli</i>
Spider	<i>Cicurina reyesi</i>
Spider	<i>Cicurina trivisiae</i>
Spider	<i>Cicurina wartoni</i>
Spider	<i>Tayshaneta concinna</i> ¹
Spider	<i>Tayshaneta devia</i> ¹
Spider	<i>Eidmannella reclusa</i>
Pseudoscorpion	<i>Aphrastochthonius</i> N. S.
Pseudoscorpion	<i>Tartarocreagris comanche</i> ²
Pseudoscorpion	<i>Tartarocreagris reddelli</i>
Pseudoscorpion	<i>Tartarocreagris intermedia</i>
Pseudoscorpion	<i>Tartarocreagris</i> N. S. 3
Harvestman	<i>Texella spinoperca</i>
Millipede	<i>Speodesmus</i> N. S
Ground Beetle	<i>Rhadine s. subterranea</i>
Ground Beetle	<i>Rhadine s. mitchelli</i>
Ground Beetle	<i>Rhadine austinica</i>

¹ *Tayshaneta concinna* and *Tayshaneta devia* are listed in the regional permit with the genus *Neoleptoneta*, but a 2012 study revised the genus *Neoleptoneta*, thus identifying these species in the genus *Tayshaneta* (Campbell et al. 2012).

² *Tartarocreagris comanche* is improperly listed in the regional permit as the New Comanche Trail Cave harvestman.

2.0 CAVE MANAGEMENT SUMMARY

This annual report covers the fiscal year 10/01/21 - 9/30/22 (FY22). In FY22, the BCCP partners continued efforts to determine and track the status of the 62 karst features covered by the BCCP 10(a) permit. The permit holders continued efforts to acquire, protect, and monitor the karst species in the caves included in the Permit (see Tables 3 and 5 for species localities).

Of the 62 BCCP permit caves, a total of 24 are still in the hands of private landowners and 38 are formally protected on the BCP. Of the 24 that are privately owned, three caves (Pennie's, Pipeline, and Cave X) have protection agreements that include development setbacks from the cave entrance, and two cave entrances (Lost Oasis and Whirlpool Caves) are located on lands owned in part by Texas Cave Management Association (TCMA). As of May 4, 2021 the City of Austin BCP finalized a Cave Management Agreement with TCMA, this agreement spells out the responsibilities of both parties for managing, monitoring and protecting Lost Oasis and Whirlpool Caves. Also, in February 2020, AW BCP purchased the 5-acre lot that encompasses most of Whirlpool Cave, including the Travis County Room. TC BCP also conducts species monitoring for the privately owned Cold Cave for the Preston Oaks HOA. This brings the total to 52 caves that are afforded some level of protection or monitoring, and nine (Armadillo Ranch Cave, Bandit Cave, Bee Creek Cave, Ceiling Slot, Fossil Garden Cave, Hole-In-The-Road Cave, Jacks Joint, McNeil Bat Cave and Moss Pit) that are still unprotected, and it is unclear what management activities are conducted, if any at these nine caves. Lost Gold Cave had development setbacks but is considered unprotected and negatively impacted since the owner has removed the buffer fencing, cleared vegetation in the surface catchment area, and installed infrastructure within the surface catchment area years ago and was granted an administrative variance by the City Environmental Officer to allow these negative impacts to remain in place and so therefore, the cave will not be restored.

It should be noted that some of these protected caves only have protected entrances but could be threatened by surrounding development or planned development. The 48 BCCP caves that are formally part of the BCP are currently managed as follows: 22 caves protected and managed to some extent as part of the BCP on COA land; one cave protected on the Texas Nature Conservancy (TNC) land; two caves protected on combined TCMA/CoA land; 15 caves protected as part of the BCP on TC land; eight caves protected as part of private Section 10(a) or Section 7 agreements with USFWS. Ownership and protection status of each of the 62 BCCP caves is detailed in Table 7.

The monitoring and management of BCCP permit caves entails faunal surveys annually for 15 caves, bi-annually for 25 caves; cricket exit counts are conducted at 28 caves, and red-imported

fire ant treatments are performed at various times of the year for 35 caves. Of the permit caves, COA BCP conducts faunal surveys in 23 caves, cricket exit counts at 16 caves, and red imported fire ant treatments at 18 caves. TC BCP conducts faunal surveys in 18 caves, cricket exit counts at 11 caves, and red imported fire ant treatments at 18 caves. Zara Environmental is contracted to conduct bi-annual faunal surveys and red imported fire ant treatments at Pennie's Cave.

In addition to protecting and monitoring caves covered by the BCCP permit, COA and TC also provide protection for other karst features found on the BCP containing ES and SOC (Tables 4 and 6). Some of these additional karst features are incorporated into TC and COA's shared biological monitoring program, as described in Section 6.0. As of FY22, 13 endangered species karst features which were not listed on the BCCP permit are being protected on BCP lands (six features on TC BCP; seven features on COA BCP; Table 4). Additionally, 14 SOC karst features not listed on the Permit are also being protected on BCP lands (six features on TC BCP; eight features on COA BCP; Table 6).

To assist with analyzing the adequacy of the current preserve design for each karst feature, including the amount of surface and subsurface habitat needed to support these ecosystems, the COA and TC have been working together to maintain a comprehensive database for the 62 features and other features identified within the BCP since the regional permit was issued in 1996. The database also incorporates monitoring data and management issues for each karst feature. The karst database is discussed in more detail in Section 5.0.

Table 3. Endangered Karst Invertebrate Locations within BCCP caves of Travis County, Texas

This table, originally in the BCCP 1996 documents, has been revised to show new species location information. *Key and footnotes follow table.*

Cave Name	Current Preserve Status	Karst Fauna Region	Tooth Cave Pseudoscorpion <i>Tartarocreagris texana</i>	Tooth Cave Spider <i>Tayshaneta myopica</i>	Tooth Cave Ground Beetle <i>Rhadine persephone</i>	Kretschmarr Cave Mold Beetle <i>Texamaurops reddelli</i>	Bee Creek Cave Harvestman <i>Texella reddelli</i>	Bone Cave Harvestman <i>Texella reyesi</i>
Amber Cave	BCP Jollyville/TC	Jollyville Plateau	X 1996		X 2010 (Reddell)	X 1996		
Bandit Cave	Private	Rollingwood					P 1996 X 2009	
Beard Ranch Cave	BCP Ivanhoe/COA	Jollyville Plateau						X 1996
Bee Creek Cave	Private	Rollingwood					X 1996	
Broken Arrow Cave	BCP Lime Creek Preserve/COA	Cedar Park			X 1996			
Cold Cave	Private	McNeil/Round Rock						X 1996
Cotterell Cave	BCP Spicewood Springs Park/COA	Central Austin						X 1996
Disbelievers Cave	BCP Private 10(a)	Jollyville			X 1996			
Eluvial Cave	BCP Private 10(a)	Jollyville						X 1996
Fossil Cave	BCP Schroeter Park/COA	McNeil/Round Rock						X 1996
Fossil Garden Cave	Private	McNeil/Round Rock						X 1996
Gallifer Cave	BCP Jollyville/TC	Jollyville Plateau		P 1996 X 2010 (Ledford)	P 1996 X 2005	X 2009 (Chandler)		X 1996
Hole-in-the-Road Cave	Private	McNeil/Round Rock						X 1996
Japygid Cave	BCP Private 10(a)	Jollyville			X 1996	P 1996 X 2005		
Jest John Cave	BCP Forest Ridge/COA	Jollyville Plateau					X 1996 Delete X 2017 (Ubick)	X 2017 (Ubick)

Cave Name	Current Preserve Status	Karst Fauna Region	Tooth Cave Pseudoscorpion <i>Tartarocreagris texana</i>	Tooth Cave Spider <i>Tayshaneta myopica</i>	Tooth Cave Ground Beetle <i>Rhadine persephone</i>	Kretschmarr Cave Mold Beetle <i>Texamaurops reddelli</i>	Bee Creek Cave Harvestman <i>Texella reddelli</i>	Bone Cave Harvestman <i>Texella reyesi</i>
Jester Estates Cave	BCP Forest Ridge/COA	Jollyville Plateau	X 2008 (Cokendolpher)	X 2010 (Ledford)			X 1996	
Jollyville Plateau Cave	BCP Private 10(a)	Jollyville			X 1996			X 1996
Kretschmarr Cave	BCP Jollyville/TC	Jollyville Plateau			X 1996	X 1996		
Kretschmarr Double Pit	BCP Jollyville/TC	Jollyville Plateau	P 1996 X 2005		P 1996 X 2005	X 2016 (Reddell)		
Lamm Cave	Private Section 7	Jollyville Plateau			X 1996			
Little Bee Creek Cave	BCP Ullrich WTP/COA	Rollingwood					X 1996	
McDonald Cave	BCP Jollyville/TC	Jollyville Plateau						X 1996
McNeil Bat Cave	Private	McNeil/Round Rock		X 2010 (Ledford)				X 1996
M.W.A. Cave	BCP Private 10(a)	Jollyville	P 1996 X 2005		X 1996	P 1996 X 2005		X 1996
New Comanche Trail Cave	BCP Lake Travis/TC	Jollyville Plateau		X 1996				X 1996
No Rent Cave	BCP McNeil/TC	McNeil/Round Rock						X 1996
North Root Cave	BCP Jollyville/TC	Jollyville Plateau			X 1996			X 2017 (Ubick)
Pickle Pit Cave	Private Section 7	Jollyville Plateau						X 2018 (USFWS)
Rolling Rock Cave	BCP Lime Creek Preserve/ COA Sec.10(a)	Cedar Park			X 1996			
Root Cave	BCP Jollyville/TC	Jollyville Plateau		X 2010 (Ledford)	X 1996			X 1996

Cave Name	Current Preserve Status	Karst Fauna Region	Tooth Cave Pseudoscorpion <i>Tartarocreagris texana</i>	Tooth Cave Spider <i>Tayshaneta myopica</i>	Tooth Cave Ground Beetle <i>Rhadine persephone</i>	Kretschmarr Cave Mold Beetle <i>Texamaurops reddelli</i>	Bee Creek Cave Harvestman <i>Texella reddelli</i>	Bone Cave Harvestman <i>Texella reyesi</i>
Spider Cave	BCP Park West/COA	Jollyville Plateau			X 2004 (Reddell)		X 2004 (Reddell)	
Stark's North Mine Cave	BCP Stark's/TC	Not within a KFR					X 2009 (USFWS)	
Stovepipe Cave	BCP Canyon Creek/ COA	Jollyville Plateau		X 2009 Delete X 2018 (USFWS)	X 1996	X 1996		P 1996 X 2009 (USFWS)
Tardus Hole	BCP Jollyville/TC	Jollyville Plateau			X 1996	X 2009 (Chandler)		
Tooth Cave	BCP Jollyville/TC	Jollyville Plateau	X 1996	X 1996	X 1996	X 1996		X 1996
Weldon Cave	BCP McNeil/TC	McNeil/Round Rock						X 1996

Sources: BCCP Permit 1996; Elliott 1992; Reddell 2004,2005, 2010, 2016; HNTB 2005; USFWS 1994, 2009a, 2009b, 2009c; Ledford 2010, Ubick 2017.

Key and Footnotes

X 1996 = confirmed occurrence based on collected specimen, the designation in the 1996 BCCP permit

P 1996 = probable occurrence based on observation but not confirmed with collected specimen; the designation in 1996 BCCP permit

X 2004 (Reddell) = confirmed by J. Reddell (pers. comm 2004)

X 2005 = was listed as confirmed in the HNTB summary of James Reddell's data, 2005 report for USFWS

X 2008 = Cokendolpher (pers. comm 2008) confirmed that Jester Estates Cave is a new site for *Tartarocreagris texana*, as also reported in USFWS 2009b.

X 2009 = USFWS – according to the 2009 5 year review on *Texella reyesi* the report lists *T. reyesi* as confirmed for Stovepipe Cave (USFWS 2009a); *Texella reddelli* 5-year review confirms *T. reddelli* for Stark's North Mine (USFWS 2009c); *Neoleptoneta myopica* 5-year review confirms this species for Stovepipe Cave (USFWS 2009b).

X 2009 (Chandler) = confirmed by D. Chandler, as reported in USFWS 5-year review (2009b).

X 2010 (Ledford) = confirmed by J. Ledford (pers. comm 2010)

X 2010 (Reddell) = confirmed by J. Reddell (pers. comm 2010)

X 2016 (Reddell) = confirmed by J. Reddell (pers. comm 2016)

Delete X 2017 (Ubick) = *T. reddelli* was accidentally listed as occurring in this cave, the species is actually *T. reyesi* (personal communication Ubick 2017)

X 2017 (Ubick) = confirmed by D. Ubick (pers. comm 2017)

X 2018 (USFWS) = according to the 2018 5 year review on *Texella reyesi* the report list *T. reyesi* as confirmed for Pickle Pit Cave (USFWS 2018)

Delete X 2018 (USFWS) = according to the 2018 5 year review on *Tayshaneta myopica* the report list *T. devia* as confirmed for Stovepipe Cave (USFWS 2018)

Table 4. Non-BCCP listed Caves/Karst Features with Listed Invertebrates Protected on BCP*Key follows table*

Cave Name	Current Preserve Status	Karst Fauna Region	Tooth Cave Pseudoscorpion <i>Tartarocreagris texana</i>	Tooth Cave Spider <i>Tayshaneta myopica</i>	Tooth Cave Ground Beetle <i>Rhadine persephone</i>	Kretschmarr Cave Mold Beetle <i>Texamaurops reddelli</i>	Bee Creek Cave Harvestman <i>Texella reddelli</i>	Bone Cave Harvestman <i>Texella reyesi</i>
Black-cap Cave	COA	Jollyville Plateau		P				X 2021
Cortana Cave	COA	Jollyville Plateau		X 2010				X 2008
Down Dip Sink	COA	Jollyville Plateau			X 2007a			
Garden Hoe Cave	COA	Jollyville Plateau			X 2007b			
Geode Cave	TC	Jollyville Plateau		X 2008	X 2008			X 2008
Hammett's Cave	Westcave	Pedernales					X 2021	
IV-3	COA	Jollyville Plateau						X 2018a
LU-11	TC	Jollyville Plateau		X 2008				
LU-12	TC	Jollyville Plateau						X 2008
Little Black Hole	COA	Rollingwood					X 2009c	
Persephone Caverns	COA	Jollyville Plateau			P	P		P
Pond Party Pit	COA	Jollyville Plateau			X 2016			X 2010
RI-1	TC	Jollyville Plateau					X 2010	

Cave Name	Current Preserve Status	Karst Fauna Region	Tooth Cave Pseudoscorpion <i>Tartarocreagris texana</i>	Tooth Cave Spider <i>Tayshaneta myopica</i>	Tooth Cave Ground Beetle <i>Rhadine persephone</i>	Kretschmarr Cave Mold Beetle <i>Texamaurops reddelli</i>	Bee Creek Cave Harvestman <i>Texella reddelli</i>	Bone Cave Harvestman <i>Texella reyesi</i>
Tight Pit Cave	TC	Jollyville Plateau		X 2010				
Two Trunks Cave	TC	Jollyville Plateau			X 2008 (USFWS)			

Sources: Reddell 2016; USFWS 2008, 2009c; Zara Environmental 2007a, 2007b, 2008, and 2010 and Ubick 2021.

X 2018 (USFWS) = according to the 2018 5 year review on *Texella reyesi*

Key: X = confirmed occurrence based on collected specimen

P = probable location based on proximity to other known sites and being within the known range of the species.

Table 5. Karst Invertebrate SOC within BCCP Caves, Travis County, Texas^{1,2}

Key and footnotes follow table

Cave Name	<i>Aphrastochitonius</i> N.S.	<i>Caecidotea reddelli</i>	<i>Candonia</i> sp. nr. <i>stagnalis</i>	<i>Cicurina bandida</i> ³	<i>Cicurina travisae</i> ⁴	<i>Cicurina</i> sp. ⁵	<i>Eidmannella reclusa</i>	<i>Miktoniscus</i> N.S.	<i>Tayshaneta concinna</i>	<i>Tayshaneta devia</i>	<i>Rhadine austinica</i>	<i>Rhadine</i> s. <i>subterranea</i>	<i>Rhadine</i> s. <i>mitchelli</i>	<i>Speodesmus</i> N.S.	<i>Sphalloplana mohri</i>	<i>Tartarocreagris comanche</i>	<i>Tartarocreagris intermedia</i>	<i>Tartarocreagris</i> N.S. 3	<i>Texella spiniperca</i>	<i>Trichoniscinae</i> N.S.
Adobe Springs Cave						X														
Airmen's Cave				X							X						X		X	
Amber Cave					X								X							
Armadillo Ranch Sink		X																		
Arrow Cave				X							X									
Bandit Cave				X							X									X
Beard Ranch Cave					X															
Bee Creek Cave				X							X									
Blowing Sink Cave				X							X									
Broken Arrow Cave																				
Buda Boulder Spring		X																		
Cave X		X	X	X				X			X			X						
Cave Y				X							X									
Ceiling Slot Cave						X														
Cold Cave						X						X								

Cave Name	<i>Aphrastochthonius</i> N.S.	<i>Caecidotea reddelli</i>	<i>Candona</i> sp. nr. <i>stagnalis</i>	<i>Cicurina bandida</i> ³	<i>Cicurina travisae</i> ⁴	<i>Cicurina</i> sp. ⁵	<i>Eidmannella reclusa</i>	<i>Miltoniscus</i> N.S.	<i>Tayshaneta concinna</i>	<i>Tayshaneta devia</i>	<i>Rhadine austinica</i>	<i>Rhadine</i> s. <i>subterranea</i>	<i>Rhadine</i> s. <i>mittelli</i>	<i>Speodesmus</i> N.S.	<i>Sphalloplana mohri</i>	<i>Tartarocreagris comanche</i>	<i>Tartarocreagris intermedia</i>	<i>Tartarocreagris</i> N.S. ³	<i>Texella spiniperca</i>	<i>Trichoniscinae</i> N.S.
Cotterell Cave					X							X								
Disbelievers Cave						X														
District Park Cave				X							X									
Eluvial Cave																				
Flint Ridge Cave				X							X									
Fossil Cave												X								
Fossil Garden Cave						X						X								
Gallifer Cave					X															
Get Down Cave				X							X									
Goat Cave				X										X						
Hole-in-the-Road Cave						X														
Ireland's Cave				X							X									
Jack's Joint		X				X														
Japygid Cave																				
Jest John Cave					X															
Jester Estates Cave					X							X								

Cave Name	<i>Aphrastochthonius</i> N.S.	<i>Caecidotea reddelli</i>	<i>Candona</i> sp. nr. <i>stagnalis</i>	<i>Cicurina bandida</i> ³	<i>Cicurina travisae</i> ⁴	<i>Cicurina</i> sp. ⁵	<i>Eidmannella reclusa</i>	<i>Miltoniscus</i> N.S.	<i>Tayshaneta concinna</i>	<i>Tayshaneta devia</i>	<i>Rhadine austinica</i>	<i>Rhadine s. subterranea</i>	<i>Rhadine s. mitchelli</i>	<i>Speodesmus</i> N.S.	<i>Sphalloplana mohri</i>	<i>Tartarocreagris comanche</i>	<i>Tartarocreagris intermedia</i>	<i>Tartarocreagris</i> N.S. ³	<i>Texella spinoperca</i>	<i>Trichoniscinae</i> N.S.
Jollyville Plateau Cave																				
Kretschmarr Cave					X								X							
Kretschmarr Double Pit					X															
Lamm Cave																				
Little Bee Creek Cave				X							X									
Lost Gold Cave				X					X		X									
Lost Oasis Cave				X							X									
M.W.A. Cave																		X		
Maple Run Cave				X							X									
McDonald Cave					X					X										
McNeil Bat Cave												X								
Midnight Cave				X							X									
Moss Pit																				
New Comanche Trail Cave						X	X									X				
No Rent Cave	P					X						X								
North Root Cave					X															

Cave Name	<i>Aphrastochthonius</i> N.S.	<i>Caecidotea reddelli</i>	<i>Candona</i> sp. nr. <i>stagnalis</i>	<i>Cicurina bandida</i> ³	<i>Cicurina travisae</i> ⁴	<i>Cicurina</i> sp. ⁵	<i>Eidmannella reclusa</i>	<i>Miktoniscus</i> N.S.	<i>Tayshaneta concinna</i>	<i>Tayshaneta devia</i>	<i>Rhadine austinica</i>	<i>Rhadine</i> s. <i>subterranea</i>	<i>Rhadine</i> s. <i>mittelli</i>	<i>Speodesmus</i> N.S.	<i>Sphalloplana mohri</i>	<i>Tartarocreagris comanche</i>	<i>Tartarocreagris intermedia</i>	<i>Tartarocreagris</i> N.S. 3	<i>Texella spiniperca</i>	<i>Trichoniscinae</i> N.S.
Pennie’s Cave				X							X			X						
Pickle Pit					X															
Pipeline Cave				X										X						
Rolling Rock Cave						X								X						
Root Cave					X															
Slaughter Creek Cave				X																
Spanish Wells Cave		X													X					
Spider Cave					X		X													
Stark’s North Mine									X											
Stovepipe Cave	X				X		X			X										
Talus Springs Cave																				
Tardus Hole																				
Tooth Cave					X		X						X							
Weldon Cave	X					X						X								
Whirlpool Cave				X							X									

Sources: Elliot 1997, Paquin and Hedin 2005, Paquin et al. 2008, TMM 2007, Zara Environmental 2008, 2010, Ledford et al. 2012, Hedin 2015, Reddell 2016, Hedin 2022.

Key and Footnotes

X = confirmed location based on collected specimen.

¹ *Cicurina ellioti* listed as an SOC in the regional permit is not included in this table because this species has now been synonymized with *Cicurina buwata*, a non-SOC (Cokendolpher 2004).

² *Tartarocreagris reddelli* listed as a SOC in the regional permit is not included in this table because this species has now been synonymized with *Tartarocreagris infernalis*, a non-SOC (Muchmore 2001).

³ Occurrences of *Cicurina bandida* include localities formerly listed as *Cicurina cueva* and *Cicurina reyesi*, which have been formally grouped together into the single species *C. bandida* (Paquin et al. 2008).

⁴ Occurrences of *Cicurina trivisae* include localities formerly listed as *Cicurina reddelli* and *Cicurina wartoni*, which have been formally grouped together into the single species *C. trivisae* (Hedin 2015).

⁵ Localities of possible SOC's; blind *Cicurina* specimens not yet confirmed to species level.

