Annual Report October 1, 2006 — September 30, 2007
Endangered Species Act Section 10(a)1(B) Permit for the Incidental Take of the Barton Springs Salamander (*Eurycea sosorum*) for the Operation and Maintenance of Barton Springs Pool and Adjacent Springs
Permit # PRT – 839031

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Summary of Compliance

Compliance Status	HCP Measure
6.1.1 The City of Austin will coordinate the management of salamander habitat areas and be responsible for maintaining information and scientific data on the Barton Springs salamander. The City of Austin will also be responsible for the timely transmittal of information and data to the Service. The City of Austin will submit an annual report to the U.S. Fish and Wildlife Service, Austin Ecological Field Services Office, 10711 Burnet Road, Suite 200, Austin, Texas, 78758. The annual report will address the status of the salamander, provide an analysis of biological data, and review pool maintenance and management activities during the year. The City of Austin will be responsible for all measures in the HCP. In the annual report, each point of the HCP will be addressed. The permit and HCP will be for a period of 15 years. Copies of the annual report will also be submitted to the City Manager and City Council.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes:
6.1.2 The City of Austin will make daily visual inspections of all habitat areas (spring sites) and note any problem conditions such as vandalism, trash and debris, introduction of exotic fish or animals, or disturbance of habitat.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: Environmental Resource Management staff checks the spring sites Monday through Friday. Barton Springs Pool staff checks the springs on weekends. City salamander biologists are also on-call 24 hours/day, 7 days/week.
6.1.3 When the pool is lowered for cleaning and maintenance, trained City of Austin staff will visually inspect all of the exposed areas of the pool for stranded salamanders. This visual inspection will also include Eliza Spring, Old Mill Spring (Sunken Garden), and Upper Barton Spring. Any stranded salamanders will be moved to permanent water. This measure will be in place upon the issuance of this permit. Until the dam or comparable water control device is installed in the shallow end of the pool, a minimum of four biologists will be present at drawdown to search for stranded salamanders. After installation of the water control device, a minimum of two biologists will be present when the pool is lowered.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☒ Measure Needs Amendment Notes:
6.1.4 The City of Austin will modify the existing gate system for the drawdown of the pool. The new gate system will be designed to control the rate of drawdown and the level of water in the pool. The current system is an all or nothing approach that does	☐ Full Compliance ☐ Partial Compliance ☒ Measure Completed ☒ Measure Needs Amendment Notes:

not allow control or manipulation of the drawdown process, which is most critical during low aquifer conditions. The new gate system will be in place within six month of the issuance of this permit. If low aquifer conditions (flows less than 54 cubic feet per second) occur during this one-year period, the City of Austin will modify or suspend pool maintenance procedures (in consultation with the Service), to minimize and mitigate incidental take of salamanders.	
6.1.5 The City of Austin will install a pump system to provide spring water for pool maintenance. The pump system will also provide spring water for the fissures areas during pool drawdown. The pump would use spring water from the main pool. This measure will be in place within six months of issuance.	☐ Full Compliance ☐ Partial Compliance ☒ Measure Completed ☐ Measure Needs Amendment Notes: The original pump on the downstream dam was replaced in the fall of 2006 and the City plans to install a second pump in the same location in order to provide spring water for the majority of cleaning activities, except during droughts when water conservation will take precedence.
6.1.6 The City of Austin will clean the shallow end of Barton Springs Pool without drawdown of the entire pool. One option is to install a water control structure between the shallow and deep ends of the pool to create a permanent barrier between the cleaning operations and the main salamander habitat. The purpose of this water control structure is to eliminate the drawdown of the deep end during routine cleaning of the shallow end. This measure will be in place within six months of permit issuance. If the installation of the water control structure is not completed within the six-month deadline due to construction delays or adverse weather conditions, the City of Austin will modify or suspend pool maintenance procedures (in consultation with the Service), to minimize and mitigate incidental take of salamanders.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☒ Measure Needs Amendment Notes: One partial drawdown was conducted in May 2007. City will propose an amendment that indicates that the adjustable gates are a suitable alternative to the permanent barrier suggested in this measure.
6.1.7 The City of Austin will modify the beach areas in Barton Springs Pool. Portions of the beach areas will be replaced with walkways and wading areas made of exposed aggregate concrete, limestone or other hardened surface. The remaining beach area will be lowered to a minimum depth of 2 meters (6.5 ft.) and additional salamander habitat will be created to mitigate for any loss of habitat. This measure will be in place within six months of permit issuance. **a)** The City may clean the walkway on an as needed basis (~ 1 per week) using pressure washers (underwater) or other agreed to means.	☐ Full Compliance ☐ Partial Compliance ☒ Measure Completed ☒ Measure Needs Amendment Notes: Construction of walkways was abandoned in 1999 with the concurrence of the Service. **a)** ☒ Full Compliance Notes: In a letter dated February 17, 1999, the Service agreed to a minor amendment eliminating construction of a walkway over the beach. (See enclosed.) Since the walkway doesn't exist, it doesn't need cleaning.

b) The salamander habitat would be cleaned using only low-pressure hoses or other agreed to means. This cleaning would be done quarterly or as needed to keep the upper 2-3 inches of habitat from becoming embedded with sediment. **c)** The City of Austin will maintain 11,000 square feet of "beach habitat" for the salamander. Gravel or cobble of appropriate size will be used to replace sections of the habitat that get washed out. **d)** The City of Austin will clean non-salamander habitat areas in the deep end of the pool quarterly or as needed using a combination of high-pressures hoses and a vacuum system.	**b)** ☒ Partial Compliance Notes: The unusually high number of floods this year (18) resulted in rapid, repeated accumulation of sediment throughout the Pool. City biologists cleaned salamander habitat as frequently as possible after floods, but could not keep pace with flood-related deposition, particularly on the "beach." City biologists will continue to clean salamander habitat at least once per month until salamander habitat is no longer embedded. The City is also evaluating a water recirculation system in the "beach" to remove existing excess sediment and impede future accumulation and nuisance algal growth. As part of the short-term projects in the Barton Springs Pool Improvements Master Plan, a pilot project will be conducted in 2007 – 2008. The results will be used to determine if and how a larger scale system could be constructed and evaluate whether such a system should be included in the long-term projects of the Master Plan. The City will request an amendment to this measure to more clearly require use of low-pressure water (<= 20psi), regardless of the cleaning device. **c)** ☒ Partial Compliance Notes: Maintenance of the beach as suitable habitat for *E. sosorum* is a problem because the flow velocity over and through the substrate not sufficient to prevent accumulation of excess sediment and nuisance algae. This area is also too large for staff to maintain by hand during routine salamander habitat cleaning. Consequently, the City is studying long-term solutions that include a water recirculation system for this area and methods to restore a more natural stream-like flow regime throughout Barton Springs Pool. **d)** ☒ Full Compliance Notes: The deep end of the Pool was cleaned weekly because of the rapid accumulation of sediment and gravel.
6.1.8 The City of Austin will not drawdown the deep end of the pool if flow in the aquifer is lower than 54 cfs. This measure will minimize the impact of low aquifer levels at the adjacent spring sites, as well as conserve water in the aquifer during low flow	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☒ Measure Needs Amendment Notes: The City will request an amendment that,