Table 6. Non-BCCP Caves/Karst Features with Karst SOC Protected on BCP^{1,2}

Key and footnotes follow table

Cave Name	BCP Owner	<i>Aphrastochitonius</i> N.S.	<i>Caecidotea reddelli</i>	<i>Candonia</i> sp. nr. <i>Stagnalis</i>	<i>Cicurina bandida</i> ³	<i>Cicurina travisae</i> ⁴	<i>Cicurina</i> sp. ⁵	<i>Eidmannella reclusa</i>	<i>Miktoniscus</i> N.S.	<i>Tayshaneta concinna</i>	<i>Tayshaneta devia</i>	<i>Rhadine austinica</i>	<i>Rhadine</i> s. <i>l5ubterranean</i>	<i>Rhadine</i> s. <i>mittchelli</i>	<i>Speodesmus</i> N.S.	<i>Sphalloplana mohri</i>	<i>Tartarocreagris attenuata</i>	<i>Tartarocreagris comanche</i>	<i>Tartarocreagris intermedia</i>	<i>Tartarocreagris</i> N.S. ³	<i>Texella spinoperca</i>	<i>Trichoniscinae</i> N.S.
Black-cap Cave	COA						X	P														
Brewpot Cave	TC										X											
Caverns of Sweet Nora	COA						X															
Cedar Chopper Cave	TC						X															
Cortana Cave	COA						X															
Down Dip Cave	COA						X															
Gaping Maw	COA						X				P						P					
Flying Kave	TC						X															
Geode Cave	TC					X		X														
Hammett's Cave	Westcave						X															
Hoskin's Cave	COA				X																	
IV-3	COA					X																
LU-29	TC						X															
Millennium Cave	COA				X																	
Persephone Caverns	COA					P	X	P					P				P					

Cave Name	BCP Owner	<i>Aphrastochitonius</i> N.S.	<i>Caecidotea reddelli</i>	<i>Candona</i> sp. nr. <i>Stagnalis</i>	<i>Cicurina bandida</i> ³	<i>Cicurina trivisiae</i> ⁴	<i>Cicurina</i> sp. ⁵	<i>Eidmannella reclusa</i>	<i>Miktoniscus</i> N.S.	<i>Tayshaneta concinna</i>	<i>Tayshaneta devia</i>	<i>Rhadine austinica</i>	<i>Rhadine</i> s. <i>l</i> <i>Subterranean</i>	<i>Rhadine</i> s. <i>mittelli</i>	<i>Speodesmus</i> N.S.	<i>Sphalloplana mohri</i>	<i>Tartarocreagris attenuata</i>	<i>Tartarocreagris comanche</i>	<i>Tartarocreagris intermedia</i>	<i>Tartarocreagris</i> N.S. ³	<i>Texella spiniperca</i>	<i>Trichoniscinae</i> N.S.
Pond Party Pit	COA					X							X									
RI-1	TC						X															
RI-3	TC						X															
Siebert Sink	COA				X					X											X	
Two Trunks Cave	TC					X																
Wyoaka Cave	COA				X																	
Y2 Cave	COA				X																	

Sources: Bayless pers. comm 2013, Paquin and Hedin 2005, Sanders pers. comm 2013, TMM 2007, Zara Environmental 2008, 2010, Hedin 2015, Reddell 2016, Hedin 2022.

Key and Footnotes

X = confirmed location based on collected specimen.

P = probable location based on proximity to other known sites and being within the known range of the species.

¹ *Cicurina ellioti* listed as an SOC in the regional permit is not included in this table because this species has now been synonymized with *Cicurina buwata*, a non-SOC (Cokendolpher 2004).

² *Tartarocreagris reddelli* listed as a SOC in the regional permit is not included in this table because this species has now been synonymized with *Tartarocreagris infernalis*, a non-SOC (Muchmore 2001).

³ Occurrences of *Cicurina bandida* include localities formerly listed as *Cicurina cueva* and *Cicurina reyesi*, which have been formally grouped together into the single species *C. bandida* (Paquin et al. 2008).

⁴ Occurrences of *Cicurina trivisiae* include localities formerly listed as *Cicurina reddelli* and *Cicurina wartoni*, which have been formally grouped together into the single species *C. trivisiae* (Hedin 2015).

⁵ Localities of possible SOC's; blind *Cicurina* specimens not yet confirmed to species level.

3.0 OWNERSHIP AND PROTECTION STATUS

Many karst features listed in the BCCP permit have adequate protection, based on the criteria outlined in USFWS's *Karst Preserve Design Recommendations* (USFWS 2012). However, some of the caves listed in Table 7 as protected may not be adequately protected as defined in USFWS (2012). Efforts are being made by the BCCP Permit Holders to contact owners of privately owned caves to assess their protection efforts and to assist them with protection where possible.

Though not specifically required in the BCCP permit, the updated USFWS karst preserve design recommendations direct that the protected area surrounding the cave should be at least 16–40 ha (40–99 acres) in size to capture the majority of plant and animal community elements needed to support the karst ecosystem, as well as protect the cave footprint and surface/subsurface drainage basins of the cave (USFWS 2014a). Some caves within the BCP meet or exceed these recommendations, while others do not due to conditions that existed before the Permit was issued, such as pre-existing development in the form of subdivisions, roads, power lines, petroleum lines, and sewer lines that preclude complete protection of the recommended preserve areas. BCCP Permit Holders will continue to do what is reasonable to protect these features from pre-existing development and continue efforts to acquire and protect the karst features listed in the BCCP permit.

Per BCCP Permit Conditions S2 and T2, if new karst features “are discovered with a significant diversity of troglobitic fauna, those karst features may be submitted to the Service for consideration for exchange with karst features identified for protection by the BCCP” (USFWS 1996a). In order to allow the Permit holders to implement these Permit conditions, COA and TC created a Cave Substitution Policy that provides a process that allows caves listed in the BCCP permit to be substituted with other suitable caves in a manner that is transparent, science based, and consistent with the vision and intent established for the BCCP. This policy includes a definition of “significant diversity of troglobitic fauna” as it applies to eligibility of a cave for substitution and determines parameters that quantify preservation of environmental integrity for BCCP-listed caves and candidate substitution caves as it applies to management of caves. These defined criteria will be used in determining both the need to substitute a feature listed on the Permit as well as whether the substitution cave will adequately replace the previously identified BCCP cave or caves. The BCCP Cave Substitution Policy was adopted by the BCCP Coordinating Committee in August 2015.

Karst Preserve Management

Karst preserves, even those pre-existing at the time containing permit caves, were not specified in the HCP/EIS. Karst preserves were directed to be created for the 62 listed karst features in the governing documents that generally include the water sources to the caves (surface and subsurface catchment areas) and other management areas.

Twelve of the 62 caves lie on City of Austin property that is managed by Austin Parks & Recreation Department (PARC). An interdepartmental management agreement between PARC and AW that specifies management activities of BCP land management plans are in progress. The dual management sites include Bull Creek District Park and Greenbelt, St. Edward's Park, Barrow Preserve, Commons Ford Park, Shoal Creek Greenbelt (Buda Boulder Spring); Barton Creek Wilderness Area and Greenbelt (Airmen's Cave and Cave Y), Mt. Bonnell, Blowing Sink Research Management Unit (now renamed William H. Russell Karst Preserve with Blowing Sink Cave), Stillhouse Hollow Nature Preserve (Cotterell Cave), Goat Cave Karst Nature Preserve (Goat Cave and Maple Run Cave); Dick Nichols District Park (District Park Cave); Circle C Ranch on Slaughter Creek (Midnight Cave, Arrow Cave, and Slaughter Creek Caves); and Hubert C. Schroeter Neighborhood Park (Fossil Cave). This agreement would allow AW BCP to conduct necessary restoration and cave management, to provide adequate protection for the sites, fence as necessary to protect the preserve, find and restore non-BCCP permit caves for potential substitution of impacted permit caves, and eliminate toxic chemical application in sensitive water source areas.

William H. Russell Karst Preserve

While Blowing Sink Cave is the deepest cave on the BCCP permit, extending 240 feet to the water table, it has been obstructed since October 2013. The entire preserve contains surface and/or subsurface catchment area for Blowing Sink Cave. This preserve is currently managed by Austin Nature Preserves of Austin Parks and Recreation Department. There is no formal interdepartmental agreement yet that would allow dual management and restoration by AW BCP. In February 2020, a Tier III Management Plan was produced for the newly renamed William H. Russell Karst Preserve by AW BCP and Austin Nature Preserves Division of Austin Parks & Recreation Department. While the land management plan specifies the required management work, the interdepartmental agreement specifies which department is responsible for and empowered to accomplish the management tasks.

Village at Western Oaks Karst Preserve and Watershed Management Area

The Village at Western Oaks Karst Preserve and Watershed Management Area (VWO Karst Preserve) contains the BCCP permit Get Down Cave and was acquired by the City of Austin

in June 2016 under Watershed Protection Department management. An interdepartmental agreement in July 2018 delegated AW BCP with management of the karst preserve and Watershed Protection responsibility for the water quality ponds and Millennium Cave, a non-permit education cave that underlies one pond.

The preserve has public trails maintained by the Village at Western Oaks Homeowners Association, including trash removal, pet waste bags, and trail maintenance. A formal agreement between VWOHOA and AW BCP was drafted in FY21 and is expected completed in FY23 along with a Tier III management plan.

A Friends of the Preserve group was started by neighbor Stephanie Simmons, which participates in public education of preserve sensitivity through a Facebook page. The Friends educate neighbors on alternatives to pesticides, including the use of boiling water to suppress red imported fire ants, the benefits of increasing our tree canopy, and use of native plants, along with information on endangered songbirds and karst invertebrate ecosystems. They also notify and facilitate events, including neighborhood cave tours, Tree Folks planting, Native Plant Giveaways, Boy Scout projects, and others.

Karst Preserve Friends FY22 Activities

- We held our 7th Annual “Texas Most Wanted: Invasive Plant Buy-Back & Native Plant Swap”.
 - Beautiful weather for a full weekend event March 19th-20th, 2022
 - Had little friends rescue Bluebonnets from the KP trail and learn about the Bluebonnet seed cycle.
 - Many Nandinas were turned in for the large native plant bounties
- We hosted our 3rd Annual “Texas Arbor Day” event
 - More Beautiful weather on November 5th, 2022
 - Focused on Tree TLC
 - Planted many, many fresh *Ungnadia speciosa* seeds throughout the fall
 - Also planted several *Quercus macrocarpa* nuts
- To keep up with our activities, follow us on Facebook:
 - <https://www.facebook.com/groups/KarstPreserveFriends>

Whirlpool Karst Preserve

Whirlpool Cave is the third largest cave of the 62 permit caves and has historically been used in public education. In FY21, AW BCP and TCMA approved a formal management agreement

for Whirlpool, Lost Oasis, and Avery Ranch (non-BCCP permit education) caves on May 4, 2021.

Whirlpool Cave is managed by Liz Herren on behalf of TCMA. Liz Herren, Justin Shaw, Rich Zarria and other members of TCMA discovered a new room south of the mapped cave. In May 2021 a drip gauge was installed under active drip formations as part of a hydrogeological studies. Continuous measurement of airflow and carbon dioxide are monitored in the East Cavern passage. Surface measurements of temperature and humidity at 3 ft height were installed on the surface in May 2021 to compare differences between grasslands and forests over the cave.

In February 2020, AW BCP acquired a 4.7-acre private lot that overlies the majority of Whirlpool Cave. Whirlpool Cave Preserve is now a formal BCP karst preserve (Figure 1). A Tier III management plan is expected to be created in FY23. The majority of the South Caverns passage lies outside the preserve in private homeowners association. A future step will be to seek inclusion of about 200 feet in the preserve through easement, acquisition, or management agreement. In FY22 a fence was installed along the northern border of the BCP tract to discourage homeless encampments and dumping of trash.

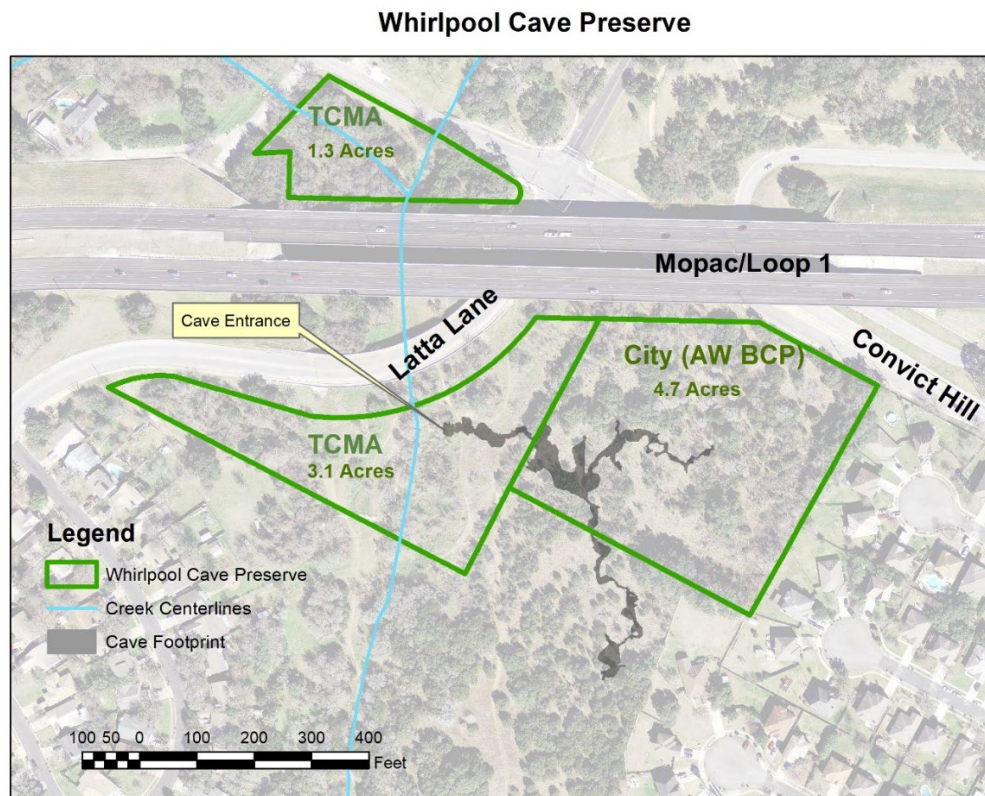


Figure 1. New lot acquired by AW BCP containing a large portion of Whirlpool Cave.

In FY22, AW BCP in collaboration with the Hill Country Conservancy (HCC), COA Public Works, and contract artist Barbara Attwell installed a cave mural along the Violet Crown Trail adjacent to Whirlpool Cave. HCC and COA Public Works is are the design phase of putting together more educational signs regarding caves, these new educational kiosks should be installed in FY23.

Lost Oasis Karst Preserve

Lost Oasis Cave Preserve is managed by Drew Thompson on behalf of TCMA and is adjacent to Tabor WQPL where Flint Ridge is located. A formal agreement for BCP management was created with TCMA, although the cave is currently being managed per Tier II Karst Land Management Plan with regular fire ant treatments, annual faunal surveys, visitor traffic counts, etc. Significant progress was made on the lead at the bottom of the cave in FY2022, and there is still strong airflow so work will continue in FY2023.

Four Points Private Karst Preserve

On February 27, 2019 AW and TC BCP staff met with representatives of the Four Points Preserves that contain four (Disbelievers, Eluvial, Japygid, and MWA caves) of the 62 permit caves in a private karst preserve (Figure 2). BCP requested ownership and management responsibilities for the preserves. On September 13, 2019, representatives of the owner committed to transferring ownership after buildout of associated development and a certificate of occupancy is issued, which may take approximately 2 years. BCP has no data on what, if any, management has been occurring on this preserve or the status of the four permit caves, as this is reported directly to USFW. The transfer process has proceeded in FY22. The properties will be surveyed and hopefully COA BCP will take over ownership and management in FY23.

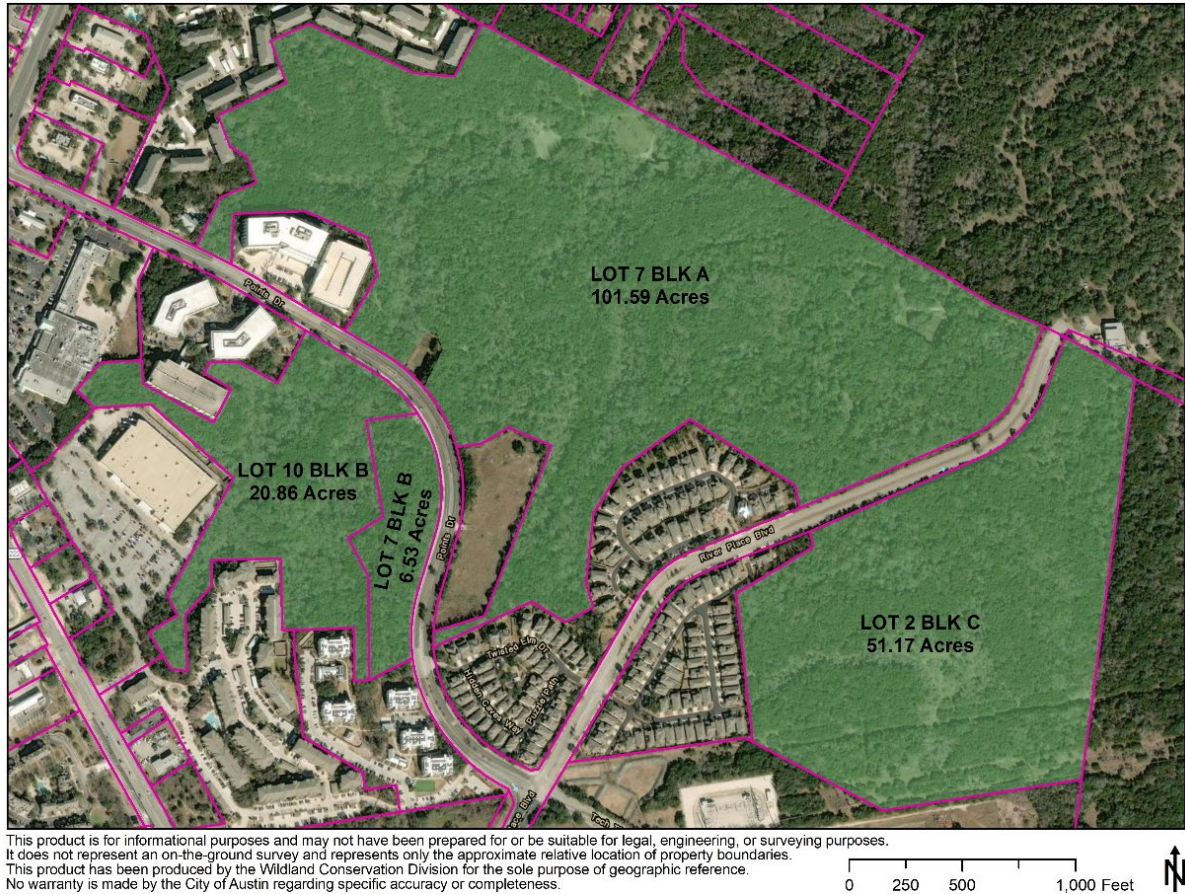


Figure 2. Four Points Preserve Map

Little Bee Creek Karst Preserve

COA BCP contractor Crystal Datri, Wren Daytree LLC discovered a new spring location for the Barton Springs salamander (*Eurycea sosorum*). The date of discovery was January 11, 2022. This new discovery extends the known range for the Barton Springs salamander north by 2.1 km. This finding was published in the Herpetological Review 53(3), 2022.

Other AW BCP karst preserves, including Testudo Cave Karst Preserve, Lime Creek Preserve, Stovepipe Cave Karst Preserve (Canyon Creek), and Jester Estates Cave Karst Preserve. In FY21, AW BCP utilized Section 7 conservation measures funding from TxDOT to develop formal karst preserves near FM 2222 and FM 620 by excavating previously unknown caves of ranch fill and extending the few previously known caves on Stovepipe (Canyon Creek), Cortaña, Park West, and Kent Butler preserves, as described in the Hydrological Studies and Cave Restoration section. The new caves reveal new cave drip areas and creates habitat to enhance the preserves. Many of these karst areas are associated with springs which are also investigated for fauna and water quality/discharge rate.

Table 7. FY22 Ownership, protection, monitoring and access status of the 62 BCCP caves/karst features (36 caves with ES and 25 caves with SOC) ^{1, 2}.

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
Adobe Springs Cave	SOC	BCP/TNC	Fenced	Protected on preserve	TC bi-annual surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring	none
Airmen's Cave	SOC	BCP/COA	Gated	Protected on parkland Seeking access easement from overlying Brodie Oaks Mall.	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring Hydrogeological Study completed Dec. 2021 (Appendices)	access by permit*
Amber Cave	ES	BCP/TC	Gated and fenced	Protected on preserve (very close to road and sewer line)	TC quarterly surface monitoring; red-imported fire ant (RIFA) survey/ control; annual species monitoring; annual cave cricket exit count	none
Armadillo Ranch Sink	SOC	Private		Private - Unknown		none
Arrow Cave	SOC	BCP/COA	Gated	Protected on parkland (There are nearby homes immediately south of the cave entrance).	COA quarterly surface monitoring; annual species monitoring	none
Bandit Cave	ES	Private	Gated	Protected by private ecologically concerned landowner		none
Beard Ranch Cave	ES	BCP/COA		Protected on preserve	COA quarterly surface monitoring; annual faunal survey	none
Bee Creek Cave	ES	Private		Private- AW BCP inquired about purchasing in April 2021 but not interested in selling at this time.		none
Blowing Sink Cave	SOC	BCP/COA	Gated	Protected on preserve (200 acre preserve, but subsurface catchment extends	COA monthly surface and annual species monitoring;	none

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
				more than a mile west). Lower half of the cave has been inaccessible since 2013. A Tier III plan was completed February 28, 2020.	RIFA control as needed	
Broken Arrow Cave	ES	BCP/COA	Fenced	Protected on preserve	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; bi-annual RIFA control	none
Buda Boulder Spring	SOC	BCP/COA		Protected on parkland (close proximity to a hike and bike trail).	COA bi-annual surface monitoring; annual species monitoring.	none
Cave X	SOC	Private/COA Protection Agreement	Gated and fenced	Protected by landowner with 4.5-acre setback to protect cave entrance. Protected to some extent (not actively managed and the setback is inadequate). Owner rejected COA offer on Sept. 19, 2017 to assist in cave management and monitoring. Regents built a sports field within the Cave X buffer, over the footprint of the cave sometime between January 2018 and November 2019. Regents Sch WP staff a proposed restoration plan on December 2022 which is currently under review.	In the past, occasional species and surface monitoring by COA and SWCA. SWCA completed cave cricket exit counts in October 2015 and one partial cave faunal survey in February 2016 as part of an agreement to allow for on site construction of a berm to reduce flooding concerns. It is unknown if further biological monitoring has been performed	none
Cave Y ¹	SOC	BCP/COA	Gated	Protected on parkland.	COA quarterly surface monitoring, bi-annual species monitoring; bi-annual cave cricket exit counts; RIFA control as needed	none
Ceiling Slot Cave	SOC	Private		Private - Unknown		none

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
Cold Cave	ES	Private	Gated	Private - Unknown	TC bi-annual surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring	none
Cotterell Cave	ES	BCP/COA	Gated and fenced	Protected on parkland. (There are nearby homes immediately east of the cave entrance)	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; RIFA control as needed	none
Disbelievers Cave	ES	BCP/Private Section 10(a)		Protected by 10a permit, hired Plateau Land & Wildlife Management		none
District Park Cave	SOC	BCP/COA	Gated	Protected on parkland.	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; RIFA control as needed	1 st room open, past 1 st room protected by gate, access by permit*
Eluvial Cave	ES	BCP/Private Section 10(a)		Protected by 10a permit, hired Plateau Land & Wildlife Management		none
Flint Ridge Cave	SOC	BCP/COA	Gated	Protected on Water Quality Protection Land (portions of the cave and its catchment area are overlain by the newly constructed SH45 SW)	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; RIFA control as needed	none
Fossil Cave	ES	BCP/COA	Access protected by large rocks	Protected on parkland. All caves in park are filled in and require restoration.	Exact location of cave is unknown. COA quarterly surface monitoring of features suspected to be Fossil Cave	none
Fossil Garden Cave	ES	Private		Private – Unknown		none

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
Gallifer Cave	ES	BCP/TC	Gated and fenced	Protected on preserve	TC quarterly surface monitoring; bi-annual cave cricket exit counts; RIFA survey/control; bi-annual species monitoring	none
Get Down Cave	SOC	BCP/COA	Gated and fenced	Protected on preserve	COA monthly surface monitoring; annual cave cricket exit counts; annual species monitoring; annual RIFA control	none
Goat Cave	SOC	BCP/COA	Fenced	Protected on parkland.	COA monthly surface monitoring; annual species monitoring; RIFA control as needed	access by permit*
Hole-in-the-Road	ES	Private		Private –Unknown. (very close to a major roadway)		none
Ireland’s Cave	SOC	BCP/ TC	Gated and fenced	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; annual species monitoring	none
Jack’s Joint	SOC	Private		Private - Unknown		none
Japygid Cave	ES	BCP/Private Section 10(a)		Protected by 10a permit, managed by Plateau Land & Wildlife Management		none
Jest John Cave	ES	BCP/COA		Protected on preserve	COA annual cave cricket exit count; bi-annual surface monitoring	none
Jester Estates Cave	ES	BCP/COA	Gated and fenced	Protected on preserve (3.2 acre preserve surrounded by homes).	COA monthly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; bi-annual RIFA control	none

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
Jollyville Plateau Cave	ES	BCP/Private Section 10(a)		Protected by 10a permit, managed by Plateau Land & Wildlife Management		none
Kretschmarr Cave	ES	BCP/TC	Gated and fenced	Protected on preserve. Close to roadway and in power line ROW.	TC quarterly surface monitoring; RIFA survey/control; bi-annual cave cricket exit counts; bi-annual species monitoring	none
Kretschmarr Double Pit	ES	BCP/TC	Fenced	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; annual species monitoring	none
Lamm Cave	ES	BCP/Private Section 7	Gated and fenced	COA negotiated setback (approximately 150')	Occasional surface and species monitoring by COA and TC	none
Little Bee Creek Cave	ES	BCP/COA	Gated	Protected on preserve	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring	none
Lost Gold Cave	SOC	Private	Gated	Private – COA WPD had negotiated a small setback from future development. In FY19, silt-laden runoff from a new water well and playscape structures were found built in the buffer by City inspectors, due to these violations a stop order was in place on the well installation, City staff initially attempted to work with the landowner to remove the illegal improvements and restore the site, however, the City Environmental Officer decided to give property owner a variance which allows all the structures to remain and so therefore, the site will not be restored		none
Lost Oasis Cave	SOC	Private/ TCMA	Gated and fenced	Protected by TCMA. Formal management agreement with AW BCP to ensure permit compliance was signed on May 4, 2021	COA bi-annual cave cricket exit counts; bi-annual species monitoring; bi-annual RIFA control	controlled access**

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
M.W.A. Cave	ES	BCP/Private Section 10(a)		Protected by 10a permit, managed by Plateau Land & Wildlife Management		
Maple Run Cave	SOC	BCP/COA	Gated	Protected on parkland.	COA monthly surface monitoring bi-annual cave cricket exit counts; bi-annual species monitoring; RIFA control as needed	access by permit*
McDonald Cave	ES	BCP /TC	Fenced	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; annual species monitoring	none
McNeil Bat Cave	ES	Private		Private – Unknown (close proximity to high school)		none
Midnight Cave	SOC	BCP/COA	Fenced	Protected on parkland (close proximity to soccer fields).	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; RIFA control as needed	access by permit*
Moss Pit	SOC	Private		Private – Unknown		none
New Comanche Trail Cave	ES	BCP/TC	Fenced	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; annual cave cricket exit count; annual species monitoring	none
No Rent Cave	ES	BCP/TC	Gated	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; quarterly cave cricket exit counts; quarterly species monitoring	none

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
North Root Cave	ES	BCP/TC	Fenced	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; annual species monitoring	none
Pennie's Cave	SOC	Private		Landowner had filled entrance but Zara re-excavated and gated the entrance in May 2008. COA WPD established a 300 ft. buffer around the cave. Zara's Management report is attached in the Appendix	Zara Environmental species monitoring; Zara Environmental RIFA surveys/control	none
Pickle Pit ⁴	ES	BCP/Private Sec. 7	Gated	Protected by Section 7 permit.	TC/COA occasional species monitoring; sporadic surface inspections by concerned neighbor	none
Pipeline Cave	SOC	Private	Gated	Private – nearby petroleum pipeline exists. Lacks formal management agreement to ensure permit compliance. Permission granted for temporary access to allow for restoration, faunal surveys, and hydrogeological studies.	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; RIFA control as needed	none
Rolling Rock Cave	ES	BCP/COA	Fenced	Protected on preserve	COA quarterly surface and annual species monitoring; RIFA control as needed	none
Root Cave	ES	BCP/TC	Fenced	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control as needed; annual species monitoring	none
Slaughter Creek Cave	SOC	BCP/COA	Gated	Protected on parkland (Nearby homes are immediately south of cave entrance,	COA quarterly surface and annual species monitoring; RIFA control	none

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
				and Mopac South excavation to cave level 500' east).	as needed.	
Spanish Wells Cave	SOC	BCP/TC	Fenced	Protected on preserve	TC quarterly surface monitoring; bi-annual cave cricket exit counts; RIFA survey/control; bi-annual species monitoring	none
Spider Cave	ES	BCP/COA	Fenced	Protected on preserve	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; bi-annual RIFA control	none
Stark's North Mine ²	ES	BCP/TC	Gated	Protected on preserve	TC quarterly surface monitoring; bi-annual cave cricket exit counts; RIFA survey/control; bi-annual species monitoring	none
Stovepipe Cave	ES	BCP/ COA	Fenced	Protected on preserve	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; RIFA control as needed	none
Talus Springs Cave ³	N/A	BCP/Private Section 10(a)	Gated	Protected by Homeowners Association and TC, only has 50' setback from houses and is probably affected by uphill development.	TC bi-annual surface monitoring; RIFA survey/control; annual species monitoring	none
Tardus Hole	ES	BCP/TC	Fenced	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; annual species monitoring	none
Tooth Cave	ES	BCP/TC	Gated and Fenced	Protected on preserve	TC quarterly surface monitoring; bi-annual cave cricket exit counts; RIFA survey/control; bi-annual species monitoring	none

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
Weldon Cave	ES	BCP/TC	Gated	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; quarterly cave cricket exit counts; quarterly species monitoring	none
Whirlpool Cave	SOC	Private/ TCMA	Gated	Protected by TCMA. Formal management agreement with AW BCP to ensure permit compliance was finalized and signed by all parties on May 4, 2021. On February 2020, AW BCP acquired a private lot that overlies much of the cave	TCMA routine surface monitoring; COA bi-annual species monitoring and cave cricket exit counts to assess tawny crazy ant impacts	controlled access**

¹Cave Y was considered an ES cave (*Texella reddelli*) in the 1996 BCCP Permit, but has since been determined not to contain *Texella reddelli* (Reddell 2004).

²Stark's North Mine was listed as a SOC cave in the 1996 BCCP Permit, but has since been determined to contain *Texella reddelli* (USFWS 2009c).

³Talus Springs Cave has never been known to contain ES or SOC. This cave was placed on the BCCP permit because it contained the amphipod *Stygobromus birfurcatus*, originally considered as a SOC candidate; however, *S. birfurcatus* was not included in the Permit's final list of 25 SOC karst species to be protected.

⁴Pickle Pit was listed as a SOC cave in the 1996 BCCP Permit, but has since been determined to contain *Texella reyesi* (USFWS 2018).

* Access by Permit - Permit may be issued by COA – Austin Water Utility or Austin Parks and Recreation Department (PARD) staff.

** Controlled Access - Private cave owners control the access.

4.0 ACCESS STATUS AND KARST EDUCATION/RESTORATION ACTIVITIES

Public education on caves and cave ecosystems is recognized as vital for karst species preservation in the BCP Karst Land Management Plan (2016). Currently, most opportunities for children to enter caves and learn about cave ecosystems is through programs provided by COA Watershed Protection Department (WPD), the Balcones Canyonlands Preserve Program of Austin Water (BCP), and Austin Nature and Science Center (ANSC) summer camps. Adult wild cave tours in the Austin area are not widely available, although many tours are conducted through TCMA and the Underground Texas Grotto. Overall, there is more demand for cave education than can be met with existing programs.

One factor limiting cave education is a deficit of caves suitable for immersion, particularly considering the high demand and its effectiveness as both a teaching tool and management practice to support stewardship for cave ecosystems. Cave education/recreation primarily occurs in 10% of the BCCP caves, which have been used for this purpose prior to the 1996 permit. Whirlpool Cave (owned and managed by TCMA) has the highest traffic of all the BCCP caves, totaling 613 person trips in FY22. Although studies on human impacts to cave ecosystems are limited, it is assumed that high human traffic in a cave will negatively impact the cave fauna.

Wildflower and LaCrosse caves are relatively small non-BCCP caves on the Lady Bird Johnson Wildflower Center that received 183 and 1,593 visitors respectively in FY22. Wildflower Cave has been used for education by COA Earth Camp since 1997 after it was restored by cleaning out trash fill. Wildflower Cave is unsuitable for many cave tours due to its currently limited extent and small size.

Restoring Non-BCCP Caves for Education

By developing non-BCCP caves as a safe and accessible option for adequately trained and responsible groups for guided education/recreation tours, education can be promoted while reducing BCCP cave impacts. Restoration of filled non-BCCP caves for educational purposes is expected to reduce traffic/impact to other publicly accessed BCCP listed caves, namely District Park, Goat, Lost Oasis, Maple Run, and Whirlpool Caves. Caves are a heritage for the Austin area and provide resources for public education and opportunities to connect with local communities.

While fairly obvious once trash and ranch fill are removed, the cave ecosystem improves in education caves such as LaCrosse, Wade, and Wildflower caves are, it is still assumed that excessive traffic is detrimental to cave ecosystems until more detailed analysis is conducted

and reported. Consequently, it is a goal to restore new education caves to both provide more resources for public cave education and to reduce traffic on federal permit caves. A compilation of historic traffic in both BCCP permit and education caves is shown below in Figures 3 & 4. In FY21, an interlocal agreement with the Lady Bird Johnson Wildflower Center will allow AW BCP to restore filled caves there for education and cave ecosystem preservation. No significant progress was made in restoring new education caves or improving existing education caves in FY22. Ladybird Lounge Cave discovered at the Wildflower Center is a very significant cave, but the difficulty of entering the cave combined with the extremely delicate formations makes it unsuitable for an education cave. There are other features nearby that will be restored in FY23 or following years that will likely be more suitable for education trips, but we won't know until we open them up.

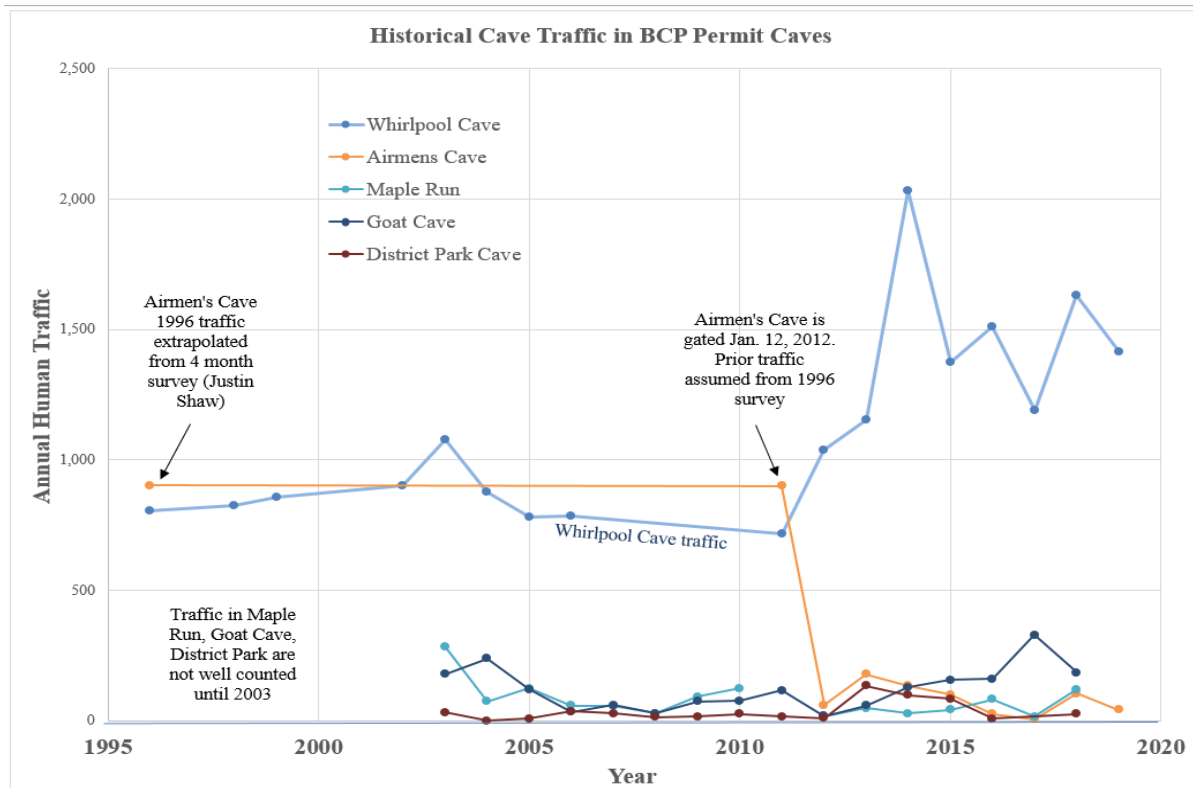


Figure 3. Historical traffic in BCP permit caves

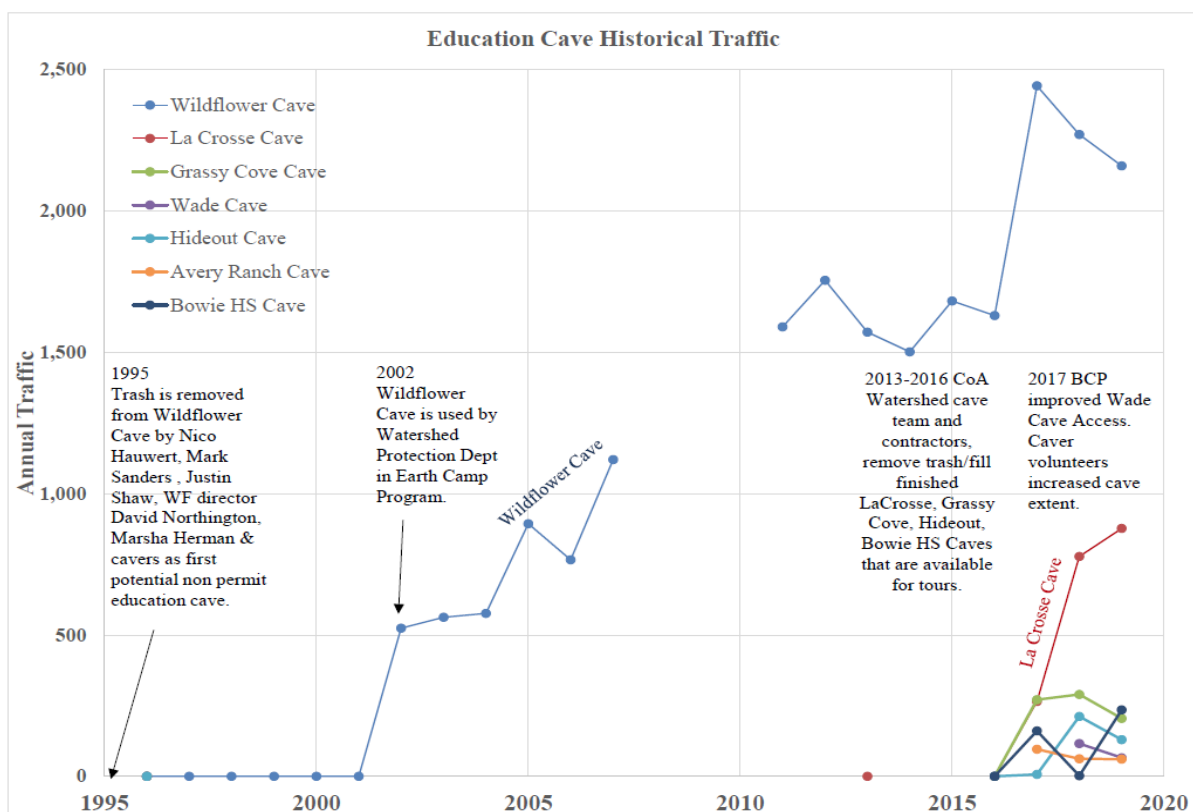


Figure 4. Historical traffic in education caves

FY22 Cave Education Summary

City of Austin (COA) Education Programs

During the 2021-2022 school year, the COA Watershed Protection Department (WPD) conducted cave and aquifer education through Earth Camp and Earth School (water quality programs for fifth graders), Watershed Detectives (middle school program), Hydrofiles (high school program), supporting additional outreach through CaveSim (education program involving a simulated cave experience), Clean Creek Camp (a summer parent/child water quality program), and Nature Nights at the Lady Bird Johnson Wildflower Center (public event for all ages). The 2021-2022 school year updates are detailed below:

Earth Camp and Earth School

Earth Camp is available to Title I (low socio-economic) schools in Austin Independent School District (AISD). The Lady Bird Johnson Wildflower Center is partnered with Earth Camp. During the 2021-2022 school year, students participated in a fieldtrip to LaCrosse Cave to learn about the cave habitat, how water flows through karstic limestone from the recharge zone of the Edwards Aquifer to Barton Springs, and how actions on the land affect water quality.

Throughout the school year, 1,206 fifth-grade students from 21 Title 1 schools participated in tours of LaCrosse Cave through this program. An additional 966 fifth graders from 10 schools received Earth School, which included live hands-on experiments with watershed models that feature a recharge zone with sinkholes and a karst aquifer model (Table 8). More details on these programs can be found online at: www.austintexas.gov/EarthCamp and www.austintexas.gov/earthschool.

Watershed Detectives and Hydrofiles

Watershed Detectives and Hydrofiles reach middle and high school classes with hands-on inquiry-based investigations of Austin's water resources. Local field studies involve monitoring local creeks and caving into the Edwards Aquifer. Students learn about hydrogeology and cave biology through “Austin Underground” videos and cave tours led by COA WPD staff. During the 2021-2022 school year, eight middle school students were given educational caving tours in Whirlpool Cave. Additionally, 46 high school students were given educational caving tours in LaCrosse Cave (Table 8). More details on these programs can be found online at:

www.austintexas.gov/watershededetectives and www.austintexas.gov/hydrofiles.

CaveSim

CaveSim provides standards-aligned programs for schools. They align the program with what students are currently learning, exciting demos, hands-on labs, and a simulated caving experience. All programs are taught by experienced educators and use the theme of cave exploration to get students excited about learning traditional subjects. COA WPD provided funding for CaveSim to reach 251 students from two Cities Connection Children to Nature target Elementary Schools and 240 middle school students, reaching a total of 491 students (Table 8). Programs covered many topics including groundwater (hydrogeology), conservation of caves and water, biology, physics, chemistry, and exploration of natural places. More details on these programs can be found online at: www.cavesim.com

Clean Creek Camp and Nature Nights

In summer 2022, families and the general public were given opportunities to receive educational caving tours through Clean Creek Camp and Nature Nights at the Lady Bird Johnson Wildflower Center. Clean Creek Camp is a partnership between COA WPD and Keep Austin Beautiful. Activities focus on watersheds, the Edwards Aquifer, and citizen actions that improve water quality. Clean Creek Camp is offered in summer to parents and their children ages 9-14. Clean Creek Camp brought 30 participants into LaCrosse Cave (Table 8). During the Lady Bird Johnson Wildflower Center’s Nature Night event on June 30, 2022, the COA WPD and COA Wildland Conservation Division worked together to provide educational tours

of LaCrosse Cave and Wildflower Cave to 150 participants. An additional 35 participants went on a karst hike that included a tour of a sinkhole, disappearing stream, and the entrance of a cave to learn about the recharge zone and cave habitat (Table 8). More details on these programs can be found online at: www.austintexas.gov/department/clean-creek-camp and www.wildflower.org/nature-nights.

Table 8. Summary of school year 2021-2022 COA WPD education programs providing virtual cave field trips and aquifer outreach.

Program	Grade	Total reached
Earth Camp (cave tour)	5 th	1,206
Earth School* (*presentation does not include cave immersion, but it does involve demonstrations of watershed model that features a recharge zone with sinkholes and a karst aquifer model)	5 th	966
Watershed Detectives	6 th -8 th	8
Hydrofiles	9 th -12 th	46
CaveSim outreach	3 rd -8 th	491
Clean Creek Camp	N/A	30
Nature Nights Caving	N/A	150
Nature Nights Karst Hike	N/A	35

Austin Water Balcones Canyonlands Preserve Program

AW BCP has done fewer cave tours during the pandemic but have instead given virtual presentations over Zoom or other software covering Cave Biology, Cave Conservation, and Hydrogeology. In FY22 that changed and AW BCP was the host of the National Cave & Karst Management Symposium (NCKMS) in San Marcos, <https://symposium2021.nckms.org>. Below is a list of presentations given and other outreach activities.

- **Nov 1-5, 2021:** National Cave & Karst Management Symposium (NCKMS), hosted by Austin Water- Balcones Canyonlands Preserve.
- **Nov 3, 2021:** NCKMS Field Trips: Cave Restorations on the Urban Frontier led by Drew Thompson and Colin Strickland
- **Nov 3, 2021:** NCKMS Field Trips: South Austin Wild Cave Tour: Management to Protect Cave Ecosystems, led by Mark Sanders and Rich Zarria.
- **Nov 3, 2021:** NCKMS Field Trips: Finding Caves in Northern Hays County: Recognition of Caves in an Environment of Widespread Filling, led by Nico Hauwert.