conditions.	with Service approval, allows gradual, partial drawdowns during low discharge conditions.
6.1.9 The City of Austin will place thin limestone slabs over fissures in the shallow section of the fissures area to minimize impacts from recreational use.	☐ Full Compliance ☐ Partial Compliance ☒ Measure Completed ☒ Measure Needs Amendment Notes: Limestone slabs were difficult to securely attached to substrate and failed to maintain good quality habitat beneath; their use was abandoned in 2001 after conferring with the Service. The City will request an amendment to this measure that reflects the failure of this approach to achieve the desired result.
I**6.1.10** The City of Austin will lower the water in the deep end of the pool, if necessary, for cleaning only with Service concurrence. The water in the deep end of the pool will not be lowered when the lowering would cause Eliza Spring to go dry. This measure will be in place after the water control structure is installed or an alternative is implemented.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☒ Measure Needs Amendment Notes: Since implementation of this measure in 1997, sediment and gravel accumulated to the degree that 2 full drawdowns annually for cleaning have not been sufficient to maintain suitable salamander habitat or a healthy stream ecosystem in the Pool. With Service approval, monthly partial drawdowns were conducted from 2003 – 2004 during discharges above 54 cfs. This approach temporarily increases flow velocity in the caves and fissures of the Pool as well as Eliza Spring. Higher velocity, in turn, improves salamander habitat by enhancing the natural removal of excess material from the substrate, and impeding further accumulation. The known incidental take during these partial drawdowns was 2 stranded salamanders and no mortalities in any of the four *E. sosorum* spring sites. (See permit report 2003 – 2004.) The success of the adjustable gates as water control devices suggests that the drawdown limitations of this permit should be re-evaluated and revised. Therefore, the City will request an amendment that allows regular partial drawdowns for cleaning.
6.1.11 The City of Austin will maintain water over the fissure area during pool drawdown in order to minimize stranding of salamanders. The ability to retain water over the fissures will be in place at the time of permit issuance. The City of Austin will clean the fissure area quarterly or as needed, using a combination of low-pressure hoses and wire hand brushes or other agreed to means. In addition, until the water control structure is	☒ Full Compliance ☐ Partial Compliance ☒ Measure Completed ☒ Measure Needs Amendment Notes: The City will request amendments to this measure to prohibit the use of stiff, wire brushes to clean salamander habitat because they remove beneficial periphyton from the substrate and leave

in place or the beach area is lowered, the City of Austin will use a spring water sprinkler system to keep the beach area wet during drawdown.	small wire particles as the bristles degrade, to more clearly prohibit the use of high-pressure water (> 20 psi), and to reflect the installation of adjustable gates and lowering of the beach
6.1.12 The City of Austin will control surface water runoff around Barton Springs Pool, Eliza Spring, Old Mill Spring, and Upper Barton Spring. During heavy rains, storm water runoff can carry sediment and potential pollutants directly into Barton Spring, Eliza Spring, Old Mill, and Upper Barton Spring. Plans and schedules for the improvements, approved by the Service, will be complete within one year of the issuance of this permit. All of this work will be completed within two years of permit issuance. The City will also install temporary silt and erosion control measures in order to minimize adverse impacts due to surface water runoff. These measures will be in place upon issuance of the permit.	☐ Full Compliance ☒ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: All three perennial spring sites are protected from storm water runoff from adjacent development. The Barton Springs Lift Station relief interceptor will be completed in November of 2007. This project replaces the deteriorated sewer lift station adjacent to Eliza Spring with a gravity-driven continuous sewer pipe. The old lift station carried a high threat of failure that could cause underground and overland sewage flow into Eliza spring. The new pipe is a three layer pipe-within-a-pipe system that allows gravity to carry sewer water to the new lift station system in Lower Barton Creek, downstream of Barton Springs. Upper Barton Spring is an ephemeral site that stops flowing when total Barton Springs discharge is below 40 cfs; it has no artificial runoff protection structures. However, the City continues to examine feasible runoff protection methods that will not destroy the natural flow regime or be destroyed by flood waters of Barton Creek.
6.1.13 The City of Austin will modify Old Mill Spring (Sunken Garden) to restore the natural surface spring flow into Barton Creek. The pipe that currently drains the spring will be capped. This improvement will be in place within one year of issuance of this permit.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: Since the pipe was capped in 1999, the City has continued to enhance and restore the habitat in and around Old Mill Spring (Zenobia/Sunken Garden). In the last year efforts have been focused on restoring more natural surface water flow from the spring Pool to the outflow stream. City biologists have been gradually excavating excess rock and sediment from the spring pool, thereby increasing the ease with which groundwater reaches the surface and its capacity to prevent sediment accumulation. The City has also worked with several public groups to rebuild the stream banks, remove invasive terrestrial vegetation, and plant appropriate native vegetation. The City plans to improve flexibility in management of water depth and flow velocity, especially during droughts, by install an adjustable gate in the innermost wall of the spring Pool. This project has