- **Nov 2, 2021:** NCKMS Oral Presentation: Austin Cave Restoration, by Colin Strickland.
- **Nov 2, 2021:** NCKMS Oral Presentation: Central Texas Cave Life, by Colin Strickland.
- **Nov 4, 2021:** NCKMS Oral Presentation: Ventilating high CO₂ caves, by Mark Sanders, Colin Strickland, and Drew Thompson.
- **Nov 4, 2021:** NCKMS Oral Presentation: The Sinkhole Stabilization of the Blowing Sink Research Management Area by Drew Thompson.
- **Nov 5, 2021:** NCKMS Oral Presentation: Widespread Cave Filling in Austin Texas by Nico Hauwert.
- **Nov 4, 2021:** NCKMS Poster Presentation: Monitoring Air Quality in Caves With a Butane Lighter by Mark Sanders, Colin Strickland, and Drew Thompson.
- **November 29th, 2021:** Presentation and tour of cave at McNeil High School, by Colin Strickland and Justin Shaw
- **April 20th, 2022:** Presentation to Ladybird Johnson Wildflower Center staff about the exploration of Ladybird Lounge Cave, by Drew Thompson and Colin Strickland.
- **April 28th, 2022:** USFWS BCP tour. In the morning they visited the TC BCP Ribelin tract, lunch and presentations at COA BCP Reicher Ranch, then a tour of COA BCP Stovepipe Karst Preserve lead by Colin Strickland, Drew Thompson, and Nico Hauwert.
- **May 19th, 2022:** Presentation and tour of cave at McNeil Highschool, by Mark Sanders and Colin Strickland.
- **September 20th, 2022:** Barton Springs University simulated cave dye trace, by Nico Hauwert, Colin Strickland and Drew Thompson. [Barton Springs University - Home](#)
- **September 20th - present:** Barbara Attwell set up her Austin's Endangered Heritage paintings in the Beverly S. Sheffield Education Center at Barton Springs. They are going to remain for an unspecified duration.
[The Cave Project - At the Well \(barbaraattwell.net\)](#)

Colin Strickland continues to produce short educational videos about karst invertebrates that are shared on the Wildlands Facebook page and used in cave training classes. They can be viewed on his YouTube channel: <https://www.youtube.com/@biosubterranea>

Austin Parks and Recreation

The Splash! Exhibit in Zilker Park includes a simulated cave and indoor displays, movies, and activities regarding the Edwards Aquifer.

<http://www.austintexas.gov/department/austin-nature-science-center>

FY22 Access Status

Because of the COVID 19 pandemic many caves were closed after March 2020 for cave tours and fewer cave tours were offered. Tours have started to pick back up with the wide availability of vaccines. In FY22, access was granted to COA-owned BCCP caves, TCMA-owned BCCP caves and other non-BCCP caves for educational/recreational/rescue training. The increased number of non-BCCP caves available has reduced traffic to BCCP caves. In FY22, 106 people entered COA-owned BCCP Caves, with visitors issued access permits by COA staff. COA-owned BCCP Caves include: Airmen's Cave (16), District Park (12), Goat Cave (70), Maple Run Cave (4), and Midnight Cave (4). A total of 633 people were granted access to TCMA-owned BCCP caves including: Lost Oasis (20) and Whirlpool (613) caves. An additional 1,864 people visited non-BCCP caves including Avery Ranch Cave (45), Grassy Cove Cave (35), Hideout Cave (0), LaCrosse Cave (1,593), Wildflower Cave (183), and Wade Cave (8) (Table 9). See Table 3 for access and gating status of all the BCCP caves.

Table 9. Summary of FY20 educational and recreational cave trips into Non-BCCP Caves compared to BCCP Caves.

Status	Cave	Visitors	Total Visitors
Non-BCCP Caves	Avery Ranch	45	1,864
	Bowie	0	
	Grassy Cove	35	
	Hideout	0	
	LaCrosse	1,593	
	Wildflower	183	
	Wade	8	
BCCP Caves	Airmen's	16	739
	District Park	12	
	Goat	70	
	Lost Oasis	20	
	Maple Run	4	
	Midnight	4	
	Whirlpool	613	
Non-BCCP and BCCP Caves Combined			2,603

5.0 MANAGEMENT COORDINATION AND OVERSIGHT

COA and TC determined that there was a need to create a master database on BCP karst fauna monitoring and management with the ability to analyze these data to determine current status and compliance with the regional permit, as well as determine future needs of the listed species. The Karst Database houses all faunal survey data from BCCP caves and provides much of the information needed for these karst analyses. This database is now available for use by BCP partners to enter survey data, and all available data have been entered to date. Though the intent is for this database to be a “shared” information source for all the BCP partners, there are still confidentiality challenges on how to establish this protocol. This database will focus on permit compliance, species status, and contribution to recovery.

Based on recommendations made in Dr. Butch Weckerly’s analyses of karst survey efforts on the BCP (Weckerly 2010), COA and TC modified and expanded the BCP’s cave monitoring program in FY11. COA and TC identified 25 caves within Travis County managed through BCP partners that provide a more evenly distributed dataset across cave clusters and karst fauna regions (KFRs); this dataset includes both BCCP caves and other ES/SOC caves on the BCP. The number and frequency of karst faunal surveys and cave cricket exit counts are now synchronized among managing partners to better accommodate comparisons and determine species trends. The goal of the cave monitoring program is to provide a clearer understanding of the species distribution and health of karst ecosystems across the BCP.

In FY16, COA/TC BCP staff collaborated on creating guidelines to provide best management practices (BMPs) at construction sites where tawny crazy ants (TCA; *Nylanderia fulva*) have not been confirmed, to supplement BMPs created in FY15 focusing on construction activities within known TCA sites. TCA are a newly discovered non-native ant species which could potentially adversely affect forest and karst ecosystems on the BCP. Implementation of these BMPs will be critical to minimizing the potential of introducing new populations of this destructive species to other parts of Austin and elsewhere. In FY22, these BMPs continue to be disseminated to appropriate TC/COA departments and other agencies.

In FY22, AW BCP staff continued air monitoring in Ireland’s Cave, Grassy Cove, and Whirlpool Cave. This monitoring is intended to better understand factors influencing airflow and factors influencing concentrations of carbon dioxide gas, which is a potential hazard. The results of this monitoring are presented in Appendix **.

6.0 BIOLOGICAL MONITORING

Caves containing endangered and rare karst invertebrates on BCP properties are monitored to determine long term trends in populations of cave organisms and overall cave conditions. All COA and TC-owned BCP caves with endangered species are surveyed annually. In addition, TC and COA incorporated the newly expanded monitoring plan in FY11, which includes the 25 Travis County caves selected to represent an evenly distributed dataset across cave clusters and KFRs. Caves included in this monitoring plan are surveyed bi-annually, occurring in Spring (May) and Fall (November) or Summer (August) and Winter (mid-January-mid February). Biomonitoring of the caves follow methodology and techniques supported by USFWS to provide results that can be compared between caves throughout the region for better study and analysis (USFWS 2014a).

Beyond USFWS recommendations, survey methodology also follow guidelines described in the *2016 Balcones Canyonlands Preserve Land Management Plan: Tier II-A Chapter IX Karst Species Management*. The protocol for research and monitoring cave fauna involves the use of one to seven (depending on size of cave and logistics) predesignated, permanent survey zones per cave in which all living organisms encountered are identified and enumerated. Survey zones are either transects approximately 5 meters in length that span the width of the cave, or distinct units of the cave such as a small room or an easily discernible section, so that the size and location of the survey area remains constant during the study for trend comparison. For each survey zone, start and end time and the presence of trash or new vandalism are recorded. Relative humidity, temperature, nutrient input, dampness condition, and the presence of red-imported fire ants (RIFA; *Solenopsis invicta*) and TCA are also recorded both outside the cave and at each transect or zone. All data collected during cave surveys are entered into the BCP Karst Database.

Any unknown invertebrates observed during faunal surveys are collected and identified by a karst invertebrate specialist. In caves containing endangered species, collecting only occurs with a special collecting permit obtained by USFWS. All collected specimens are deposited within the Texas Memorial Museum or other reputable facility (USFWS 2014a). The date of deposition and collection number is also recorded (USFWS 2014a).

Land managers also monitor the entrances of caves containing endangered species at least once a year for anything that might harm the rare invertebrates including presence of toxic substances, unauthorized access by recreational cavers, and surface disturbances which might have erosive potential or cause changes in surface drainage patterns.

The overall health of caves is also monitored by performing semi-annual cave cricket exit counts. Cave cricket exit counts are done as crickets emerge from caves during good weather

nights (i.e., not raining, warm, etc.). The duration of the counts is timed for two hours starting at sunset, to maintain consistency with all surveys done between managing partners. Current weather conditions, surface temperature, and relative humidity are documented for each survey. Crickets emerging are placed in one of three age classes: nymph (up to 5 mm), sub-adult/juvenile (5-12mm) and adult (>12mm). Number of individuals exiting the cave is counted in ten-minute intervals. Time of first cave cricket exit and any other vertebrates exiting the cave are also recorded. An evaluation of TC/COA's cave cricket exit count survey protocol determined that this methodology meets criteria necessary to assess cave cricket abundance at caves as well as estimate changes over time in the number of cave crickets that emerge from cave entrances, both of which are necessary for determining the state of cave ecosystems and evaluating the effectiveness of the BCP's karst management goals (Weckerly 2012).

FY22 TC/COA Collaborative Monitoring Projects

Since FY12, BCP staff have included monitoring for presence of TCA at all visits to cave sites, using a monitoring and collection protocol and reporting procedures created by TC and COA BCP staff and updated in FY15. In FY13, at least two BCCP caves (Whirlpool Cave and No Rent Cave) were confirmed to be infested by TCAs. COA and TC staff continued to conduct quarterly biological surveys at Whirlpool Cave from FY13 – FY17 to document TCA use of cave environments and assess impacts of this new invasive species on cave fauna (EXHIBIT A). Surveys at Whirlpool Cave were reduced to bi-annually in FY18. For FY 22 staff did not observe any TCA activity in Whirlpool cave. In FY14, TC and COA also expanded monitoring of Weldon and No Rent Caves to document the arrival and impacts of another TCA population in the vicinity of these caves (EXHIBIT A). Subsequently, the TCA population at these caves had disappeared for unknown reasons until February FY22 where they were documented in and around No Rent Cave again. At which time, they were also seen around the entrance of Weldon Cave but were not observed in the cave until May 2022. As a result, quarterly faunal surveys and cricket exit counts were reintroduced to monitor the impacts of TCA on these caves. TC is now collaborating with Dr. Ed LeBrun at BFL to study and inoculate the population with the microsporidian pathogen to attempt to mitigate any impacts to the karst invertebrates contained within.

TC and COA BCP staff began conducting bi-annual cave faunal surveys of Millipede Cave and Millipede Annex Cave in FY13 and continued surveys for FY22 to gather baseline data for the McNeil High School courtyard restoration project, which commenced in FY15 (EXHIBIT A). Management activities such as vegetation planting and trash removal were coordinated with McNeil High School staff and students to improve surface conditions of these

two non-BCCP ES caves, with the intent of improving nutrient input and benefiting cave crickets and cave fauna. In FY18, staff observed and collected an extremely rare arachnid, Order Schizomida from Millipede Cave for species identification, and the species was also confirmed in the adjacent millipede annex cave December 2021. The specimen was determined to be *Stenochrus portoricensis*, believed to be native to the Yucatan Peninsula and has been discovered in greenhouses in Europe. It's likely that this species was inadvertently introduced via plants purchased at local nurseries by school staff. BCP staff will continue to monitor this newly introduced predator to see what direct and/or indirect impacts it will have on cave fauna.

Starting in FY20, COA and TC staff assisted with the USFWS to address phylogenetic and species determination questions for the federally listed cave mold beetles of Travis and Williamson Counties. The goal was to collect up to 3 specimens from a large list of caves that were within the known ranges of *Texamaurops reddelli*, *Batrisodes reyesi*, *Batrisodes texanus*, and *Batrisodes cryptotexanus*. This phylogenomic approach will help answer the species delimitation questions with a robust molecular dataset. Collections for this project were completed in FY21, and staff along with other collaborators was able to successfully collect from many of the selected caves. Preliminary results in FY 22 show that *B. reyesi* does not occur in Beck Cave cluster/Round Rock KFR but is apparently a new undescribed species, likely sister to *B. texanus/cryptotexanus*. Also results still show overlap in range distribution for *B. texanus* and *B. cryptotexanus*.

In FY22 Shahan Derkarabetian, Pierre Paquin, James Reddell, and Marshal Hedin published the paper, Conservation genomics of federally endangered *Texella* harvester species (Arachnida, Opiliones, Phalangodidae) from cave and karst habitats of central Texas. In the paper they did not take formal taxonomic action, however, the report states that “Based on all data available, we hypothesize that the northern *T. reddelli* samples from the three caves that we sampled (from east Jollyville FKR) are members of *T. reyesi*”, so if that's the case, then all of the *T. reddelli* caves north of the Colorado river would actually be *T. reyesi*. The report states that “We hypothesize that the Colorado River also acts as a species level barrier in *Texella*.”

To date, staff will wait till formal taxonomic action takes place prior to changing the species determination on Table 3 of this report. In regards to *T. reyesi*, the report found that there was a significant amount of genetic variation within the *T. reyesi* range, however, they hypothesize that these be considered the same species, “...while there is clear genetic and ecological differentiation within *T. reyesi*...the level of male genitalic divergence is limited...A conservative taxonomy would treat these as different populations within a single variable

species...”, so the *Texella* north of the Colorado River, Northern Travis and Williamson Counties are all hypothesized to be *T. reyesi*, therefore, no changes to the existing species determination.

In FY 22 USFWS staff requested COA and Travis County staff collect more *Texella* specimens in selected caves to allow for a more thorough analysis of the species range and if some of these sites have undescribed species.

TC and COA BCP sent an assortment of blind *Cicurina* spiders to Dr. Marshal Hedin in FY21 for molecular identification. The results for this were acquired in FY22 and the report can be seen in Balcones Canyonlands Conservation Plan Annual Report Appendices. The most notable finding was the specimens collected at Hammett’s Cave in Westcave Preserve appear to be a novel species. In order to continue this analysis, more collections will be done there, and any nearby caves, if future access is granted in FY23.

TC and COA BCP continued to assist James Reddell with his project of updating the cave faunal lists and accurate locations of area caves for the Texas Speleological Society (TSS) database.

City of Austin FY22 Biological Monitoring

During FY22, COA BCP staff conducted bi-annual monitoring on the following 16 pre-selected caves: Airman’s Cave, Broken Arrow Cave, Cave Y, Cortana Cave (non-BCCP cave), Cotterell Cave, District Park Cave, Flint Ridge Cave, Jester Estates Cave, Little Bee Creek Cave, Maple Run Cave, Midnight Cave, Pond Party Pit (non-BCCP cave), Seibert Sink (non-BCCP cave), Spider Cave, Stovepipe Cave, and Testudo Tube (non-BCCP cave) (EXHIBIT A). In an effort to get a better handle on baseline data, in FY 18 COA BCP staff completed one year of quarterly faunal surveys at Get Down Cave, Lost Oasis Cave, and Pipeline Cave. Survey frequency for these caves has been reduced to bi-annual surveys for Pipeline Cave and Lost Oasis and annually for Get Down Cave. The reason why we reduced the frequency for Get Down Cave was to limit staff exposure to soft ticks/ TBRF. Staff completed quarterly surveys for one year for the newly restored Black Cap Cave, and Persephone Caverns and will now drop surveys to twice yearly. Staff also completed twice yearly surveys for the recently restored Gaping Maw Cave and will continue twice yearly surveys for this cave. (EXHIBIT A). Faunal surveys in these caves were conducted by permitted COA biologists in either Fall 2021/Spring 2022 or Winter 2022/Summer 2022. As part of a long-term site restoration project, COA BCP staff continued to conduct bi-annual surveys at Millipede and Millipede

Annex Cave (EXHIBIT A). Annual faunal surveys were also conducted in Another Cave, Arrow Cave, Beard Ranch Cave, Blowing Sink, Collaboration Cave, Goat Cave, Ladybird Lounge Cave, Rolling Rock Cave, and Slaughter Creek Cave. (EXHIBIT A).

In FY22, COA BCP staff, with the help of volunteers, conducted bi-annual cave cricket exit counts at the same 16 caves pre-selected for faunal surveys (EXHIBIT B). surveys and cricket counts at Get Down Cave will be reduced to once annually in January due to safety concerns with soft ticks/TBRF. Staff completed quarterly cricket exit counts for one year for the newly restored Black Cap Cave, and Persephone Caverns and will now drop surveys to twice yearly. Staff also completed twice yearly surveys for the recently restored Gaping Maw Cave, and will continue twice yearly surveys for this cave. (EXHIBIT B). COA BCP staff also conducted one cave cricket exit count at Jest John Cave (EXHIBIT B).

Travis County FY22 Biological Monitoring

TC's BCP staff conducted bi-annual monitoring on the following eight pre-selected caves: Adobe Springs, Cold Cave, Gallifer Cave, Geode Cave (non-BCCP cave), Kretschmarr Cave, Spanish Wells Cave, Stark's North Mine, and Tooth Cave. Faunal surveys in these caves, with permitted TC biologists, were conducted in Fall 2021/Spring 2022 or Winter 2022/Summer 2022 (EXHIBIT A). In response to a recent resurgence of TCA, TC staff started performing quarter faunal surveys at two TC-owned BCCP caves: No Rent and Weldon Caves. Annual faunal surveys were also conducted in four other TC-owned BCCP caves with federally listed species: Kretschmarr Double Pit, McDonald Cave, New Comanche Trail Cave, and Tardus Hole (EXHIBIT A). TC staff also conducted an annual faunal survey at one additional BCCP listed cave: Ireland's Cave (EXHIBIT A).

TC BCP staff conducted bi-annual cave cricket exit counts in FY22 at all the caves pre-selected for faunal surveys: Adobe Springs Cave, Cold Cave, Gallifer Cave, Geode Cave, Kretschmarr Cave, Spanish Wells Cave, Stark's North Mine, and Tooth Cave. Exit counts were conducted in Fall 2020/Spring 2021 or Winter 2021/Summer 2021. TC staff started performing quarterly cricket exit counts at No Rent and Weldon Caves in response to TCA reintroduction. An annual cricket exit count was also conducted in one TC-owned BCCP cave: New Comanche Trail Cave (EXHIBIT B).

RIFA surveys were only performed in Spring 2022 on eight of fifteen TC-owned BCCP caves and one additional ES cave with federally listed species. RIFA mounds were surveyed within an 80 m radius around cave entrances, and all active mounds found during surveys were treated

with boiling water as recommended by USFWS (2014b). In Spring of 2022, a total of 186 RIFA mounds were treated within these 80 m cave survey areas, with an additional 21 RIFA mounds treated in the vicinity of caves but outside of survey areas. Survey results and treatments for individual caves are documented in Table 10.

In addition to managing the karst features required in the BCCP permit, TC voluntarily managed other karst features located on BCP land in FY22 including Cactus Pit, Brew Pot Cave, Kretschmarr Sink, and karst features RI-1, LU-11 and LU-12.

TC BCP staff along with its contractor, Zara Environmental, have made significant gains in locating, restoring, and monitoring various caves on the Kotrla Unit (Endres, Flying K, Kotrla, and Scott & White tracts) for potential substitution of Ceiling Slot and Moss Pit Caves. In FY17, the Unit was only composed of the Kotrla and Scott & White tracts (~950 acres) where several karst features were found, including seven significant caves (refer to FY17 Annual Report). In FY19, with the permission of the landowner of the adjacent Flying K Ranch, TC BCP investigated the property to see if other caves could be discovered. Like the Kotrla and Scott & White tracts, the Flying K contained numerous features of varying degree. Most of these required some excavation, which was conducted by Zara in FY20, to see if they harbored karst invertebrate habitat. Twenty-one features were evaluated, of which, five were found to be significant caves. In FY22, due to high karst potential, TC BCP was able to acquire an additional 620 acres of the Flying K Ranch bringing the Kotrla Unit to a total to 1,576 acres.

In FY22, Zara performed services that were a continuation of work from FY17 which focused on the Kotrla and Scott & White tracts to identify karst features, evaluate them for habitat, excavate if necessary and conduct biological surveys. Through a variety of on ground searches and LiDAR analyses, TC BCP and Zara were able to locate 17 previously unknown karst features, of which seven currently qualify as caves. Notably, some of these caves contain significant troglobitic diversity and there are still ongoing efforts to get a full inventory, but some results can be seen in Exhibit A. The report for all FY22 activities can be found in the Balcones Canyonlands Conservation Plan Annual Report Appendices.

Other Biological Monitoring Efforts

Zara Environmental conducted biological monitoring at Pennie's Cave in FY22 as part of an adaptive cave management plan for a development project that began with the reopening of the cave's entrance in 2012. Due to difficulty with securing a contract due to COVID 19, Zara Environmental scaled back monitoring efforts and conducted one Spring RIFA treatment with boiling water in FY22. Due to high CO₂ levels, in FY18 Zara installed a semi-permanent in-

cave air ventilation system that greatly improved air quality, thus allowing for in-cave faunal monitoring, staff was also able to complete the interior cave mapping. A written report of their work in FY22 was also provided (Zara Environmental 2022a; Appendix T10 of BCCP FY22 Annual Report).

COA BCP Staff have continued conducting bat monitoring activities in FY 2022. Acoustic bat monitoring equipment were deployed in the entrances of Goat Cave and County Line Bat Cave. The data collected from the acoustic bat meters (SM4BAT-FS Ultrasonic Bat Detector) will determine what species of bats are present during which times of the year. A meter had been deployed at Hays Ranch Bat Cave and was pulled when the batteries died, but we have yet to look at the data from it. Bat meters will be deployed at Hays Ranch Bat Cave and Barker Bat cave in Early 2023 utilizing external batteries for longer recording durations.

In FY 23 COA BCP staff will continue to assist James Reddell and the Texas Speleological Survey (TSS) in surveying, excavating, and mapping the karst of the USFWS Balcones Canyonlands National Wildlife Refuge (BCNWR). One cave of interest that may be a suitable substitution for another BCP permit cave that has inadequate protections is Collaboration Cave. Collaboration Cave was initially a 25.5 ft deep shaft plugged with rocks and soil. After 14 days of excavation the shaft is approximately 35 ft deep and there is about 40 ft of horizontal passage with a small stream flowing through it. The stream is inhabited by stygobitic isopods *Caecidotea* sp. and amphipods *Stygobromus* sp. Colin Strickland produced a video of this cave stream and its inhabitants which can be viewed here:

<https://www.youtube.com/watch?v=XbFbXYWo16c>.

Excavation activities will continue both upstream and downstream until all promising leads have been exhausted. At which point, the cave will be mapped, and thorough faunal surveys will be conducted. These efforts continue to expand the knowledge of cave fauna in the karst fauna region shared by two BCCP caves: Jack's Joint and Armadillo Ranch Sink. Once the map and faunal surveys are completed, COA BCP staff will provide a written report of their efforts. Due to the pandemic no excavation work was done in FY2020, FY2021, or 2022, hopefully work can continue in FY2023.

In FY22 COA BCP started a new project of looking at Trichoniscid species in the Austin area. Once enough material is collected the DNA will be analyzed by Bold Systems (<https://www.boldsystems.org>). Though DNA analysis alone will not properly describe them, it can give us an idea of the diversity present, and maybe encourage a taxonomist to take on the project. Depending on how successful this project is, we may plan to expand DNA analysis

to other species. We are particularly interested in species where we are unable to find a taxonomist who can make species level determinations. *Rhadine* beetles as well as stygobitic isopods and amphipods are good candidates. Also, *Speodemus*, since there are likely cryptic species that DNA analysis will reveal.

COA BCP has continued to collaborate with Texas State University, Baylor School of Medicine, and the Centers for Disease Control (CDC) on a study to further understand and document the recent increased occurrence of Tick-borne Relapsing Fever (TBRF) in Central Texas. TBRF is a bacterial infection that can cause recurring bouts of fever, headache, muscle and joint aches, and nausea. *Borrelia* bacteria that cause TBRF are transmitted to humans through the bite of infected soft ticks of the genus *Ornithodoros*. All recently confirmed cases of TBRF in the Austin area have been attributed to *Borrelia turicatae*, and the ticks have all been confirmed as *Ornithodoros turicata*. Soft ticks (Family: Argasidae) differ from the more familiar hard ticks (Family: Ixodidae) in two main ways. They have a short feeding duration, usually less than half an hour, and they do not search for hosts in grass or brush but instead reside in animal burrows (CDC TBRF, 2015).