	been funded as part of the Barton Springs Improvements Master Plan and, once completed, will illustrate not only the Sunken Garden Amphitheater, but also the remaining walls of the historic Old Mill.
6.1.14 The City of Austin will improve the efficiency of the Barton Creek bypass. As currently designed, the cleaning grate at the upstream end of the bypass quickly becomes clogged during storms. The clogging of the grate decreases the efficiency of the bypass and increases the frequency of floods that affect Barton Springs Pool. A more efficient system will be in place within one year of issuance of this permit.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: Initial modifications to the bypass grate, which were completed in 2000, appear to be inadequate under some conditions. The City will make further modifications in the next 5 years as part of the Barton Springs Improvements Master Plan. (See attached information on short-term projects of Barton Springs Improvements Master Plan.)
6.1.15 The City of Austin will implement a program to increase public awareness and community support for the salamander and the Barton Springs portion of the Edwards Aquifer. The SPLASH! Exhibit at Barton Springs Pool will be a major focus of this effort.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: An integrated Barton Springs Interpretive Plan will be developed and implemented by City Nature Center staff as part of the Barton Springs Improvements Master Plan. (See attached information on short-term projects of Barton Springs Improvements Master Plan.)
6.1.16 Access to Eliza Spring and Old Mill Spring (Sunken Garden) will be restricted to ensure no disturbance of salamander habitat at these spring areas. These sites will be used as outdoor educational facilities for the study of the biology and ecology of Central Texas springs. These measures will be in place within one year of permit issuance.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: Old Mill and Eliza Springs were closed to the public with the issuance of this permit October 2, 1998. These springs are used for educational activities under the supervision of authorized City of Austin staff. Initial chain-link fencing around Old Mill Springs was erected in 1999. The chain link fencing was replaced with new wrought iron fencing in April of 2006.
6.1.17 Educational signs (kiosks) will be installed to enhance public awareness of the salamander and aquifer. Outdoor educational displays will highlight the biology and ecology of the Central Texas springs with emphasis on the Barton Springs Salamander. These measures will be in place within one year of permit issuance.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: Additional educational materials will be developed as part of an integrated Barton Springs Interpretive Plan. (See attached information on short-term projects of Barton Springs Improvements Master

	Plan.)
6.1.18 The City of Austin will set up a fund for conservation and research efforts for the Barton Springs salamander. The City will deposit $45,000 annually (for the term of the permit) into this fund from the revenues generated by Barton Springs Pool. This fund will also be open to donations from any group or private individual. A committee of technical representatives will decide the allocation of money from this fund. At a minimum, the committee will consist of one technical representative from the City and one technical representative from the Service. These technical representatives must be experienced in salamander biology. Other committee members could include State, County, University, or other qualified biologists and karst aquifer hydrogeologists and swimmer/stakeholder representatives. The City and the Service would retain veto power in deciding how the money is allocated. The funds will be used for study of salamander biology, captive breeding and refugia, watershed related research, improved pool cleaning techniques, education, and/or land acquisition. The committee will decide how the money will best be spent. The funding will be in place within six months of permit issuance.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: The City transfers $45,000 annually to the Austin Community Foundation, who has contracted with the City and the Service to manage the financial assets of the Barton Springs Salamander Conservation Fund. The balance in this fund as this date is $356,395. The City manages all other aspects of the Fund in cooperation with the Service, including project review and funding decisions. Two projects have been funded and are in progress; the third will begin in 2008. They are: 1. Phylogeography of *Eurycea sosorum* populations ($60,521.00). Final report expected in 2008. 2. Toxicity of Coal-tar PAHs to *E. nana* ($78,439) Final report expected in 2008. 3. Estimating Population Dynamics and Life History of *Eurycea sosorum* in Eliza Spring Using Mark-Recapture Methods ($149,144). The first phase of this project is to begin in January of 2008.
6.1.19 The City of Austin will deposit $10,000 (in addition to the $45,000 mentioned above) into the conservation fund. This will mitigate for the incidental take that occurred as a result of cleaning the pool and operation from May 30, 1997 (listing effective date) to the date the permit is issued. The fund will be set up and the money deposited within 6 months of permit issuance.	☒ Full Compliance ☐ Partial Compliance ☒ Measure Completed ☒ Measure Needs Amendment Notes: The City deposited this $10,000 and annual contributions as stipulated in 6.1.18 into the Barton Springs Conservation Fund Special Revenue Fund from 1997 until 2003. On October 20, 2003 the City, the Service signed a contract with the Austin Community Foundation to administer the Barton Springs Salamander Conservation Fund. The balance of $193,588 in the City's Special Revenue Fund was transferred to the ACF.
6.1.20 The City will prohibit the use of high-pressure hoses in salamander habitat.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☒ Measure Needs Amendment Notes: The City will request an amendment to this measure to more clearly delineate the use of low-pressure *water* (< 20 psi) regardless of device or type and size of hose.
6.1.21 The City of Austin may remove woody debris	☒ Full Compliance

by any methods approved by the Service. All debris will be visually inspected for salamanders before and after removal.	☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes:
6.1.22 In the event of a flash flood or potential flash flood, it is necessary to prepare Barton Springs Pool area to limit damage. To prepare for such an event, section of fence, trashcans, railings and other items are moved to higher ground. The endangered species biologist for the City of Austin will be notified before Barton Springs Pool is lowered. Barton Springs will not be lowered if flow is lower than 54 cfs or if the City of Austin endangered species biologist indicates that Barton Springs Pool should not be lowered.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: The water was drawdown 14 times in response to 18 floods of Barton Springs Pool, which occurred while aquifer discharge was above 54cfs. This approach appears to be effective in reducing sediment deposition in the Pool from overland water flow from Barton Creek. It may also reduce the accumulation of sediment that arrives with the groundwater.
6.1.23 The City of Austin may clean sediment and debris from the adjacent spring sites using low-pressure hoses or other agreed to means on an as needed basis.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☒ Measure Needs Amendment Notes: The City will request an amendment to more clearly delineate the use of low-pressure water, regardless of device or type and size or hose.
6.1.24. The City of Austin will not allow the introduction of exotic plants or animals in any springs in Zilker Park.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes:
6.1.25. The City of Austin will not move salamanders between spring sites.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☒ Measure Needs Amendment Notes: The City will request an amendment to this measure to allow human-mediated migration among sites with approval of the Service. The small number of *E. sosorum* (<1000 wild breeding adults) and preliminary molecular data (Bendik 2006) indicate that the species is at risk of detrimental effects due to small population size, i.e., loss of genetic variation, accumulation of deleterious mutations, inbreeding, random genetic drift, and prolonged bottlenecks (Hartl and Clark 1989, Lande 1995, Falconer and Mackay 1996, Lynch 1996). One method for reducing this risk is to foster genetic exchange among recently fractured populations, effectively increasing