COA BCP continues to monitor soft tick populations to better understand the level of risk that may be associated with caves accessed by the public (Figure 4). Priority has been given to the education caves due to the large number of children visiting them, followed by caves in the Barton Creek Greenbelt that are well known hangouts for hikers that are seeking relief from the Texas heat.

Pit fall traps using dry ice were deployed in caves in the Austin area to survey soft tick populations. Specimens were collected alive and stored in ventilated plastic vials for transport to Texas State University's Professor Dr. Ivan Castro and his students. Some ticks were then sent to Job Lopez at Baylor College of Medicine for *Borrelia* identification and further TBRF research. The information gathered is being shared with Jeff Taylor of the Epidemiology and Disease Surveillance Unit of the Austin Public Health Department, and the CDC.

The number of ticks has dropped in Live Oak Cave; but has risen in Airman's Cave. Environmental researcher Ethan Perrine has stepped forward to help continue our efforts in the study of the rise and fall of tick numbers within our caves. Researcher Job Lopez collected soft ticks from voids adjacent to live oak cave and also collected large #'s of soft ticks in small voids at the base of Barton Creek's Seismic Wall. It is unclear what causes some caves to have such high numbers. It is likely due to the presence of favorable cave environments (soft, dry soil that is easy to burrow in) and ample access for specific host species such as mice, racoons, and rock squirrels. Reddell (1988) noted that relapsing fever is typically associated with dry,

shelter-like cave entrances with specific mammals such as goats and that infections of a cave by *O. turicata* with *Borrelia turicatae* could possibly be cyclic. Some birds and mammals, particularly predators, are associated with reductions in ticks, either by reducing/intimidating host species such as rodents or by directly preying on ticks (Hofmeester et al., 2017; Ostfeld et al., 2018). COA BCP will continue to monitor education and public access caves, such as Airman's and Bullet Caves. The detection of a single tick does not make a cave high risk for relapsing fever; however, cave guides should be informed about the risk of TBRF should later symptoms arise. There is concern that fear-driven over reaction to TBRF could lead to impairment or destruction of cave ecosystems, as was historically the case in earlier planned bat extermination efforts as a result of irrational fear of rabies. Furthermore, the soft ticks must be infected with *Borrelia turicatae* in order to transmit TBRF.

Due to the pandemic, and the lack of cave tours only Live Oak Cave at Village at Western Oaks Karst Preserve was surveyed in FY2022. Since cave tours will begin resuming in 2023, surveys will be conducted at education caves with favorable soft tick habitat. In FY22, caves where people have contracted TBRF and are identified as a high risk for TBRF include Live Oak Cave and Get Down Cave at Village at Western Oaks Karst Preserve; Airmen's Cave, Spider Wire Cave, and Bullet Cave along the Barton Creek greenbelt; and Little Black Hole and Under the Road Cave near the Ullrich water treatment plant. Drew Thompson was bitten by soft ticks in Get Down Cave so the Biannual cricket counts, and faunal surveys have been dropped to annually, to be performed in January, when hopefully the cold will make the ticks, which are mostly in the entrance room, less active. With the rise in the number of ticks in the entrance to Airman's Cave, the cricket counts for that cave will be postponed until a safe way to do so is conceived.

7.0 HYDROGEOLOGIC STUDIES & CAVE RESTORATION

The understanding and protection of water sources to caves is vital for preserving cave life that relies on it. Water sources include surface catchment areas that direct runoff to the cave entrance and subsurface catchment areas where overlying water infiltration from either rainfall or runoff supports cave drips. Surface catchment area delineation generally involves examination of a combination of field GPS delineation of catchment divides and drainages as well as surface topographic contour coverages. Subsurface catchment studies may involve direct tracing, water-quality characterization, drip rate monitoring, geological mapping, cave survey mapping, and cave radio surveying.

Cave restoration is an extremely slow and labor-intensive part of cave preserve management that is a necessary prerequisite for conducting hydrogeological studies, vital for re-establishing necessary nutrient input and habitat for cave ecosystems. Historical land use practices over karst areas across the Austin area involved plugging caves and sinkholes to keep water at the surface for livestock ponds, mills, and access to shallow sources. Caves were also historically used for trash disposal. Open caves also created hazards for people and livestock, and filling caves with trash seemed like a practical solution to ranchers, particularly given that, prior to local dye tracing studies, many scientists erroneously believed groundwater flowed slowly through tiny pores and that ground water was completely filtered before reaching the water table. Many caves were also covered by urbanization and many local caves that could have been preserved were filled in under the assumption that this measure protected the underlying aquifer from contamination. Efforts to remove trash and fill from caves is slow and regulated to a small group of cave-trained women and men. Once trash and fill are removed from a cave, utilization of the cave by cave-adapted organisms follow, including cave crickets, bats, and other mammals that bring nutrients from the surface. A large number of the 62 federal permit caves required excavation of fill or trash, and some such as in the case of Pipeline Cave below, still require it. An article on cave restoration by AW BCP was published in the Wildflower Center magazine in November 2019 (Hauwert and Sanders 2019). In addition to restoring cave habitat, cave restoration can also serve to restore recharge and reduce flooding where the cave catchment area is large, improve water-quality in caves filled with trash, and provide educational resources necessary to allow the public to make connections with natural ecosystems. To support cave restoration efforts, AW BCP produced a Guidelines for Cave Restoration in February 2020. In November 2018, AW BCP released version 3 of Austin Cave Activity Hazards and Safety Report that describes unique cave hazards, protocols for addressing them, and relevant safety regulations.

In addition to the large challenges of widespread historical cave filling, the highly specialized skill and dedicated physical effort required to restore them, and limited resources available for cave restoration, in January 2018, while attempting to unplug BCCP permit Blowing Sink Cave, it was observed that regulation of cave restoration was unclear. In order to clarify the regulatory status of cave restoration and provide distinction of cave restoration from other development activities that could harm caves, Austin Water, Watershed Protection Department, Parks and Recreation Department, and the Development Services Department finalized an MOA which took effect on April 1, 2020 that clarifies that cave restoration using hand-held tools is not a development activity requiring a permit. However, for cave restoration, the use of backhoes and similar heavy machinery, laying of impervious cover and even cave gating requires prior discussion with WPD staff. The Texas Commission on

Environmental Quality Edwards Rules similarly requires approval prior to the use of heavy machinery for cave restoration.

Some Central Texas caves are known to have high levels of CO₂ during certain times of the year, with generally higher levels in the hotter months and lower levels in the cooler months. Some of these caves are utilized for public tours, and some are inhabited by rare karst invertebrates and require faunal surveys, so knowing when CO₂ levels are lower is important. To better understand how CO₂ levels vary and how the caves ventilate, CO₂ meters, temperature/barometric pressure data loggers and anemometers were set up in Grassy Cove Cave, Ireland's Cave and Whirlpool Cave by ZARA Environmental LLC. The pulling of data and maintenance of this equipment was transferred to The City of Austin Balcones Canyonlands Preserve (COA BCP) in late 2021. The full CO₂ Monitoring Report FY22 can be found in the Balcones Canyonlands Conservation Plan Annual Report Appendices. Figure 5 from the report shows the variations in cave temperatures in Grassy Cove, Ireland's and Whirlpool. Figure 6 shows the significant negative relationship between CO₂ and barometric pressure in Ireland's Cave, with higher CO₂ levels at lower pressures and lower CO₂ levels at higher pressures. This is also shown in Figure 7 where dropping barometric pressure is correlated with CO₂ levels rising and rising pressure is correlated with falling CO₂ levels.

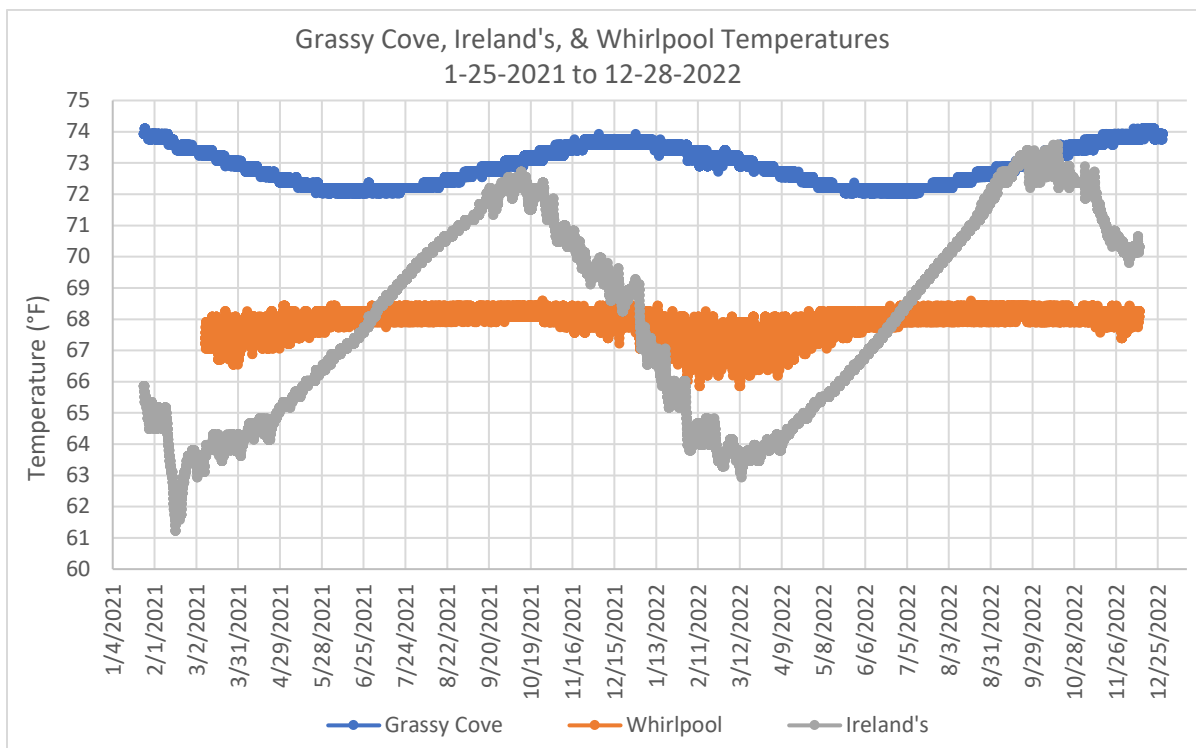


Figure 5. Grassy Cove, Ireland's, & Whirlpool Temperatures, 1-25-2021 to 12-28-2022

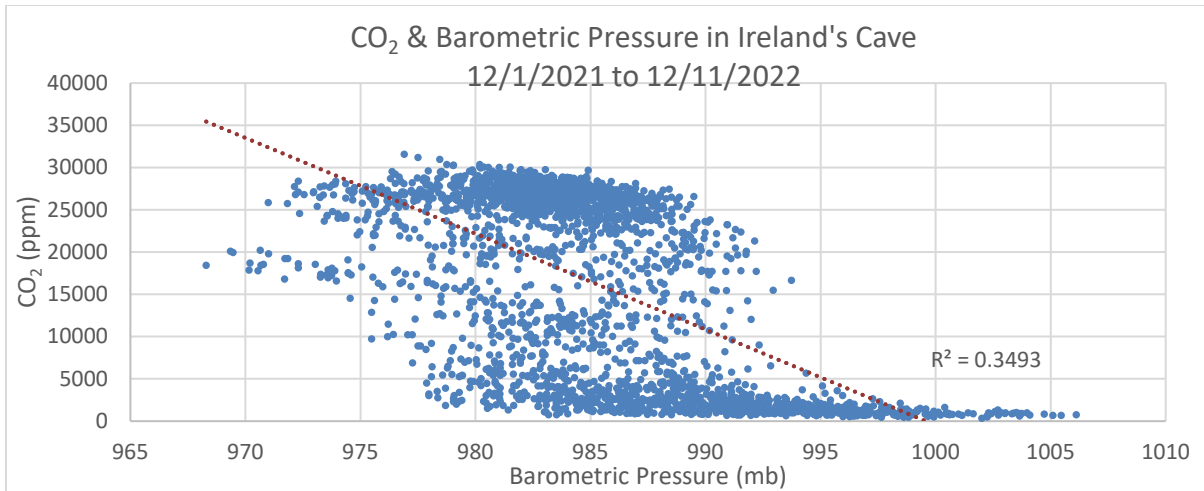


Figure 6. CO₂ & Barometric Pressure in Ireland's Cave, 8/23/2021 to 12/10/2022, ($R^2 = 0.3493$, $F(1,2649) = 1421.70$, $p < .0001$)

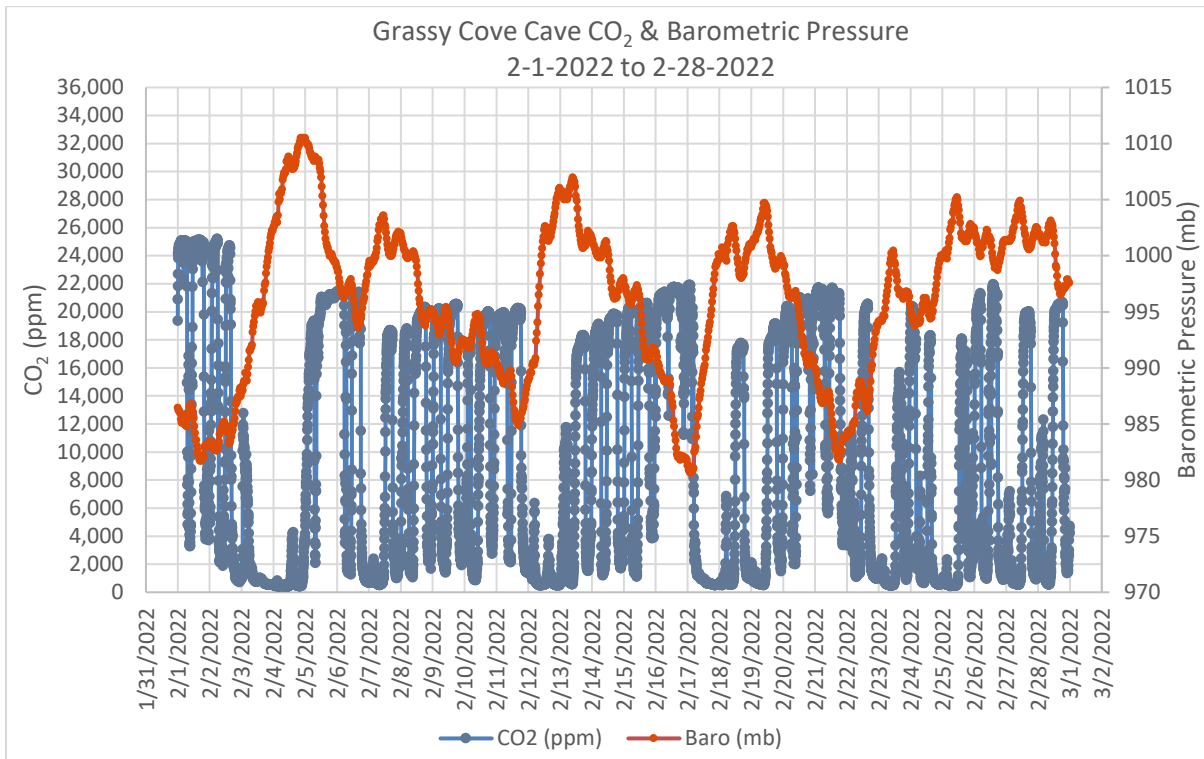


Figure 7. Grassy Cove Cave CO₂ & Barometric Pressure, 2-1-2022 to 2-28-2022

Monitoring of Flint Ridge Cave continued in FY22, drip monitoring inside Flint Ridge Cave. A data-logging Hydrolab sonde has been continually recording water quality metrics every hour since July 31st, 2019. It measures water temperature, specific conductivity, pH, and

dissolved oxygen, and turbidity. In May 2019 State Highway 45 SW began operation as a toll road over the cave and subsurface catchment area.

Using Section 7 conservation measure funds provided by TxDOT in 2018, cave restoration and spring evaluations are being conducted in the FM 2222 and FM 620 area as part of a hydrogeological study expected to be completed in FY23, but also to restore cave habitat and establish formal karst preserves based on improved scientific information.

The cave restoration portion of hydrogeological studies is the slowest, most labor and funding intensive portion. There are limited resources for cave restoration, and it requires specialized cave expertise which is not common. FY 22 cave restoration efforts are described below.

City of Austin FY22 Cave Restoration Projects

Stovepipe Preserve Cave Restoration

In preparation for an upcoming hydrological study of Stovepipe Cave multiple features on Stovepipe Preserve are being restored Including Coffee Mug Cave, Persephone Caverns, Gaping Maw Cave and Sacred Grove Cave. Prior to restoration efforts Stovepipe was the only known cave on the property. Now there are seven caves on Stovepipe Preserve with likely more to come. Cave restoration on this preserve in FY22 was funded by mitigation funds provided by TxDOT.

Coffee Mug Cave

Coffee Mug cave was discovered while karst walking on the Stovepipe Karst Preserve in the spring of 2021. The initial sink was approximately 2 inches by 2 feet and 8 feet deep with notable airflow. The feature had similar characteristics to Persephone Caverns before restoration, so it was placed high on the list for future excavation efforts. In June of 2022 Zarria Environmental was awarded the project to excavate the feature to a depth of 12 Feet. The pit flared out at approximately 6 feet down allowing easier access to work in the constricting pit. With great effort, the Zarria Environmental Team excavated to a depth of over 14 feet in depth leading into a small 2 foot by 2 foot room at the bottom of the pit. The floor is soil and the possibility to dig down further could be done but with great effort. Flat stones were placed over the enlarged entrance to help keep moisture inside the feature, with gaps for crickets to exit.

Persephone Caverns

Faunal surveys were performed quarterly to document the changes after restoration and will then be dropped to bi-annually in FY23. With its proximity to Stovepipe Cave, it is likely *Tayshaneta devia* another species of concern will eventually be found. On September 17th Zarria Environmental moved hundreds of clay balls from the south lead farther north in the passage to prepare for a future push on the south lead. Drip gauges were set up under Small But Mighty Drip and Clay Bowl Drip (Figure 8). Tricolored bats are found in the cave, with them being seen in the far northern section as well as the far southern section. They hibernate in the entrance room in the winter (Figure 9). The Biannual surveys are going to be switched to Spring and Fall to avoid disturbing the bats during hibernation. Each year a quick check of the entrance room in January will count any bats present.

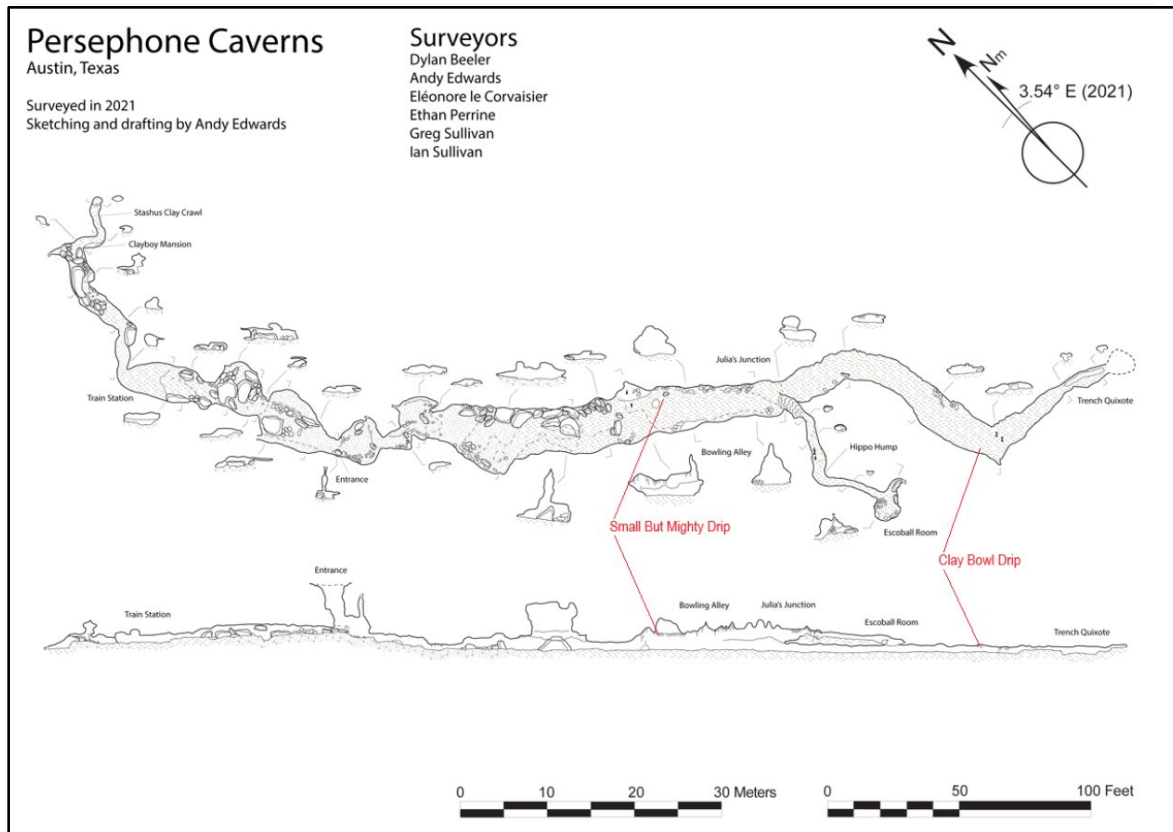


Figure 8. Locations of drip gauges in Persephone caverns



Figure 9. Hibernating tricolored bat, Persephone Caverns, January 28th, 2022, photo by Colin Strickland

Gaping Maw Cave

In December of 2021, Zarria Environmental was awarded the bid for the expansion of Gaping Maw Cave. The goal was to push the boulder filled pit at the back of the cave, taking a down at least 6 feet. The Zarria team made their way down the pit that was chalked with large breakdown blocks that had been heavily glued together with calcification. Making it down 8 feet the hit a room that is approximately 3 feet wide by 6 feet long and 2 feet tall. The new room has a mud floor and at the end of the room airflow can be felt coming out of a shallow bedding plane. The team had also made their way into another room above the pit that is approximately 3 feet wide and 4ft long by 2 feet tall (Figure 10). The new rooms both have great potential to become very good species habitat. A drip gauge was placed under Dragon Egg Drip approximately where the column is shown in the profile view below.