	total population size and adaptive genetic variation. This would maintain and enhance adaptive genetic diversity of the species by fostering genetic exchange among individuals from different spring sites. While there could be mortality of individuals associated with transfer among historically connected sites, ultimately the genetic exchange would contribute to long-term persistence of the species. In addition, potential individual mortality can be monitored and reduced by careful methods of transfer and post-transfer monitoring. The requested amendment would also allow salamanders of the same species from different sites to be housed together to meet genetic diversity goals for the captive population.
6.1.26. The City of Austin may manually trim aquatic vegetation that reaches the surface of the water.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: *Sagittaria graminea* on the beach is trimmed whenever its leaves are tall enough to become an impediment to swimmers. Other plant species present were added to the Pool during a small re-vegetation effort in April of 2007. These have not required trimming.
6.1.27 The City of Austin will not allow unauthorized SCUBA in any springs in Zilker Park.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes:
6.1.28 The City of Austin will prohibit the deliberate disturbance of substrate in the primary salamander habitat. This measure will be effective upon the issuance of this permit.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☒ Measure Needs Amendment Notes: The City is requesting an amendment to more clearly prohibit deliberate disturbance by unauthorized persons. Deliberate disturbance by City biologists occurs during surveys and when cleaning habitat. This disturbance is necessary to help clean excess sediment and debris from salamander habitat. Furthermore, it is necessary to disturb some areas of the beach while removing accumulated rocks and gravel. (See 6.1.35 below)
6.1.29 Sediment and debris that is collected during routine cleaning of the pool will be removed from the pool and disposed of properly. This will be accomplished by pumping the material into a vacuum	☐ Full Compliance ☒ Partial Compliance ☐ Measure Completed ☒ Measure Needs Amendment

truck for disposal, irrigating the lawns or other agreed to means. The sediment and debris will not be dumped into Barton Creek as a means of disposal. This measure will be effective upon the issuance of this permit.	Notes: Material removed from substrate in Barton Springs Pool by vacuum equipment is not allowed to flow into or over salamander habitat; it is diverted into the bypass tunnel and transported downstream of the Pool. The majority of material removed during routine cleaning is spring water, which contains small amounts of algae that naturally grow in Barton Springs Pool. The low concentration of algae does not pose an environmental threat to Barton Creek. The City will request an amendment that clarifies the primary intent of the measure to protect salamander habitat within Barton Springs Pool, and secondary intent to protect Barton Creek from excess sediment and debris introduced by floods and liberated during cleaning.
6.1.30 Since there is a seasonal rate of turnover in the staff involved in the pool cleaning process, the City of Austin will have professional supervisors direct and document all cleaning procedures at the pool. This measure will be in place upon the issuance of this permit.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes:
6.1.31 The City of Austin will ensure that all people working at the pool lifeguards and other staff) are knowledgeable about the salamander. Yearly training will be given to teach staff about the salamanders and the ecology of the Edwards Aquifer springs. This measure will be in place upon the issuance of this permit.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes:
6.1.32 The City of Austin will ensure that all people surveying for salamanders are properly trained. The survey work should be done under the terms and conditions of a current scientific permit issued to the City of Austin. This measure will be in place upon the issuance of this permit.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: City of Austin salamander biologists train Barton Springs Pool staff twice per year as the lifeguard roster changes. They are also collaborating with City Aquatics staff in writing a complete Barton Springs Pool lifeguard manual that includes information on care and protection of *E. sosorum* habitat.
6.1.33 The City of Austin will provide yearly spill and response training for all staff that perform maintenance activities in and around the springs in Zilker Park. The annual training will address spill and response protocols, proper containment techniques, and remediation. An annual inventory of necessary containment and remediation equipment will be conducted during the training session, and after the use	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: City of Austin biologists and Spill Response staff train Barton Springs Pool staff in spill detection and response in conjunction with training associated with 6.1.32 above.

of the equipment in response to any spill. This measure will be in effect upon the issuance of this permit.	
6.1.34 Specific areas will be designated for the fueling and maintenance of equipment and vehicles used in maintaining the spring and areas around the springs. These areas should be selected away from the springs to avoid the chance of impacts to the spring habitats. Absorbent pads will be used during all operation, fueling, and maintenance activities. This measure will be in effect upon issuance of this permit.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: All gasoline-powered machinery is fueled on top of the hill at the bathhouse. Absorbents booms are used around all equipment on or near the Pool sidewalk.
6.1.35 The City, with concurrence of the Service, will develop a policy for silt and gravel removal in the deep end of the pool. In the past, removal in the deep end has been necessary after the pool has been flooded by Barton Creek, but the City does not have a policy that outlines when and how the removal of material should occur. The take estimate may change due to this policy but would probably be a minor amendment to the HCP. The new policy will be in place within one year of the issuance of this permit.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: In November of 2006, the City used a vacuum dredge to remove some of the gravel and silt that had accumulated in the deep channel of the Pool upstream of the dam. While, the goal was to remove all material that had been deposited since the last dredging in 1991, the vacuum method could only remove material smaller than 5 inches in diameter. A method for removing the remaining large material will be developed as part of the Barton Springs Improvements Master Plan. The City will also develop a plan for regular removal of smaller amounts of accumulated material.
6.1.36 The City of Austin will, in concurrence with the Service, develop a catastrophic spill response plan for Barton Springs. The new plan will be in place within one year of the implementation of this permit. This plan will address spill prevention, containment, remediation, and salamander rescue.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes:
6.1.37 Structural and habitat restoration will occur at Eliza Spring and Old Mill Spring. Habitat restoration will include enhancement of bottom substrate with clean cobble and gravel, and the establishment of native species of aquatic plants. Care will be taken to ensure that non-native invertebrates are not introduced. Old Mill Spring enhancement will include the restoration of full surface flow to the stream. All restoration efforts will be reviewed and approved by the Service before implementation. This work will be completed within two years of the issuance of this permit.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: The City is working with experts and citizens to develop a Barton Springs Improvements Master Plan for the next decade. The master plan includes items designed to reconstruct a more natural flow regime, restore salamander habitat, inhibit nuisance algal growth and foster aquatic ecosystem stability. Other items will reduce the risk of contamination of Barton Springs Pool due to cleaning and maintenance activities (e.g., additional electrical power, which will allow complete conversion from gasoline to electric power-washers), and provide the necessary

	infrastructure to switch from treated tap water to spring water for all cleaning activities within the Pool. The City Council has dedicated $6,000,000 over the to implement short-term improvements in the next 5 years. Development of long-term improvements is ongoing; these include restoration of the overland stream from Eliza Spring to Barton Springs Pool. A second round of native aquatic plant re-vegetation in salamander habitat of Barton Springs Pool was conducted on March 6, 2007. Aquatic plants now cover approximately 200 square feet of primary salamander habitat of the fissures and spring mouths. Removal of excess sediment and gravel in the Pool is ongoing. At Old Mill (Zenobia/Sunken Garden) Spring reconstruction of the natural streambed and stream banks is nearly completed, while hand-excavation of asphalt, aggregate concrete and excess rock from within the spring Pool is ongoing. The excess rock impedes water flow up from the aquifer and contributes to the accumulation of sediment. We expect to continue this process until the upper 6 inches of habitat are sediment free and natural water flow maintains good habitat. City watershed protection staff has been working closely with the Barton Springs Edwards Aquifer Conservation District to develop a Habitat Conservation Plan that ensures the Barton Springs Complex will no go dry due to excess pumping from the aquifer.
6.1.38 The City of Austin will continue to conduct monthly surveys at all spring sites, in compliance with Federal and State Scientific Monitoring Permits.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes:
6.1.39 The City of Austin will form an Advisory Committee of local and regional experts that will meet at least annually to discuss and refine pool maintenance activities. A variety of interests including swimmers, biology and hydrogeology will be represented on this committee. In addition, this committee will review this HCP and make suggestions for needed amendments as deemed necessary. The Advisory Committee will also be responsible for refining the habitat conservation plan through adaptive management. Data collected will be used to adapt management actions. The City of Austin	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: The Barton Springs Scientific Advisory Committee met 3 times in the past year (November 12, 2006, April 11 and April 30, 2007). The committee developed and submitted written recommendations of short- and long-term activities to be included in the Barton Springs Pool Improvements Master Plan. Members of the committee also

will be responsible for implementation of adaptive management changes.	presented those recommendations to City staff on March 6, 2007.

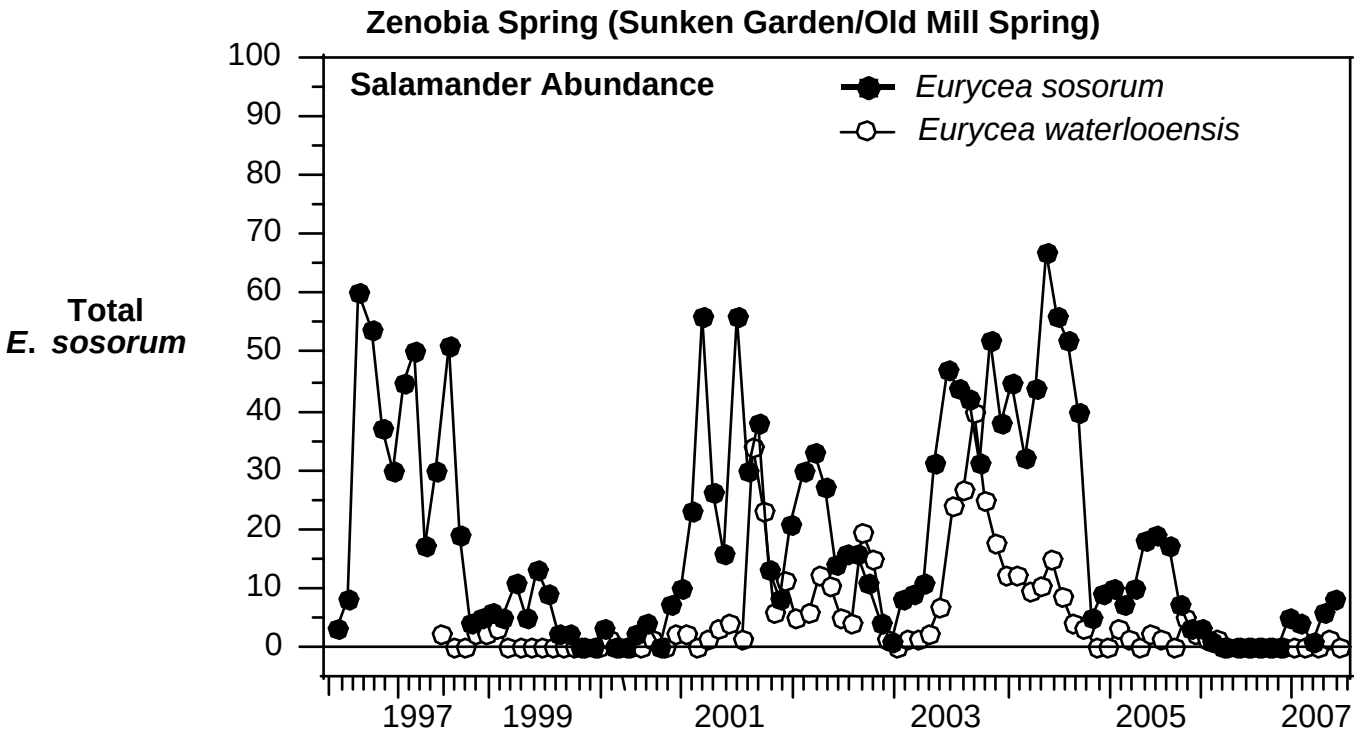
6.1.40 The City of Austin must reduce loadings of petroleum hydrocarbons, heavy metals and sediments to Barton Springs from current development and other activities located within the Barton Springs Zone, within the City limits, and subject to the City's jurisdiction. This reduction in loadings will be achieved through the measures set out in the NPDES storm water permit and its reasonable and prudent measures listed in Appendix A of the EA/HCP.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: The City continues to implement reasonable and prudent measures as delineated in TPDES (current version of NPDES). TPDES permit reports have been submitted and are available upon request.
6.1.41 The City of Austin will maintain a viable captive breeding population of Barton Springs salamanders. The City will designate a staff biologist and dedicate a minimum of $20,000 annually to the development and maintenance of this program. The purpose of this program is to provide a contingency plan for the species if a catastrophic event were to occur. Funding and design of the new program will be in place within six months of the issuance of this permit.	☒ Full Compliance ☐ Partial Compliance ☐ Measure Completed ☐ Measure Needs Amendment Notes: The Salamander Research Center currently houses 100 wild-caught and 80 captive-bred *E. sosorum*. City biologists have developed a Population Management Plan following the guidelines of the American Zoological Association. This plan will be used to more effectively manage captive breeding and re-introduction efforts.