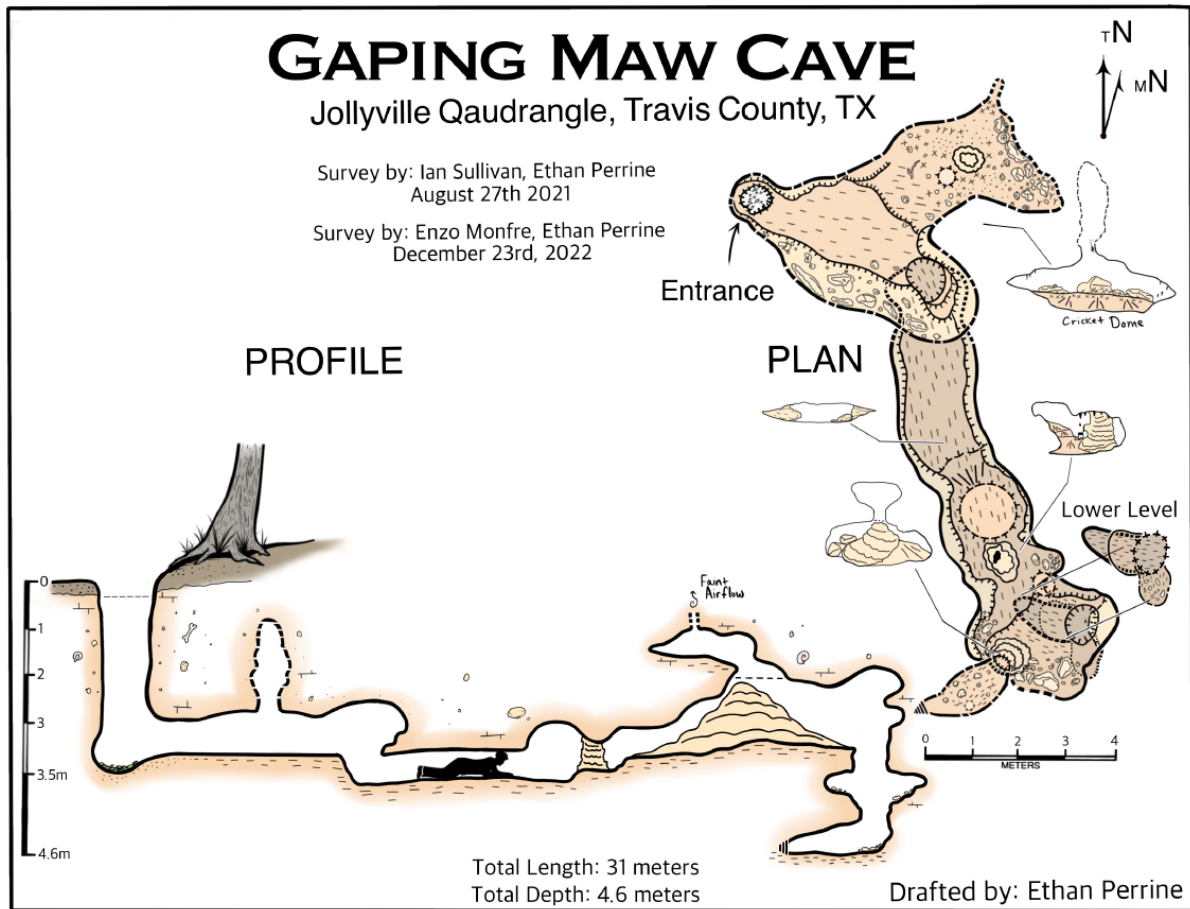


Figure 10. Gaping Maw Cave map, drafted by Ethan Perrine

Sacred Grove Cave

Sacred Grove was initially found by Colin Strickland in 2019 (Figure 11). Colin started restoration work in 2020 and got about 6 feet deep. Zarria Environmental worked on it during August and September 2022. The feature was restored to around 15 feet deep where it opened into a room with about 1 foot of space between the dirt floor and solid rock ceiling (Figure 12). Colin Strickland did a faunal survey on September 17th, 2022 and found one *Cicurina trivisa*, two *Cambala speobia*, and about a dozen *Ceuthophilus secretus*. Work will continue in FY23 to expand the cave, map it and delineate faunal survey zones.



Figure 11. Scared Grove Sink, March 10th 2020, photo by Colin Strickland



Figure 12. Scared Grove Cave, September 17th, 2022, photo by Colin Strickland

Cortaña Preserve Cave Restoration

Black-cap Cave

On the Cortaña tract, a feature just east of Cortaña Cave, which was initially a small crack in the ground with slight airflow has been enlarged to reveal what is now Black-cap Cave. The work was done by Zarria Environmental and his crew in mid-2020 with more work in FY2021 using mitigation funds provided by TxDOT. The cave was 12 ft deep with a room 15 feet wide by 20 feet long and 3 feet high. In FY2022 4CAVES worked remove more material and push the lead. The cave has approximately the same footprint but is now more than seven feet tall in some areas, so a ladder was installed to get in and out. On January 13th 2022 Colin Strickland did a faunal survey and found three Tricolored bats Hibernating in the cave (Figure 13). Bats have never been observed in nearby Cortana Cave likely because it stays too warm, but Black-cap appears to be a cold sink with a temperature of 52.5 degrees during the faunal survey. Temperature/humidity dataloggers have been installed recording on a one-hour interval and will be in place for at least one year.



Figure 13. Tricolored at, Black-cap Cave, March 3rd, 2022, photo by Colin Strickland

Park West BCP Preserve

Elm Cave

Elm Cave is a feature that is attached to Super Bowl Cave and within the vicinity of Spider Cave and Wooden Derick Cave. In August of 2022 4CAVES was awarded the bid to conduct the excavation of Elm Sink. Within the scope of work, it was requested that the contractor excavate to the West direction of the cave to a depth of more than 6 ft by 5 ft wide past the designated markers. The 4CAVES team exceeded the requirements with more than an additional 15 feet of passage being excavated. At the end of the lead a drain was opened giving the large sink a better opportunity to recharge.

South Austin Cave Restoration

Lady Bird Lounge

Lady Bird Lounge was discovered by Lady Bird Johnson Wildflower Center staff after a prescribed burn in 2018. It was witnessed expelling of a vapor plume early on a cold morning and was mistaken as the residual smoldering from the prescribed burn the day before. When the Wildflower staff showed us the new feature, we found that just inside the entrance was a sizable void and a large amount of airflow was blowing out. The entrance was just about 4 inches by 4 inches, and we could see down to a depth of over 6 ft. At this point we were working on creating a formal agreement between the Wildflower Center and the Wildland Conservation Division to open and manage caves and features on their property. Once the agreement was approved, we prepared and submitted a restoration plan and scope of work for the proposed excavation including methods of excavation, spoil containment and disposal, impact reduction, revegetation, stabilization, and allotted time to complete the excavation.

The initial excavation was conducted in November of 2021 by Drew Thompson, Mark Sanders, Colin Strickland, and Patty Calabrese. The preliminary work consisted of carefully removing the rock and sediment that was plugging the feature to expose the bedrock rim of the cave itself. The entrance was enlarged to allow access resulting in a 2 foot by 3 foot entrance that led into a 16 foot vertical squeeze into a large room. The first member down into the cave was Patty Calabrese who reported a heavily decorated large room 15 feet by 30 feet with ceiling a height of 10 feet (Figure 14). A faunal survey of the entire room was conducted and temperature/humidity dataloggers were deployed.

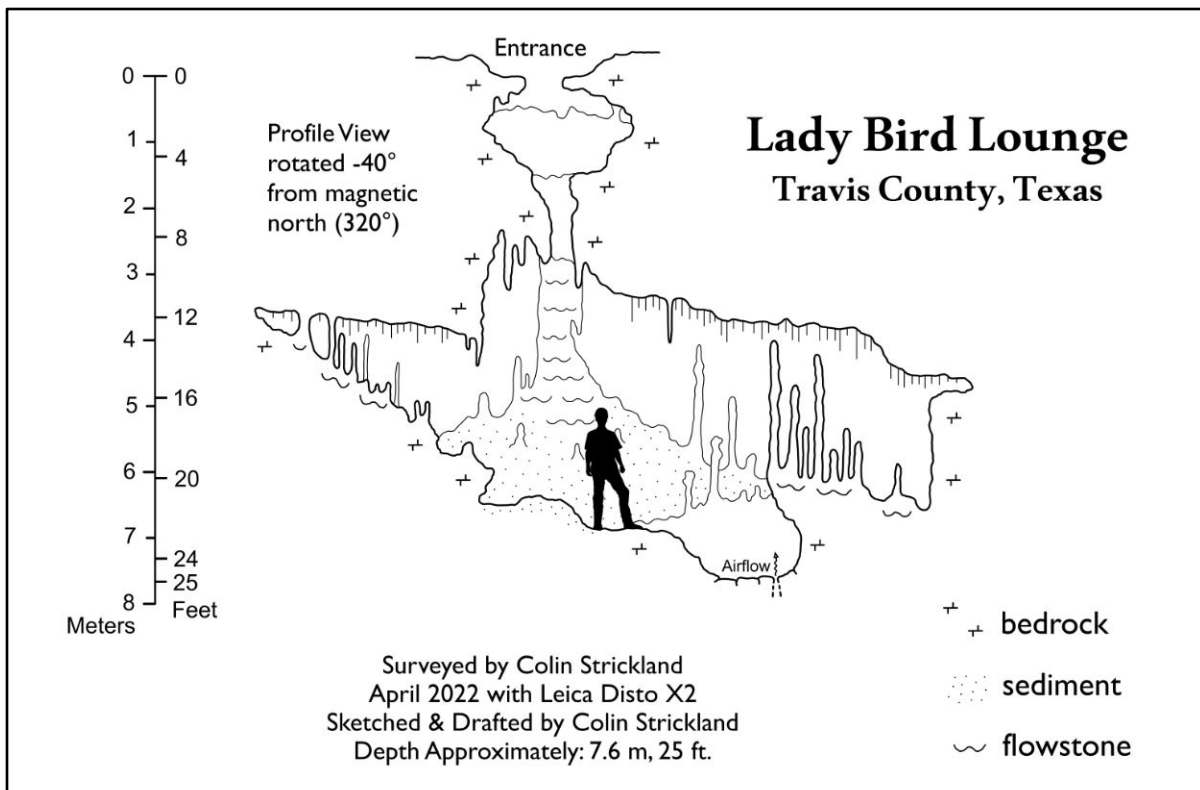


Figure 14. Initial extent of Lady Bird Lounge

At the southeast corner of the large room was the lowest part of the cave and airflow was noted coming up through large breakdown blocks. After extensive evaluation and much consideration, it was determined that it was feasible to remove the breakdown blocks with little to no degradation of the rest of the cave. Drew Thompson, Ethan Perrine, Eléonore Le Corvaisier, and Mila Yegorova, proceeded to break up and remove the material from the cave. Lady Bird Johnson Wildflower Center staff had placed a large dump trailer to remove our spoils from site. After 10 feet of excavating down through the breakdown blocks the team discovered two smaller rooms that were heavily covered in a popcorn calcite formation (Figure 15).

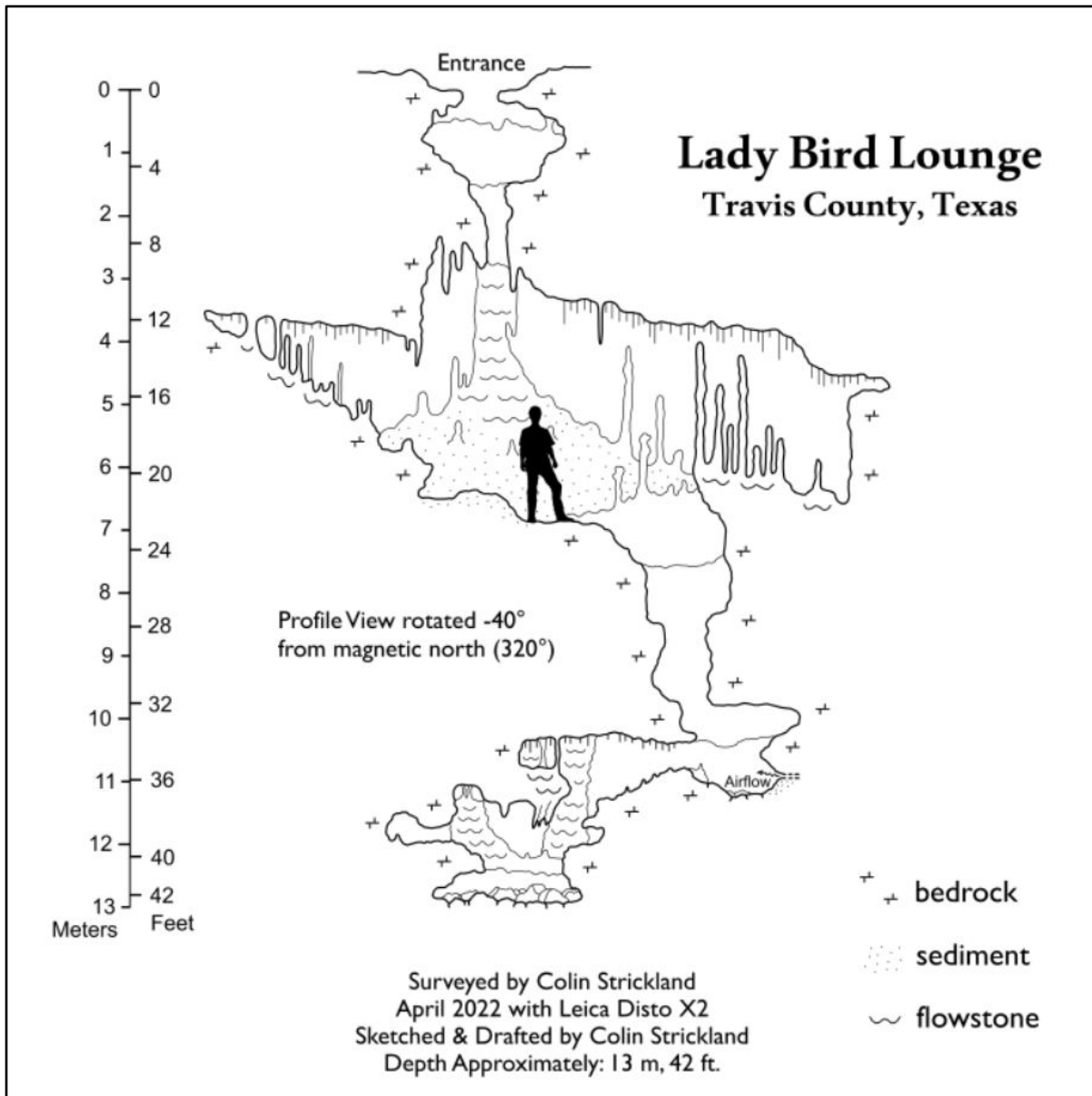


Figure 15. Two small rooms discovered in Lady Bird Lounge

To the east was a shallow bedding plane with a very large amount of airflow. The team excavated horizontally removing chalk like limestone material. At the end of the 15-foot crawl the team discovered a larger even more heavily decorated room approximately of 50 feet by 30 feet with a ceiling of around 20 feet at the highest point (Figure 16).

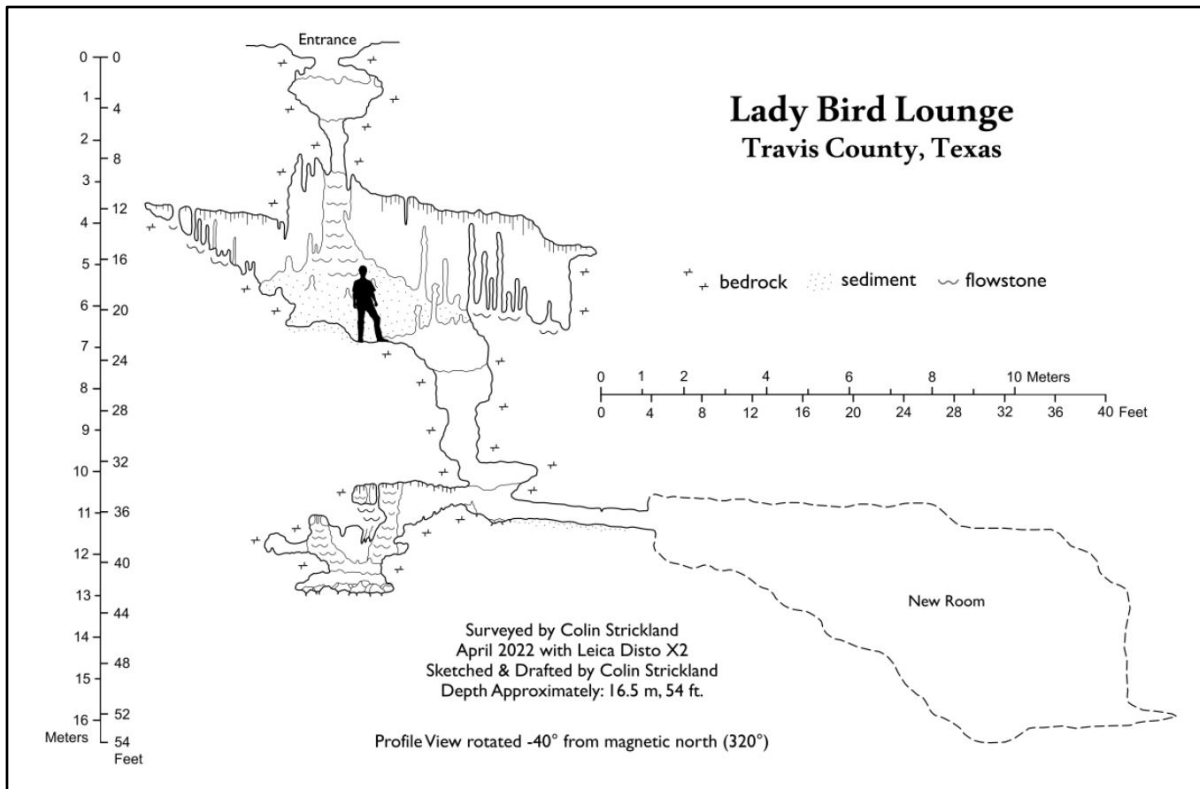


Figure 16. Discovery of large new room in Lady Bird Lounge

Many of the formations are extremely beautiful with totems taller than people and a couple of soda straws over 4 feet long (Figures 17 and 18). The room is referred to as The Omelette. The team brought in a canvas sheet and clean pairs of shoes and clothes to change into when entering the new chamber in order to keep the mud off of the clean formations. At this point excavation portion of the project had come to a completion and Colin Strickland continued his work on mapping the cave. The room is extremely complex as can be seen in the sketch shown in Figure 19. While mapping we found two leads going off of the main room. The first being a corkscrew climb down through breakdown into a room of pulverized limestone with dimensions of 20 feet by 5 feet by 4 feet tall. The other lead on the far side of The Omelette consisted of a squeeze through a bedding plane in the balcony. Drew Thompson squeezed through this passage on Colin Strickland's birthday as Colin was mapping and the passage leads to another room dubbed the Birthday Balcony Room which is approximately 50 feet by 40 ft with a ceiling height of 8 feet in the middle (Figure 20). There is passage that appears to extend beyond this room, but until we can get another project plan in place and approved it will not be excavated. The sketching of the rest of the cave a production of a complete map is scheduled for FY23.



Figure 17. Mila Yegorova and Drew Thompson in The Omellette,
photo by Colin Strickland



Figure 18. Totems and soda straws in The Omellette, Photo by Colin Strickland

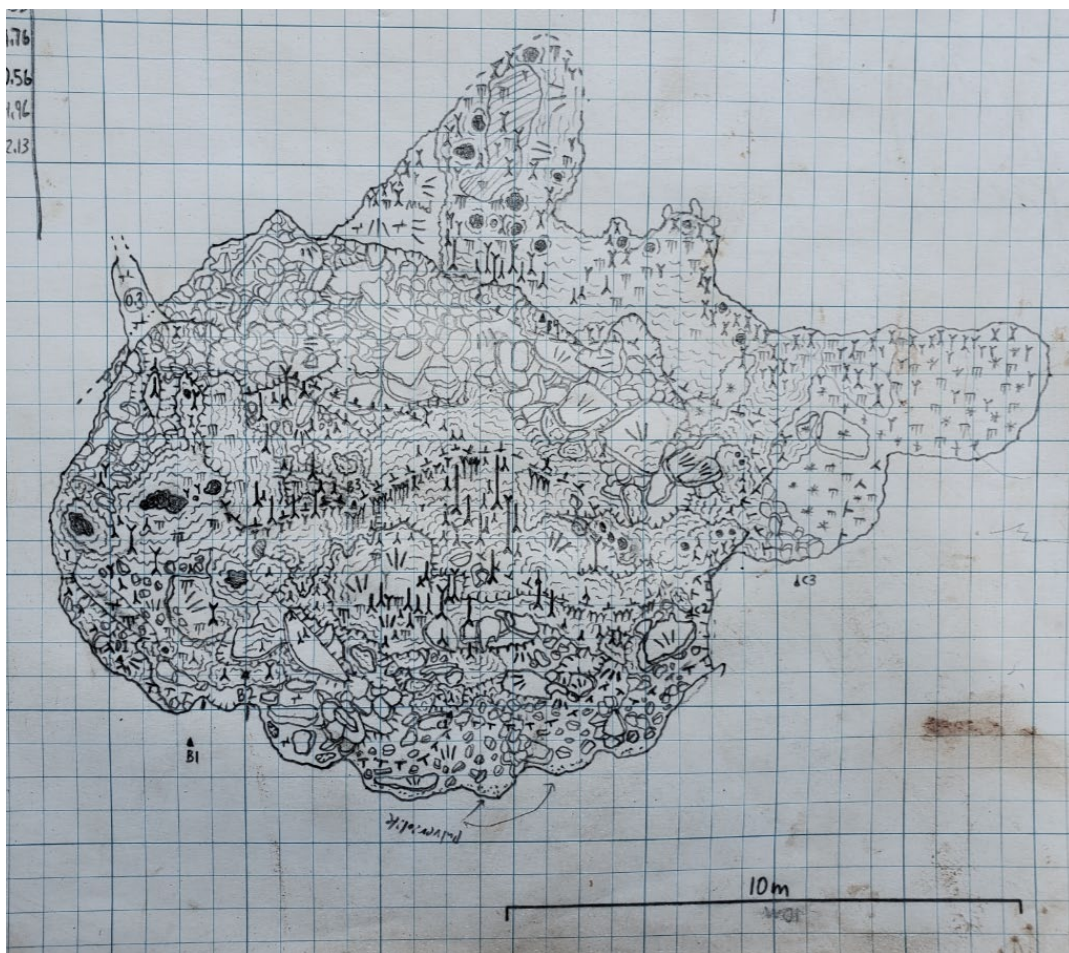


Figure 19. The Omelette plan view sketch by Colin Strickland



Figure 20. Ethan Perrine and Guin McDaid in the Birthday Balcony,
photo by Drew Thompson

8.0 RECOMMENDATIONS

COA and TC should continue to contact the owners of each privately-owned BCCP cave in order to assess current faunal assemblages and negotiate protection of these caves. The precise location of some of these privately owned caves is currently unknown; therefore, COA and TC should attempt to locate these caves in order to make a meaningful assessment. Staff will also continue to search for possible substitutions for some of the caves which are not adequately protected. Additionally, COA and TC will continue to evaluate the adequacy of protection for all 62 BCCP caves by continuing hydrological studies initiated in FY2019 and prioritize efforts accordingly. Karst preserves will be established to preserve the surface and subsurface catchment areas, cave cricket foraging areas, and other guidelines for preserves outlined by USFWS (2012).

Future research needs for the BCP should include an effort to determine to species level currently unknown troglobites such as *Speodesmus* spp., *Eidmannella* spp., and Trichoniscidae found in BCP caves to determine if these species are species of concern listed on the BCCP Permit. A recent research need has also been identified by James Reddell concerning *Rhadine* beetles in the region, with the possibility that potentially two undescribed species could be found within BCP caves. Future research and funding may be needed to answer these research questions.