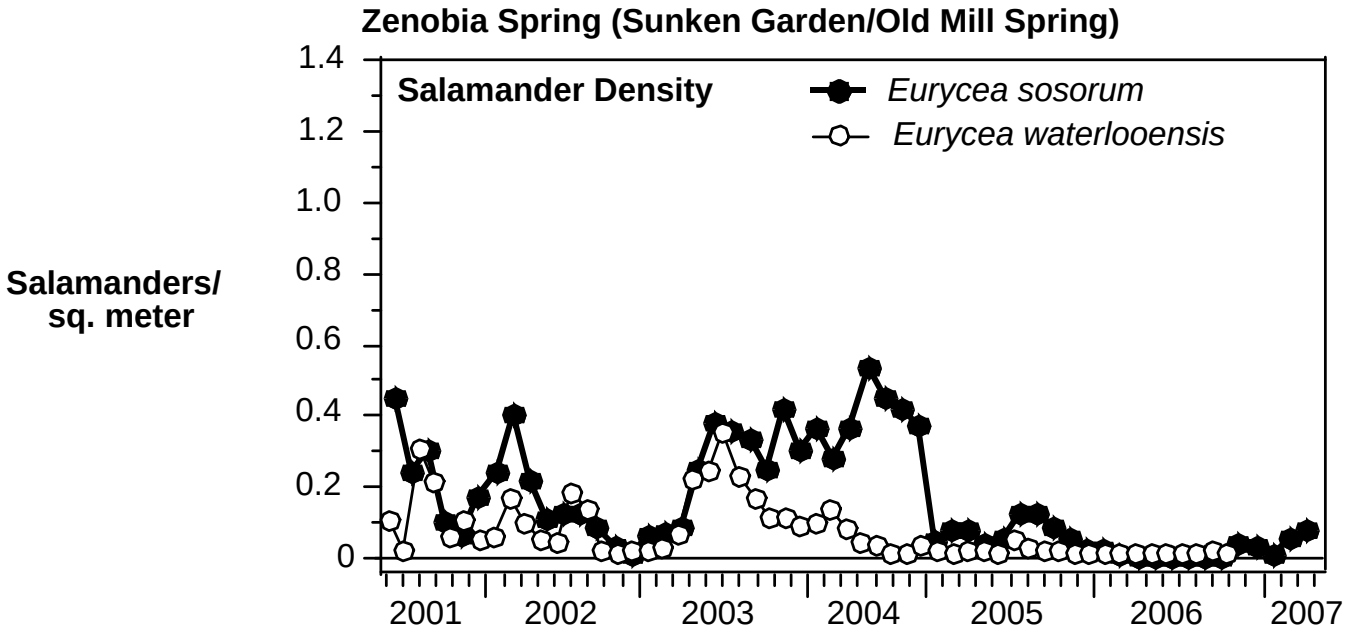
Summary of Salamander Status/Biological Data

Salamander Abundance and Density

The extended drought of 2006 appears to have affected *E. sosorum* populations differently in each spring site. When monthly salamander abundances and densities during this 14-month drought were compared to those immediately before (2003-2005) and after (2007), there were no consistent patterns. There were significant differences within Old Mill (Sunken Garden/Zenobia) and Eliza Springs, while there were none for Parthenia Spring (Barton Springs Pool). Furthermore the differences within Eliza and Old Mill Springs are in opposing directions. In Old Mill Spring, there were statistically significant decreases in *E. sosorum* abundance (no drought mean = 29.4, drought mean = 3.00; Mann-Whitney $U = 17.5$, $z = -4.299$, $p < 0.0001$) and density (no drought mean = 0.23/sq.m, drought mean = 0.02/sq.m; $U = 20.5$, $z = -4.202$, $p < 0.0001$). The stream from Old Mill ceased flowing when Barton Springs discharge dropped below 36 cfs, the spring pool became a stagnant pond when discharge dropped below 25 cfs, and no salamanders were found for several months (Fig. 1). This salamander population appears to have experienced the most severe immediate effects of drought. It is uncertain to what degree this population can recover and whether ongoing habitat reconstruction will be successful in fostering population growth.

Figure 1.


Zenobia Spring (Sunken Garden/Old Mill Spring)
Salamander Abundance
Eurycea sosorum
Eurycea waterlooensis
Total
E. sosorum
100
90
80
70
60
50
40
30
20
10
0
1997
1999
2001
2003
2005
2007


Zenobia Spring (Sunken Garden/Old Mill Spring)
Salamander Density
Eurycea sosorum
Eurycea waterlooensis
Salamanders/
sq. meter
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
2001
2002
2003
2004
2005
2006
2007

In contrast, a statistically significant increase in salamander abundance (no drought mean = 283.9, drought mean = 498.9; t = 3.761, p = 0.0006) and density (no drought mean = 3.79/sq.m, drought mean = 6.71/sq.m.; t = 3.702, p = 0.0007) occurred in Eliza Spring (Fig. 2). This salamander population appears to have been more resilient to the effects of drought, which may be related to the higher average abundance since habitat reconstruction in 2003. During the 2006 drought, the habitat in Eliza Spring retained stream-like characteristics, including largely unimpeded water flow and a diverse aquatic community (COA unpub.). These characteristics may buffer the population from immediate effects of drought, but does not indicate if there are longer-term effects yet to be manifested. Previous analysis of data from Parthenia Spring revealed a 6-month lag between increased discharge and increased salamander abundance and this pattern may become apparent in Eliza Spring in the near future.

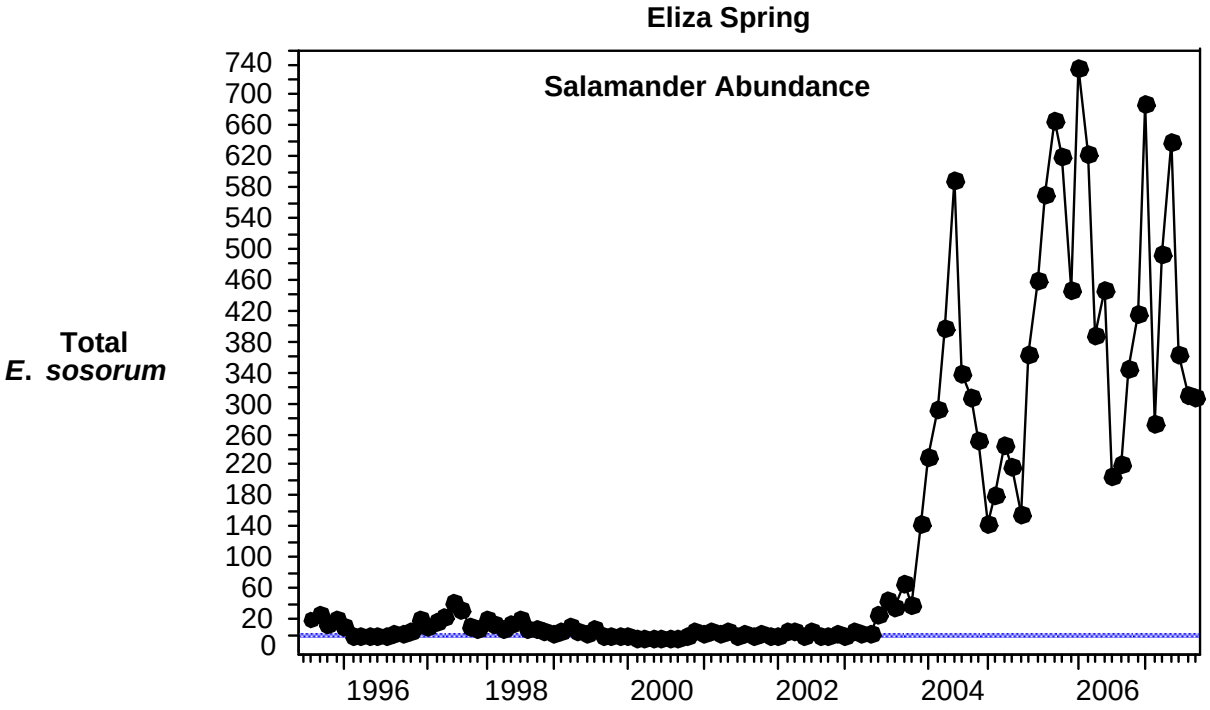
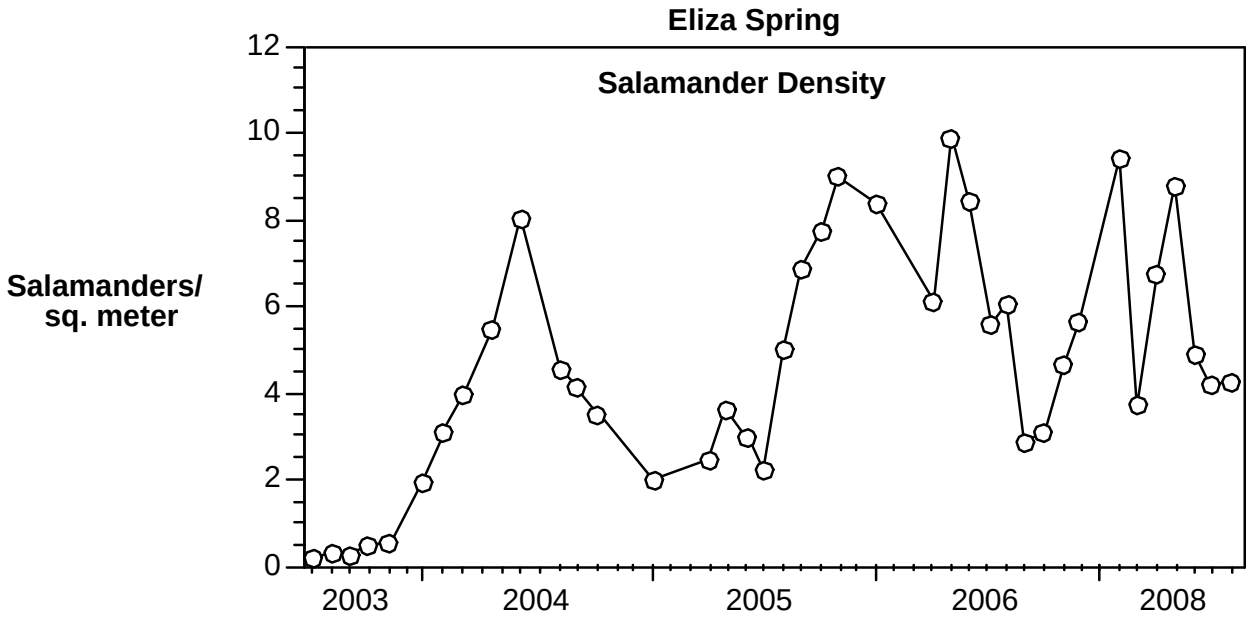
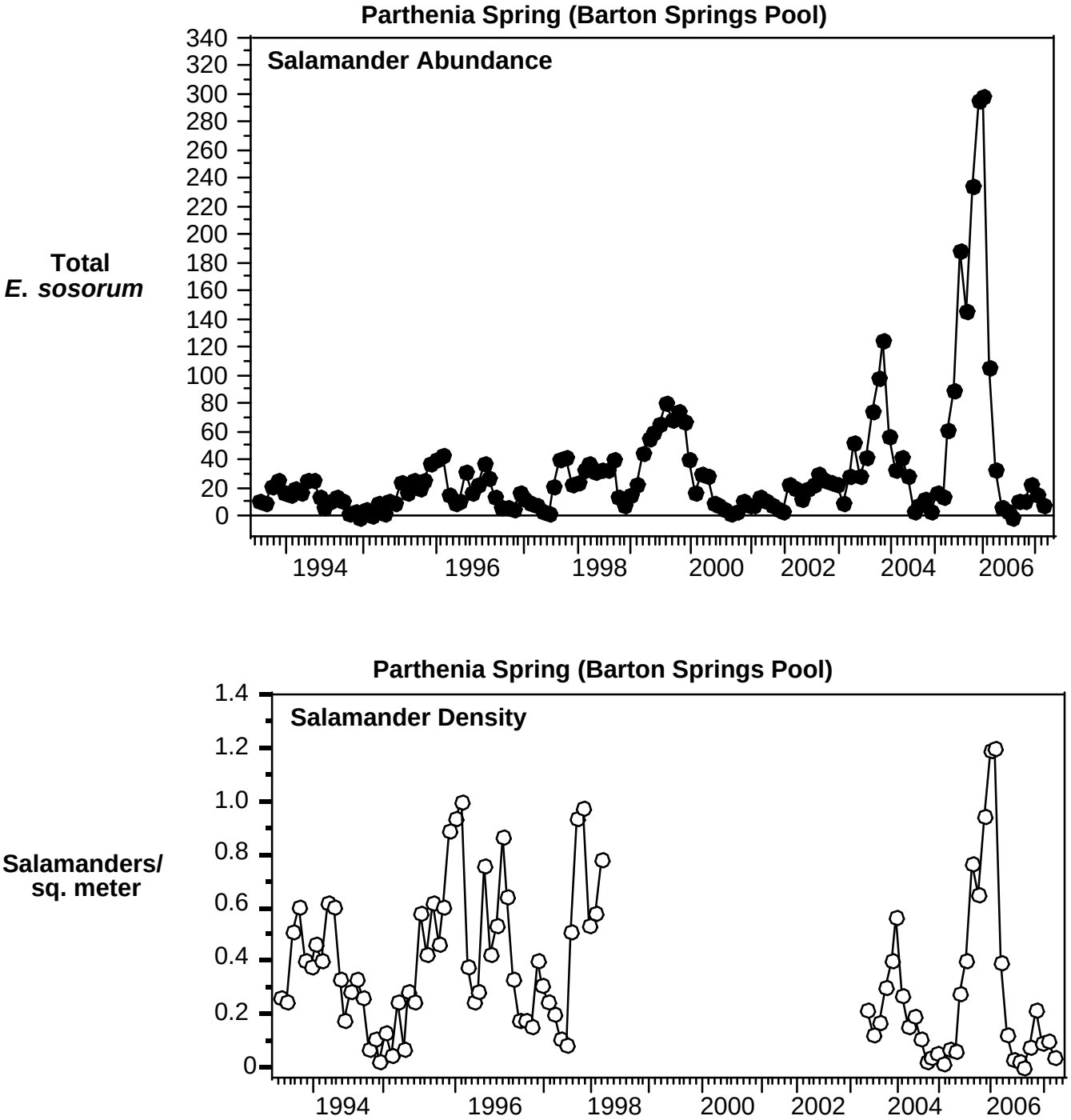


Figure 2.