9.0 KARST MANAGEMENT ACTIVITIES

The BCP Karst Land Management Plan (2016) outlines planned activities concerning the 62 BCCP karst features. Table 10 below includes a summary of monitoring and management activities for these features completed in FY22.

Table 10. FY22 BCCP Karst Feature Monitoring and Management Activities.	
<u>Adobe Springs Cave</u> The Nature Conservancy	1. TC was granted continued permission from TNC to perform bi-annual faunal surveys and cave cricket exit counts for the expanded BCP Cave Monitoring program. 2. TC performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave. 3. TC conducted bi-annual cave faunal surveys (see EXHIBIT A). 4. TC conducted bi-annual cave cricket exit surveys due (See EXHIBIT B).
<u>Airmen's Cave</u> City of Austin	1. Conducted bi-annual cave faunal surveys (See EXHIBIT A). 2. Conducted bi-annual cave cricket exit counts. (SEE EXHIBIT B)

Table 10. FY22 BCCP Karst Feature Monitoring and Management Activities.
3. COA installed a cave gate within 18 feet of the entrance of the cave in January 2012. The cave gate not only protects the cave from ongoing vandalism, but also serves to protect the public from future accidents involving untrained access. Access is still allowed via permit. 4. Conducted quarterly site inspections and continued to operate security camera. 5. A hydrogeological study report was completed Dec. 16, 2021 6. An interdepartmental agreement between PARD and AW BCP is being sought necessary to establish formal BCCP karst preserve management. 7.0 An access easement with overlying property owners is currently under negotiation, it would establish future access for monitoring.
<u>Amber Cave</u> Travis County 1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave. 2. Maintained fencing and signage to protect this area from unauthorized access and dumping. 3. Surveyed site for RIFA. Treated 7 mounds in Spring 2022. 4. TC conducted annual cave faunal surveys (see EXHIBIT A). 5. TC conducted annual cave cricket exit surveys due (See EXHIBIT B).
<u>Armadillo Ranch Sink</u> Private
<u>Arrow Cave</u> City of Austin 1. Completed annual cave faunal survey (See EXHIBIT A). 2. Conducted quarterly site inspections. City staff continues to deal with ongoing dumping problems from the adjacent neighborhood. COA PARD Rangers continue to conduct occasional patrols at these problematic sites. 3. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management.
<u>Bandit Cave</u> Private
<u>Beard Ranch Cave (Featherman's Cave)</u> City of Austin 1. Completed annual cave faunal survey (See EXHIBIT A). 2. Conducted quarterly site inspections. 3. No RIFA were found. A healthy population of native fire ants was found in close proximity to the cave.
<u>Bee Creek Cave</u> Private 1. The owner was contacted in FY21 to inquire about acquisition or management, with negative results 2. AW BCP will continue seeking acquisition of Bee Creek Cave or acquisition of substitution cave.
<u>Blowing Sink Cave</u> City of Austin 1. Inspected monthly and continued to operate security cameras. 2. Completed annual cave faunal survey (See EXHIBIT A). 3. The lower passageways have been inaccessible since the October 2013 flood; however, it is possible that some of the recently restored adjacent caves may lead to the water table. With the recent installation of the shaft allowing direct entry into the main passage of the cave, future excavation work will be feasible, thus allowing rock and silt to be removed which would open up the lower passageways of the cave. 4. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management. 5. COA BCP appreciates permission from PARD Natural Resources Division Austin Nature Preserves to access the

Table 10. FY22 BCCP Karst Feature Monitoring and Management Activities.

site.
<u>Broken Arrow Cave</u> City of Austin 1. Inspected quarterly with no sign of human visitation or vandalism. 2. Completed bi-annual faunal surveys (See EXHIBIT A). 3. Completed bi-annual cave cricket exit counts. (See EXHIBIT B). 4. Staff observed one Jollyville Plateau salamander in the cave pool.
<u>Buda Boulder Spring</u> City of Austin 1. COA BCP staff conducted bi-annual site visits and noted signs of recent transient camps near the spring. COA PARD Rangers were notified and now periodically patrol the site. 2. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management.
<u>Cave X</u> Private 1. COA entered into a Private Landowner Agreement entitled “Cave X, Management and Monitoring Plan, Covenants and Restrictions” with the property owners (Regent’s School) in Oct. 1999. The agreement sets aside a 4.5-acre area to protect the cave footprint. USFWS was involved in the discussions on protection. 2. Cave entrance is gated and also has a fence for added protection. 3. Regent’s School staff conduct periodic surface inspections of the cave including gate and lock maintenance. 4. In an effort to get a better understanding of CO2 levels in Cave X and assist in managing/monitoring, COA BCP staff requested access to install air monitoring equipment but were declined the offer by the owner in September 2017. 5. Regents built a sports field within the Cave X buffer, over the footprint of the cave sometime between January 2018 and November 2019. Regents School sent WP staff a proposed restoration plan on December 6, 2022 which is currently under review.
<u>Cave Y</u> City of Austin 1. Conducted quarterly site inspections. 2. Completed bi-annual cave faunal survey (See EXHIBIT A). 3. Completed bi-annual cave cricket exit counts. (See EXHIBIT B). 4. Surveyed site for RIFA; no mounds were discovered within the cave’s treatment area. 5. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management.
<u>Ceiling Slot Cave</u> Private
<u>Cold Cave</u> 1. TC is negotiating with the landowners concerning the possibility of purchase, conservation easement, or a management agreement for this 8-acre tract. 2. TC gained continued permission from landowner to perform bi-annual faunal surveys and cave cricket exit counts for the expanded BCP Cave Monitoring program. 3. TC performed surface inspections with no signs of vandalism to the cave entrance or in the cave, but the cave gate still in need of repair 4. TC conducted bi-annual cave faunal surveys (see EXHIBIT A). 5. TC conducted bi-annual cave cricket exit surveys. (See EXHIBIT B).

Table 10. FY22 BCCP Karst Feature Monitoring and Management Activities.

<u>Cotterell Cave</u> City of Austin 1. Conducted quarterly site inspections. 2. RIFA surveys determined that the ants were located approximately 300 feet from the cave, so no treatment was needed. 3. Conducted bi-annual cave faunal surveys (see EXHIBIT A). 4. Conducted bi-annual cave cricket exit surveys. (See EXHIBIT B). 5. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management.
<u>Disbelievers Cave</u> Private 10a Permit: PRT-808694
<u>District Park Cave</u> City of Austin 1. BCP staff conducted bi-annual cave faunal surveys (See EXHIBIT A). 2. BCP staff and volunteers conducted bi-annual cave cricket exit counts (See EXHIBIT B). 3. Conducted site surveys quarterly, other than trash at the entrance no new major problems noted. 4. Permitted access to this cave was allowed. 5. BCP staff removed trash from the un-gated portion of the cave. 6. COA BCP hydrogeologist continued to work on a hydrological study to determine the sub-surface drainage and to see if the adjacent developed area of the park could negatively impact the cave (ongoing). 7. Surveyed site for RIFA; no mounds were discovered within the cave's treatment area. 8. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management.
<u>Eluvial Cave</u> Private 10a Permit: PRT-808694
<u>Flint Ridge Cave</u> City of Austin 1. Conducted monthly site visits and continued to operate security cameras. 2. Conducted bi-annual cave faunal surveys (See EXHIBIT A). 3. BCP staff and volunteers conducted bi-annual cave cricket exit counts (See EXHIBIT B). 4. Continuous monitoring of drips was conducted in various rooms. 5. New flow meters and autosamplers were installed at the entrance sink. 6. Four autosamplers were installed inside Flint Ridge Cave. 7. COA BCP drafted a hydrogeologic study report that will delineate the subsurface catchment areas of water sources. This is expected to be released in FY23 8. BCP staff continuously monitor temperature, pH, dissolved oxygen, salinity, and turbidity with a mini-sonde hydrolab. 9. Construction of SH45SW was completed and sections of this highway are over portions of the cave and its surface/subsurface catchment areas.
<u>Fossil Cave</u> City of Austin 1. Inspected bi-annually and found no new signs of vandalism 2. Inspected for RIFA infestations on all visits. RIFA were observed within close proximity of the "suspected" cave. 3. While there are about 10 filled caves located in Schroeter Park, and it is unclear which might be Fossil Cave, once

Table 10. FY22 BCCP Karst Feature Monitoring and Management Activities.

an interdepartmental Agreement with PARD is completed that would allow AW BCP to restore Fossil Cave and establish a formal karst preserve with protective measures within a city park.

Fossil Garden Cave

Private

1. Apple Inc completed construction of their new campus in November 2020, the new campus is located immediately adjacent to Fossil Garden Cave.

Gallifer Cave

Travis County

1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave.

2. Maintained fencing and signage to protect this area from unauthorized access and dumping.

3. In FY21, Zara Environmental restored the entrance of the cave including the removal of the old gate and the construction of a new one.

4. Conducted bi-annual cave faunal surveys (see EXHIBIT A).

5. Conducted bi-annual cave cricket exit surveys. (See EXHIBIT B).

Get Down Cave

City of Austin

1. In July of FY18, COA BCP and WPD signed an Interdepartmental Agreement which allows COA BCP to manage the karst preserve and Get Down Cave according to the Tier II karst management plan and allows WPD to manage the water quality ponds and underlying Millennium Cave, which they use in their aquifer education.

2. BCP staff continued to work with neighbors regarding ways to limit negative impacts to cave crickets while treating for RIFA on adjacent private property. The protocol was posted on their web site in FY22.

3. COA BCP staff helped support neighbor Stephanie Simmons with her “Texas Most Wanted” campaign, whose goal is to promote native plants by offering free plants to the public and encouraging neighbors to remove invasive non-native species. It is hoped that this type of public education will indirectly improve habitat on the preserve.

4. BCP staff completed annual cave faunal survey (See EXHIBIT A).

5. Conducted quarterly site visits and continued to operate security cameras.

6. Removed non-native invasive plants.

7. BCP staff continued to collect soft ticks from Live Oak Cave and to collaborate with Texas State and Baylor researchers who are trying to determine more information about tick borne relapsing fever (TBRF).

8. BCP staff approved the HOA plan to hire a contractor to clear the trail of the remaining downed vegetation after the February 2021 snow and ice storm.

Goat Cave

City of Austin

1. Completed annual faunal survey (See EXHIBIT A).

2. Conducted quarterly site surveys, staff continue to operate a cellular game camera to continuously monitor the cave

3. Allowed permitted access to this cave.

4. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management.

Hole-in-the-Road Cave

Private

Ireland’s Cave

Travis County

1. TC acquired the 4.8-acre tract containing the cave from Muirfield Homeowner Association and began full management of the cave and surrounding property in FY12.

2. Fencing was completed in FY15 on the perimeter of the Ireland’s Cave tract to protect the cave preserve from trespass.

Table 10. FY22 BCCP Karst Feature Monitoring and Management Activities.	
3. Surveyed site for RIFA. A total of 84 was treated within the 80 m buffer and 10 outside of it in Spring 2022. 4. TC conducted an annual cave faunal survey (see EXHIBIT A). 5. TC and COA contracted with Zara Environmental to continuously monitor air quality in Irelands Cave. Ireland's Cave is known to have elevated levels of CO₂, and this study will provide vital information to staff on cave safety.	
<u>Jack's Joint Cave</u>	Private
<u>Japygid Cave</u>	Private 10a Permit: PRT-808694
<u>Jest John Cave</u>	City of Austin
1. Conducted biannual site visits. 2. Inspected site for RIFA infestations, no RIFA were observed near the cave. 3. Conducted one cave cricket exist count. (See EXHIBIT B).	
<u>Jester Estates Cave</u>	City of Austin
1. BCP staff conducted 10 site visits looking for signs of illegally discharged pools, dumped brush and trash from neighbors. It appears that past educational efforts have paid off, since aside from minor brush dumping, no significant illegal activities were observed. 2. Shaded fuel break was completed in FY 21. 3. Conducted bi-annual cave faunal surveys (See EXHIBIT A). 4. Conducted bi-annual cave cricket exit counts. (SEE EXHIBIT B). 5. BCP staff removed non-native invasive vegetation.	
<u>Jollyville Plateau Cave</u>	Private 10a Permit: PRT-808694
<u>Kretschmarr Cave</u>	Travis County
1. Performed surface inspections with no signs of vandalism to the cave entrance or in the cave. 2. Maintained fencing and signage to protect this area from unauthorized access and dumping. 3. Part of the 105 m setback sustained impacts in FY19 from adjacent development in the form of tree clearing. Reparations have been collected and a restoration project was conducted in FY21. 4. In FY21, Zara Environmental restored the entrance of the cave including the removal of the old gate and the construction of a new one. 5. Surveyed site for RIFA. A total of 53 was treated within the 80 m buffer and 4 outside of it in Spring 2022. 6. TC conducted bi-annual cave faunal surveys (see EXHIBIT A). 7. TC conducted bi-annual cave cricket exit surveys (See EXHIBIT B).	
<u>Kretschmarr Double Pit</u>	Travis County
1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave. 2. Maintained fencing and signage to protect this area from unauthorized access and dumping. 3. Surveyed site for RIFA. A total of 4 mounds was treated within the 80 m buffer and one outside of it in Spring	

Table 10. FY22 BCCP Karst Feature Monitoring and Management Activities.

2022.

4. Conducted annual cave faunal survey (see EXHIBIT A).

Lamm Cave

Section 7 Permit 2-15-93-F-075

(see USFWS files)

1. The City of Austin negotiated protective measures for this cave including a Land Management Plan for this cave. The cave has a setback size of approximately 4.13 acres. The radius of the setback varies from a minimum of 123 feet south of the cave to a maximum of 340 feet north of the cave.

2. The cave was gated, and the preserve area was fenced following COA WPD and BCP staff recommendations and design.

3. No application of fertilizers, pesticides or herbicides will be allowed in the CEF area.

4. TC staff continue to periodically monitor the site to make certain that the gates and fences are secure.

5. Walmart has closed the store and sold the property. COA and TC BCP staff will continue to monitor the site and attempt to contact the new owner regarding management and monitoring needs.

Little Bee Creek Cave

City of Austin

1. Conducted quarterly site visits.

2. Conducted bi-annual cave faunal survey (See EXHIBIT A).

3. Conducted bi-annual cave cricket exit counts. (See EXHIBIT B).

Lost Oasis Cave

TCMA

1. Conducted five site visits.

2. COA WPD led one cave education trip.

3. COA AW led one cave education trip.

4. COA BCP staff treated the site for RIFA with boiling water.

5. Conducted bi-annual cave faunal survey (See EXHIBIT A).

6. Conducted bi-annual cave cricket exit counts. (See EXHIBIT B).

7. Removed non-native invasive plants.

8. New fencing was installed by TCMA.

9. Formal management agreement with AW BCP to ensure permit compliance was signed by all parties on May 4, 2021

Lost Gold Cave

Private

1. The owner of the lot removed the fence for the buffer lot, cleared vegetation within the surface catchment up to the entrance of Lost Gold Cave, placed mulch and a playscape in the preserve buffer lot, WP staff attempted to work with the owner to restore the site, however, at some point gave the City Environmental Officer gave the property owner a variance to allow the encroachment to stay in place so therefore the cave is not protected.

Maple Run Cave

City of Austin

1. Conducted bi-annual cave faunal survey (See EXHIBIT A).

2. Conducted bi-annual cave cricket exit counts. (See EXHIBIT B).

3. COA BCP staff conducted quarterly site inspections and removed trash from preserve area.

4. Permitted access to this cave is allowed.

5. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management.

McDonald Cave

Table 10. FY22 BCCP Karst Feature Monitoring and Management Activities.

Travis County 1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave. 2. Maintained fencing and signage to protect this area from unauthorized access and dumping. 3. Surveyed site for RIFA but no mounds were found. 4. Conducted annual cave faunal surveys (see EXHIBIT A).
<u>McNeil Bat Cave</u> Private
<u>Midnight Cave</u> City of Austin 1. Conducted quarterly site inspections; on multiple occasions in the past vandals cut the chain to the gate. Staff continue to monitor a cellular game camera and continue to make improvements to the gate and fence to better secure the site. 2. Conducted bi-annual cave faunal surveys. (See EXHIBIT A). 3. Conducted bi-annual cave cricket exit counts. (See EXHIBIT B). 4. Permitted access to this cave is allowed, though no access permits were granted this fiscal year. 5. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management.
<u>M.W.A. Cave</u> Private 10a Permit: PRT-808694
<u>Moss Pit Cave</u> Private
<u>New Comanche Trail Cave</u> Travis County 1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave. 2. Maintained fencing and signage to protect this area from unauthorized access and dumping. 3. Surveyed site for RIFA. A total of 4 was treated within the 80 m buffer and one outside of it in Spring 2022. 4. TC conducted annual cave faunal survey (see EXHIBIT A). 5. TC conducted annual cave cricket exit survey. (See EXHIBIT B).
<u>No Rent Cave</u> Travis County 1. TC acquired No Rent Cave and surrounding land that protects a portion of the cave cricket foraging area and surface/subsurface drainage basins in FY19. 2. Zara Environmental installed an elevated cave gate in FY19. 3. TC performed surface inspections with no current signs of vandalism to the cave entrance or in the cave. 4. Surveyed site for RIFA. A total of 11 was treated within the 80 m buffer and one outside of it in Spring 2022. 5. TCA was first observed in February 2022 around the entrance of the cave as well as within. TC has been working with Dr. Ed LeBrun at BFL to study and inoculate the population. 6. TC conducted quarterly cave faunal surveys (see EXHIBIT A).

Table 10. FY22 BCCP Karst Feature Monitoring and Management Activities.

7. TC conducted quarterly cave cricket exit surveys. (See EXHIBIT B).

North Root Cave

Travis County

1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave.
2. Maintained fencing and signage to protect this area from unauthorized access and dumping.
3. TC conducted an annual cave faunal survey (see EXHIBIT A).

Pennie's Cave

Private

- 1 The entrance was re-excavated in 2012, providing access to the cave.
2. The cave entrance has been gated and fenced; boulders were also placed around the cave at the edge of a 300-ft buffer to better define the protected area.
3. Zara Environmental has continued to secure one-year contracts to conduct cave faunal surveys, map the interior of the cave and treat the site for RIFA. Although only a one-year contract, it is hoped that the owner will extend the contract for multiple years.
4. Zara Environmental provided an annual report to the BCP on all monitoring and management activities.

Pickle Pit Cave

Private USFWS Section 7 Permit 2-15-93-F-075

1. A volunteer neighbor occasionally monitors the cave entrance/ gate monthly; no problems noted.

Pipeline Cave

Private

1. A 2004 agreement between COA and Stratus set aside an approximately 8-acre buffer around Pipeline Cave that varies from 100 feet to the east and up to 300 feet west of the cave and an additional setback of 300 feet to the north and west; 150 ft. to east and south for the adjacent feature known as Confusion Sink.
2. Developer installed cave gate (including a gate on the nearby "Confusion Cave.")
3. In August 2018, COA BCP staff met with the property manager and obtained provisional access to begin monitoring and management of Pipeline and the adjacent Confusion Cave according to the Tier II karst land management plan.
4. Conducted bi-annual cave faunal surveys. (See EXHIBIT A).
5. Conducted bi-annual cave cricket exit counts. (See EXHIBIT B).
6. COA BCP provided a monitoring and management report to the property manager.
7. Staff has removed trash fill from the cave on multiple occasions, which is initially dated to late 1950's and early 1960's.

Rolling Rock Cave

City of Austin

1. Inspected quarterly and no sign of human visitation or vandalism was found.
2. Conducted one cave faunal survey. (See EXHIBIT A).

Root Cave

Travis County

1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave.
2. Maintained fencing and signage to protect this area from unauthorized access and dumping.

Slaughter Creek Cave

Table 10. FY22 BCCP Karst Feature Monitoring and Management Activities.

City of Austin 1. Conducted quarterly site inspections. 2. Conducted one cave faunal survey. (See EXHIBIT A) 3. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management.
<u>Spanish Wells Cave</u> Travis County 1. TC acquired Spanish Wells Cave and surrounding land that protects the cave cricket foraging area and surface/subsurface drainage basins in FY15. 2. Performed surface inspections with no signs of trespass or vandalism to the cave entrance or in the cave. 3. Conducted bi-annual cave faunal surveys (See EXHIBIT A). 4. Conducted bi-annual cave cricket exit count. (See EXHIBIT B).
<u>Spider Cave</u> City of Austin 1. Conducted four site visits, and no sign of human access or vandalism was found. 2. Conducted bi-annual cave faunal surveys (See EXHIBIT A). 3. Conducted bi-annual cave cricket exit counts. (See EXHIBIT B). 4. As part of the new adjacent highway expansion work, TXDOT has provided funds for hydrological studies, which includes excavation of features adjacent to spider cave, the ultimate goal of finding active drips which would allow for dye trace studies that would accurately determine the subsurface drainage basin.
<u>Stark's North Mine</u> Travis County 1. TC acquired this cave and 0.8 acres surrounding it in FY12. The area surrounding the cave is all previously developed. 2. TC acquired a conservation easement on the adjacent 0.38 acres which contains much of the cave cricket foraging area. 3. Performed surface inspections and detected signs of vandalism to the cave entrance and inside the cave. Cave gate was subsequently repaired by Zara Environmental. 4. Surveyed site bi-annually for RIFA. No mounds found within 80 m of cave. 5. Conducted bi-annual cave faunal surveys (See EXHIBIT A). 6. Conducted bi-annual cave cricket exit counts (See EXHIBIT B).
<u>Stovepipe Cave</u> 1. Conducted 6 site inspections and continued to remove new and old trash from the preserve. 2. Installed new 8' perimeter fence. 3. Conducted bi-annual cave faunal surveys (See EXHIBIT A). 4. Conducted bi-annual cave cricket exit counts (See EXHIBIT B). 5. Surveyed site for RIFA; no mounds were discovered within the cave's treatment area. 6. Continued karst assessment of site in FY20. 7. As part of the new adjacent highway expansion work, TXDOT has provided funds for hydrological studies, which includes excavation of features adjacent to stovepipe cave, the ultimate goal of finding active drips which would allow for dye trace studies that would accurately determine the subsurface drainage basin. 8. As part of a hydrological study, the drip gauge that was installed in FY 20 was continued to be monitored in FY22.
<u>Talus Spring Cave</u> Private 1. The USFWS 10a permit PRT 815447 mitigation requirement intended this cave to go to TC, however, the cave is located on private land just outside of the mitigation area. TC has continued requesting that the homeowner's association donate the land to TC.

Table 10. FY22 BCCP Karst Feature Monitoring and Management Activities.

2. Performed surface inspections with no signs of vandalism to the cave entrance or in the cave.
3. Conducted annual cave faunal survey (see EXHIBIT A).
4. Performed a non-native plant removal project on tract to increase native plant diversity.

Tardus Hole Cave

Travis County

1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave.
2. Maintained fencing and signage to protect this area from unauthorized access and dumping.
3. Surveyed site for RIFA. A total of 5 was treated within the 80 m buffer and none outside of it in Spring 2022.
4. Conducted annual cave faunal survey (see EXHIBIT A).

Tooth Cave

Travis County

1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave. However, a homeless camp was found onsite in the Fall of 2108 and was removed.
2. Maintained fencing and signage to protect this area from unauthorized access and dumping.
3. Zara Environmental replaced old cave gate with a newer elevated gate in FY18.
4. Conducted bi-annual cave faunal surveys (see EXHIBIT A).
5. Conducted bi-annual cave cricket exit surveys. (See EXHIBIT B).

Weldon Cave

Travis County

1. TC acquired Weldon Cave and surrounding land that protects a portion of the cave cricket foraging area and surface/subsurface drainage basins in FY19.
2. Zara Environmental install a cave gate in FY19.
3. TC performed surface inspections with no current signs of vandalism to the cave entrance or in the cave.
4. Surveyed site for RIFA. A total of 5 was treated within the 80 m buffer and none outside of it in Spring 2022.
5. TCA was observed around the entrance of the cave in February 2022 and within the cave in May of 2022. TC has been working with Dr. Ed LeBrun at BFL to study and inoculate the population.
6. TC conducted quarterly cave faunal surveys (see EXHIBIT A).
7. TC conducted quarterly cave cricket exit surveys. (See EXHIBIT B).

Whirlpool Cave

TCMA

1. Formal management agreement with AW BCP to ensure permit compliance was signed by all parties on May 4, 2021
2. COA conducted bi-annual cave faunal surveys (see EXHIBIT A).
3. COA conducted bi-annual cave cricket exit surveys. (See EXHIBIT B).
4. Continuous monitoring of CO₂, humidity, and airflow is being conducted in the East caverns passage by COA BCP staff.

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EXHIBIT A:
KARST FAUNAL SURVEY REPORTS

FY22 City of Austin/Travis County Karst Faunal Surveys^{1,2}

Cave	Survey Date	Monitoring Agency	Endangered Species						Species of Concern										Other Significant Troglabites							Other notable species detected
			<i>Rhadine persephone</i>	<i>Tartarocaregrus texana</i>	<i>Tayshaneta myopica</i>	<i>Texanaurops reddelli</i>	<i>Texella reddelli</i>	<i>Texella reyesi</i>	<i>Caecidotea reddelli</i>	<i>Cicurina bandida</i>	<i>Cicurina travisae</i>	<i>Eidmannella reclusa</i>	<i>Rhadine austinea</i>	<i>Rhadine subterranea</i>	<i>Sphalloplana mohri</i>	<i>Tartarocaregrus comanche</i>	<i>Tayshaneta concinna</i>	<i>Tayshaneta devia</i>	<i>Texella spiniperca</i>	<i>Cicurina buwata</i>	<i>Speodesmus bicornourus</i>	<i>Speodesmus sp.</i>	<i>Tartarocaregrus attenuata</i>	<i>Tartarocaregrus infernalis</i>	<i>Tayshaneta sp.</i>	<i>Texella mulatiki</i>
Adobe Springs Cave	11/22/2021	TC																								
Adobe Springs Cave	6/6/2022	TC																								<i>Cicurina sp. eyeless</i> (1)
Airman's Cave	2/1/2022	COA								29									1		6					<i>Cambala speobia</i> (25) <i>Perimyotis subflavus</i> (1) <i>Texoreddellia sp.</i> (3)
Airman's Cave	9/14/2022	COA								38			13						3		17				1	<i>Cambala speobia</i> (12) <i>Perimyotis subflavus</i> (1) <i>Texoreddellia sp.</i> (2)
Amber Cave	11/17/2021	TC				1					21											21				
Beard Ranch Cave	1/13/2022	COA						8														1				<i>Cambala speobia</i> (5)
Black-cap Cave	1/13/2022	COA			2							4														<i>Perimyotis subflavus</i> (3)
Black-cap Cave	5/4/2022	COA										2														
Black-cap Cave	8/9/2022	COA						5			4											1				
Broken Arrow Cave	11/19/2021	COA																		11	1					<i>Cambala speobia</i> (46) <i>Eurycea tonkawae</i> (1) <i>Stygobromus russelli</i> (3)
Broken Arrow Cave	5/18/2022	COA	1											1						9	5					<i>Cambala speobia</i> (49) <i>Eurycea tonkawae</i> (1)
Cave Y	1/18/2022	COA								2																<i>Cambala speobia</i> (1) <i>Perimyotis subflavus</i> (16) <i>Texella grubbsi</i> (1)
Cave Y	8/16/2022	COA								12												4				<i>Texella grubbsi</i> (11) <i>Texoreddellia sp.</i> (2)
Cold Cave	2/2/2022	TC						2												7		8				<i>Batrisesodes sp.</i> (18) <i>Cambala speobia</i> (~175)
Cold Cave	8/16/2022	TC						2												18		12				<i>Batrisesodes sp.</i> (29) <i>Cambala speobia</i> (~215) <i>Texoreddellia sp.</i> (2)
Collaboration Cave	10/20/2021	COA							60													2				<i>Batrisesodes sp.</i> (1) <i>Cicurina sp. blind</i> (1) <i>Stygobromus sp.</i> (70)
Cortana Cave	1/12/2022	COA			36		6				7	47									5					<i>Tartarocaregrus sp.</i> (1)
Cortana Cave	8/9/2022	COA			15		7				7	33									10					<i>Cambala speobia</i> (18)
Cotterrell Cave	1/12/2022	COA					16				60										13			1		<i>Cambala speobia</i> (2)
Cotterrell Cave	8/9/2022	COA					17				61										31			3		<i>Cambala speobia</i> (6)

			Endangered Species						Species of Concern											Other Significant Trogllobites						Other notable species detected
Cave	Survey Date	Monitoring Agency	<i>Rhadine persephone</i>	<i>Tartarocreagrís texana</i>	<i>Tayshaneta myopica</i>	<i>Texanaurops reddelli</i>	<i>Texella reddelli</i>	<i>Texella reyesi</i>	<i>Caecidotea reddelli</i>	<i>Cicurina bandida</i>	<i>Cicurina traviseae</i>	<i>Eidmannella reclusa</i>	<i>Rhadine austinea</i>	<i>Rhadine subterranea</i>	<i>Sphalloplana mohri</i>	<i>Tartarocreagrís comanche</i>	<i>Tayshaneta concinna</i>	<i>Tayshaneta devia</i>	<i>Texella spiniperca</i>	<i>Cicurina buvata</i>	<i>Speodesmus bicornouris</i>	<i>Speodesmus sp.</i>	<i>Tartarocreagrís attenuata</i>	<i>Tartarocreagrís infernalis</i>	<i>Tayshaneta sp.</i>	<i>Texella mulaki</i>
District Park Cave	12/4/2021	COA								16											1			1		<i>Cambala speobia</i> (17)
District Park Cave	6/3/2022	COA								10											2			1		<i>Cambala speobia</i> (50)
Flint Ridge Cave	5/27/2022	COA								14			1								21				2	<i>Texoreddellia</i> sp. (2)
Flint Ridge Cave	5/28/2022	COA																			14					<i>Texoreddellia</i> sp. (4)
Flying Kave	1/4/2022	TC																		2						<i>Cambala speobia</i> (15)
Flying Kave	8/15/2022	TC																		3						<i>Cambala speobia</i> (21)
Gallifer Cave	2/8/2022	TC			41			30			149															<i>Cambala speobia</i> (32) <i>Eidmannella</i> sp. (6) <i>Perimyotis subflavus</i> (5)
Gallifer Cave	8/23/2022	TC	1		26			18			86											1				<i>Cambala speobia</i> (169) <i>Eidmannella</i> sp. (1) <i>Texoreddellia</i> sp. (1)
Gaping Maw Cave	11/19/2021	COA			9						3	1										1				<i>Cambala speobia</i> (1)
Gaping Maw Cave	5/27/2022	COA									5	2														<i>Cambala speobia</i> (5)
Geode Cave	1/26/2022	TC			36						10	1														
Geode Cave	8/18/2022	TC			18						4											1				<i>Cambala speobia</i> (6) <i>Tartarocreagrís</i> sp/ (1)
Get Down Cave	2/7/2022	COA								16														1		<i>Cambala speobia</i> (4) <i>Perimyotis subflavus</i> (1)
Goat Cave	9/14/2022	COA								10												1			2	<i>Cambala speobia</i> (4)
Hammett's Cave	1/28/2022	TC					4																	6		<i>Perimyotis subflavus</i> (1) <i>Pseudoscorpindia</i> (1)
Hammett's Cave	8/10/2022	TC					13																	3		<i>Eidmannella</i> sp. (1)
Ireland's Cave	2/10/2022	TC								18			3								1					<i>Batrises</i> sp. (4) <i>Cambala speobia</i> (8) <i>Texoreddellia</i> sp. (1)
Jester Estates Cave	11/22/2021	COA		3	13			47			2															<i>Cambala speobia</i> (1)
Jester Estates Cave	5/23/2022	COA		2	5			40			1											2				
Kretschmarr Cave	11/29/2021	TC	1								6															<i>Cambala speobia</i> (3) <i>Eidmannella</i> sp. (18)

			Endangered Species						Species of Concern											Other Significant Trogllobites						Other notable species detected
Cave	Survey Date	Monitoring Agency	<i>Rhadine persephone</i>	<i>Tartarocreagris texana</i>	<i>Tayshaneta myopica</i>	<i>Texanaurops reddelli</i>	<i>Texella reddelli</i>	<i>Texella reyesi</i>	<i>Caecidotea reddelli</i>	<i>Cicurina bandila</i>	<i>Cicurina traviseae</i>	<i>Eidmannella reclusa</i>	<i>Rhadine austinea</i>	<i>Rhadine subterranea</i>	<i>Sphalloplana mohri</i>	<i>Tartarocreagris comanche</i>	<i>Tayshaneta concinna</i>	<i>Tayshaneta devia</i>	<i>Texella spiniperca</i>	<i>Cicurina buwata</i>	<i>Speodesmus bicornourus</i>	<i>Speodesmus</i> sp.	<i>Tartarocreagris attenuata</i>	<i>Tartarocreagris infernalis</i>	<i>Tayshaneta</i> sp.	<i>Texella mulaki</i>
Kretschmarr Cave	6/6/2022	TC	1			1					9															<i>Batrisesodes</i> sp. (1) <i>Cambala speobia</i> (17) <i>Eidmannella</i> sp. (16)
Kretschmarr Double Pit	11/29/2021	TC									5											5				<i>Cambala speobia</i> (4) <i>Texella grubbsi</i> (1)
Lady Bird Lounge	11/10/2021	COA								5			2									8				<i>Cambala speobia</i> (1) <i>Texoreddellia</i> sp. (1)
Little Bee Creek Cave	11/23/2021	COA					5															1				<i>Cambala speobia</i> (4)
Little Bee Creek Cave	5/11/2022	COA					1			4												2				<i>Cambala speobia</i> (13)
Lost Oasis Cave	12/3/2021	COA								10												17				<i>Cambala speobia</i> (38)
Lost Oasis Cave	6/3/2022	COA								24												48				<i>Cambala speobia</i> (29)
Maple Run Cave	1/25/2022	COA								2			1									5				<i>Cambala speobia</i> (5)
Maple Run Cave	8/19/2022	COA								4												3			1	
McDonald Cave	8/24/2022	TC									63							16			49					<i>Cambala speobia</i> (56) <i>Eidmannella rostrata</i> (7)
McMac Cave	1/4/2022	TC																								<i>Tartarocreagris</i> sp. (2)
McMac Cave	8/15/2022	TC																				1				<i>Eidmannella</i> sp. (19)
Midnight Cave	1/25/2022	COA								25												2				<i>Batrisesodes</i> sp. (1) <i>Cambala speobia</i> (36)
Midnight Cave	9/1/2022	COA								39															1	<i>Batrisesodes</i> sp. (1) <i>Cambala speobia</i> (43)
Millipede Annex Cave	11/29/2021	COA			16			34												1		5				<i>Cambala speobia</i> (6) <i>Stenochrus portoricensis</i> (3) <i>Tartarocreagris domina</i> (1)
Millipede Annex Cave	5/19/2022	COA			5			8												11		4				<i>Cambala speobia</i> (3) <i>Stenochrus portoricensis</i> (34)
Millipede Cave	11/29/2021	COA																		10		1				<i>Cambala speobia</i> (2) <i>Stenochrus portoricensis</i> (24) <i>Tartarocreagris domina</i> (1)
Millipede Cave	5/19/2022	COA			2															8						<i>Stenochrus portoricensis</i> (5) <i>Tartarocreagris domina</i> (3)
New Comanche Trail Cave	8/18/2022	TC			6						3															
No Rent Cave	2/11/2022	TC						2												48						<i>Batrisesodes</i> sp. (2) <i>Cambala speobia</i> (55) <i>Eidmannella</i> sp. (7) <i>Nylanderia fulva</i> (>1,000) <i>Perimyotis subflavus</i> (1)
No Rent Cave	5/25/2022	TC						4												65		3				<i>Cambala speobia</i> (200) <i>Eidmannella</i> sp. (1) <i>Nylanderia fulva</i> (400) <i>Pseudoscorpindia</i> (1)

			Endangered Species						Species of Concern											Other Significant Trogllobites							Other notable species detected
Cave	Survey Date	Monitoring Agency	<i>Rhadine persephone</i>	<i>Tartarocreagrís texana</i>	<i>Tayshaneta myopica</i>	<i>Texanaurops reidelli</i>	<i>Texella reidelli</i>	<i>Texella reyesi</i>	<i>Cacilotea reidelli</i>	<i>Cicurina bandida</i>	<i>Cicurina traviseae</i>	<i>Eidmannella reclusa</i>	<i>Rhadine austinea</i>	<i>Rhadine suberranea</i>	<i>Sphalloplana mohri</i>	<i>Tartarocreagrís comanche</i>	<i>Tayshaneta concinna</i>	<i>Tayshaneta devia</i>	<i>Texella spiniperca</i>	<i>Cicurina buwata</i>	<i>Speodesmus bicornourus</i>	<i>Speodesmus</i> sp.	<i>Tartarocreagrís attenuata</i>	<i>Tartarocreagrís infernalis</i>	<i>Tayshaneta</i> sp.	<i>Texella mutaii</i>	
No Rent Cave	8/31/2022	TC						3												30							<i>Cambala speobia</i> (62) <i>Nylanderia fulva</i> (>5,000)
North Root Cave	6/6/2022	TC									1																
Persephone Caverns	11/24/2021	COA				3		6			37	13		1								9	1				<i>Cambala speobia</i> 9) <i>Texoreidellia</i> sp. (2)
Persephone Caverns	1/28/2022	COA	3			2		4			52	20										32					<i>Cambala speobia</i> (6) <i>Perimyotis subflavus</i> (3) <i>Texoreidellia</i> sp. (1)
Persephone Caverns	5/20/2022	COA				1		7			31	8										9					<i>Batrisesodes</i> sp. (1) <i>Cambala speobia</i> (32) <i>Texoreidellia</i> sp. (2)
Persephone Caverns	8/27/2022	COA	7					16			38	11										33					<i>Batrisesodes</i> sp. (1) <i>Cambala speobia</i> (93)
Pipeline Cave	11/27/2021	COA								23			1									23				7	<i>Batrisesodes</i> sp. (2) <i>Cambala speobia</i> (4) <i>Texoreidellia</i> sp. (4)
Pipeline Cave	5/31/2022	COA								19												13				9	<i>Cambala speobia</i> (4) <i>Texoreidellia</i> sp. (6)
Poison Ivy Pit	1/4/2022	TC																		1							
Pond Party Pit	1/20/2022	COA						14				1										13		9			<i>Cambala speobia</i> (7)
Pond Party Pit	8/26/2022	COA	3					17			2											13		1			<i>Cambala speobia</i> (30)
Rolling Rock Cave	11/19/2021	COA																		8		1					<i>Cambala speobia</i> (4) <i>Perimyotis subflavus</i> (1)
Root Cave	2/7/2022	TC									5																<i>Cambala speobia</i> (12)
Seibert Sink	1/18/2022	COA																	3								
Seibert Sink	8/11/2022	COA								2							1		3			2					
Slaughter Creek Cave	9/29/2022	COA								10												5					<i>Cambala speobia</i> (2)
Spanish Wells	1/4/2022	TC													20												<i>Stygobromus russelli</i> (30)
Spanish Wells	8/15/2022	TC													20												<i>Stygobromus russelli</i> (15)
Spider Cave	11/23/2021	COA						4			26											3					
Spider Cave	5/18/2022	COA	2					6			22	3										5					<i>Cambala speobia</i> (3)
Stark's North Mine	11/30/2021	TC																1									<i>Perimyotis subflavus</i> (15)

			Endangered Species						Species of Concern											Other Significant Trogllobites								
Cave	Survey Date	Monitoring Agency	<i>Rhadine persephone</i>	<i>Tartarocaregri texana</i>	<i>Tayshaneta myopica</i>	<i>Tesamaurops reddelli</i>	<i>Texella reddelli</i>	<i>Texella reysi</i>	<i>Caecidotea reddelli</i>	<i>Cicurina bandilla</i>	<i>Cicurina trivisae</i>	<i>Eidmannella reclusa</i>	<i>Rhadine austiñica</i>	<i>Rhadine subterranea</i>	<i>Sphalloplana mohri</i>	<i>Tartarocaregri comanche</i>	<i>Tayshaneta concinna</i>	<i>Tayshaneta devia</i>	<i>Texella spiniperca</i>	<i>Cicurina buwata</i>	<i>Speodesmus bicornourus</i>	<i>Speodesmus</i> sp.	<i>Tartarocaregri attenuata</i>	<i>Tartarocaregri infernalis</i>	<i>Tayshaneta</i> sp.	<i>Texella mulitiki</i>	Other notable species detected	
Stark's North Mine	6/1/2022	TC																									<i>Eidmannella</i> sp (1) <i>Perimyotis subflavus</i> (1)	
Stovepipe Cave	1/18/2022	COA	2			5		24			3	15		2								80	7					<i>Cambala speobia</i> (25)
Stovepipe Cave	8/17/2022	COA	2			15		47			3	1									52		1					<i>Cambala speobia</i> (97)
Tardus Hole	11/17/2021	TC																										
Testudo Tube Cave	1/27/2022	COA												1	25					24		14						<i>Batrises</i> sp. (2) <i>Cambala speobia</i> (~143) <i>Eurycea tonkawae</i> (14) <i>Perimyotis subflavus</i> (3) <i>Stygobromus</i> sp. (40) <i>Texoreddellia</i> sp. (1)
Testudo Tube Cave	8/26/2022	COA	1											2	12					26		22						<i>Batrises</i> sp. (1) <i>Cambala speobia</i> (~169) <i>Eurycea tonkawae</i> (8) <i>Stygobromus</i> sp. (30)
Tooth Cave	11/30/2021	TC	7	3	19	1		45			133	20									5							<i>Cambala speobia</i> (32) <i>Perimyotis subflavus</i> (5)
Tooth Cave	5/26/2022	TC			8			28			116	3									2							<i>Batrises</i> sp. (3) <i>Cambala speobia</i> (8) <i>Texoreddellia</i> sp. (1)
Weldon Cave	2/11/2022	TC												1						4								<i>Aphrastochthonius</i> N.S. (1) <i>Cambala speobia</i> (17) <i>Eidmannella</i> sp. (3) <i>Perimyotis subflavus</i> (3)
Weldon Cave	5/25/2022	TC						2						4						7	1							<i>Aphrastochthonius</i> N.S. (2) <i>Cambala speobia</i> (10) <i>Eidmannella</i> sp. (1) <i>Perimyotis subflavus</i> (1)
Weldon Cave	8/31/2022	TC																		5	1							<i>Cambala speobia</i> (29) <i>Nylanderia fulva</i> (>2,000)
Whirlpool Cave	1/19/2022	COA								16			2									2						<i>Batrises</i> sp. (1)
Whirlpool Cave	8/12/2022	COA								31			1									1						<i>Japygidae</i> sp. (1) <i>Texoreddellia texensis</i> (3)
White-eyed Cave	1/4/2022	TC																										<i>Pseudoscorpindia</i> (1)

¹ All survey data and full species lists available by request through COA and TC.

² Surveyors in FY21 include: Samuel Berg, Cristina Campbell, Travis Clark, Paul Fushille, Devin Grobert, Darrell Hutchinson, Annalily Lopes, David Morgan, Mark Sanders, Nancy Sandoval, Jonny Scalise, Blake Sissel, Colin Strickland, and Drew Thompson

EXHIBIT B:
CAVE CRICKET EXIT COUNT DATA REPORTS

FY22 COA/TC CAVE CRICKET EXIT COUNT DATA REPORTS

Surveyed Caves	Fall 2021 (November/ December)				Winter 2022 (January/February/ March)				Spring 2022 (May/ June)				Summer 2022 (August/ September)			
	N:	J:	A:	TI:	N:	J:	A:	TI:	N:	J:	A:	TI:	N:	J:	A:	TI:
Adobe Springs Cave	0	0	7	7					3	32	490	525				
Amber Cave	16	32	9	57												
Airman's Cave					439	155	10	604					822	286	324	1432
Black-cap Cave					13	10	1	24					7	95	21	123
Broken Arrow Cave	53	26	88	167					72	29	122	223				
Cave Y					60	36	16	112					16	14	17	47
Cold Cave					910	884	113	1907					694	531	3365	4590
Cortana Cave					10	14	8	32					31	96	594	721
Cotterell Cave					548	239	92	879					1122	170	53	1345
District Park Cave	115	79	29	223					61	91	153	305				
Flint Ridge Cave	5	5	5	15					14	19	13	46				
Gallifer Cave					0	9	0	9					41	82	814	937
Gaping Maw	49	13	11	73					42	49	490	581				
Geode Cave					48	33	9	90					11	57	295	463
Jest John Cave													108	186	1298	1592
Jester Estates Cave	109	74	255	438					781	152	131	1064				
Kretschmarr Cave	42	90	38	170					274	146	838	1258				
Little Bee Creek Cave	2	0	0	2					0	0	15	15				
Lost Oasis Cave	21	7	0	28					308	26	61	395				
Maple Run Cave					267	1084	77	1428					175	241	327	743
Midnight Cave					7536	5538	1593	14667					3984	5227	5419	14630
New Comanche Trail Cave													0	0	572	572
No Rent Cave					173	445	2	620	204	137	311	652	138	67	294	499
Persephone Caverns	19	10	12	41	124	135	7	266	22	30	204	256	72	279	109	460
Pipeline Cave	90	36	35	161					N/A	N/A	N/A	N/A				

Pond Party Pit					393	50	52	495					116	95	73	284
Seibert Sink					165	189	102	456					54	22	53	129

Surveyed Caves	Fall 2021 (November/December)				Winter 2022 (January/February)				Spring 2022 (May/ June)				Summer 2022 (August/ September)			
Spanish Wells Cave					27	107	30	164					48	170	385	603
Spider Cave	9	7	11	27					42	24	32	98				
Stark's North Mine	4	0	22	26												
Stovepipe Cave					32	23	9	64					157	59	321	537
Testudo Tube					116	302	90	508					9	9	303	321
Tooth Cave	13	5	25	43					43	22	199	264				
Weldon Cave					695	746	12	1453	100	79	893	1072	79	59	1246	1384
Whirlpool Cave					5136	4059	101	9296					1641	2063	1377	5081

N= nymphs; J= juveniles; A= adults; TI= total individuals.