In Parthenia Spring (Barton Springs Pool) *E. sosorum* abundance and density decreased during the drought, but the relationships are not statistically significant (abundance: no drought mean = 42.5, drought mean = 113.0; *U* = 103.0, z = -0.861, p = 0.389; density: no drought mean = 0.17/sq.m, drought mean = 0.47/sq.m.; *U* =94.0, z = -1.198, p = 0.231)(Fig.3). This does not necessarily indicate that drought had no effect on *E. sosorum* in Parthenia Springs. Observable effects of the drought on this salamander population may be delayed and could become apparent in the future.

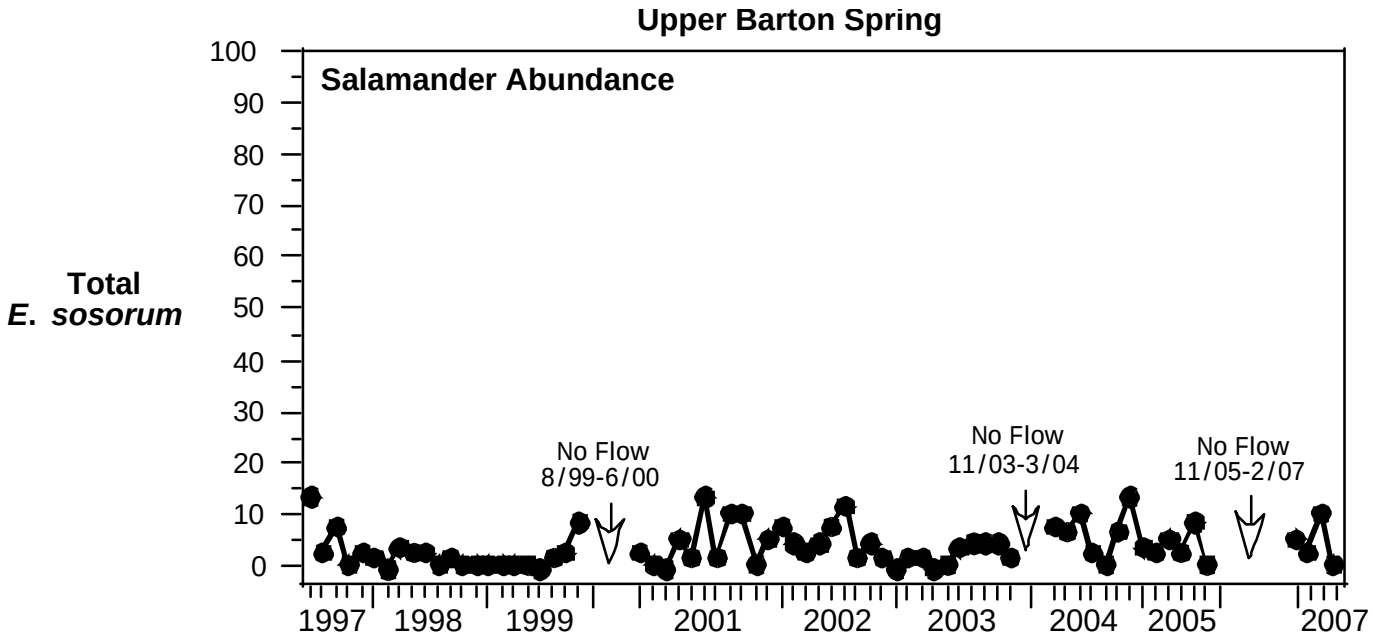
Figure 3.

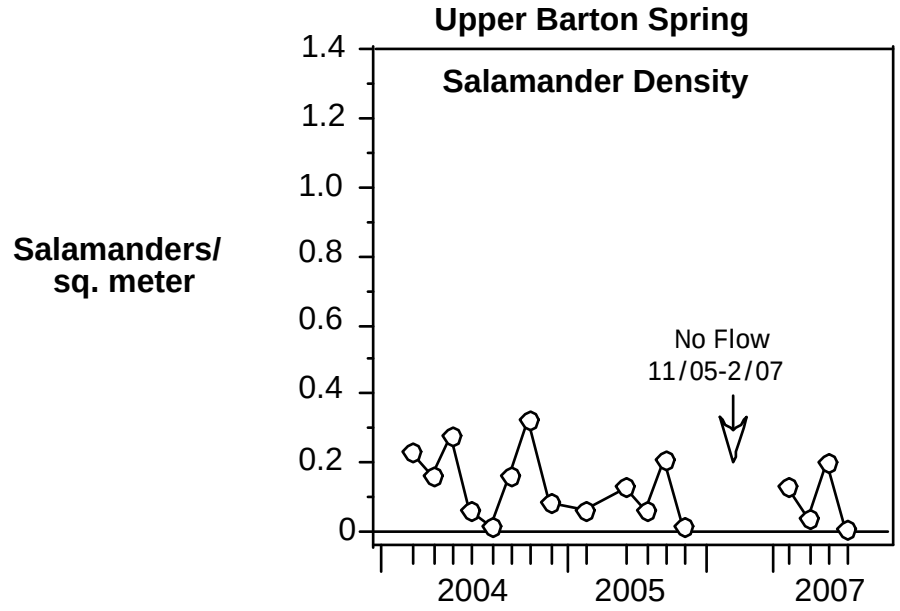


Upper Barton Spring is an ephemeral site that goes dry when total Barton Springs discharge drops below 40 cfs. There was no water at the surface in Upper Barton Spring from November 2005 through January 2007,

thus there were no salamanders observed (Fig. 4). Since *E. sosorum* is a solely aquatic species, drought clearly limits its presence at the surface. It is unclear, however, what happens to salamanders found at this site when it becomes dry. They may migrate in and out of the site, or estivate, or die. There is no evidence of estivation in any plethodontid salamander species (Duellman and Trueb 1986.) Thusfar, *E. sosorum* salamanders found after a two-year dry period appeared normal and had visible fat stores in the abdomen. How long this site has been habitat for this species is also unknown; *E. sosorum* was first recorded as present in 1997. It is also unclear whether this site can support a viable population, given its small size and ephemeral nature.

Figure 4.

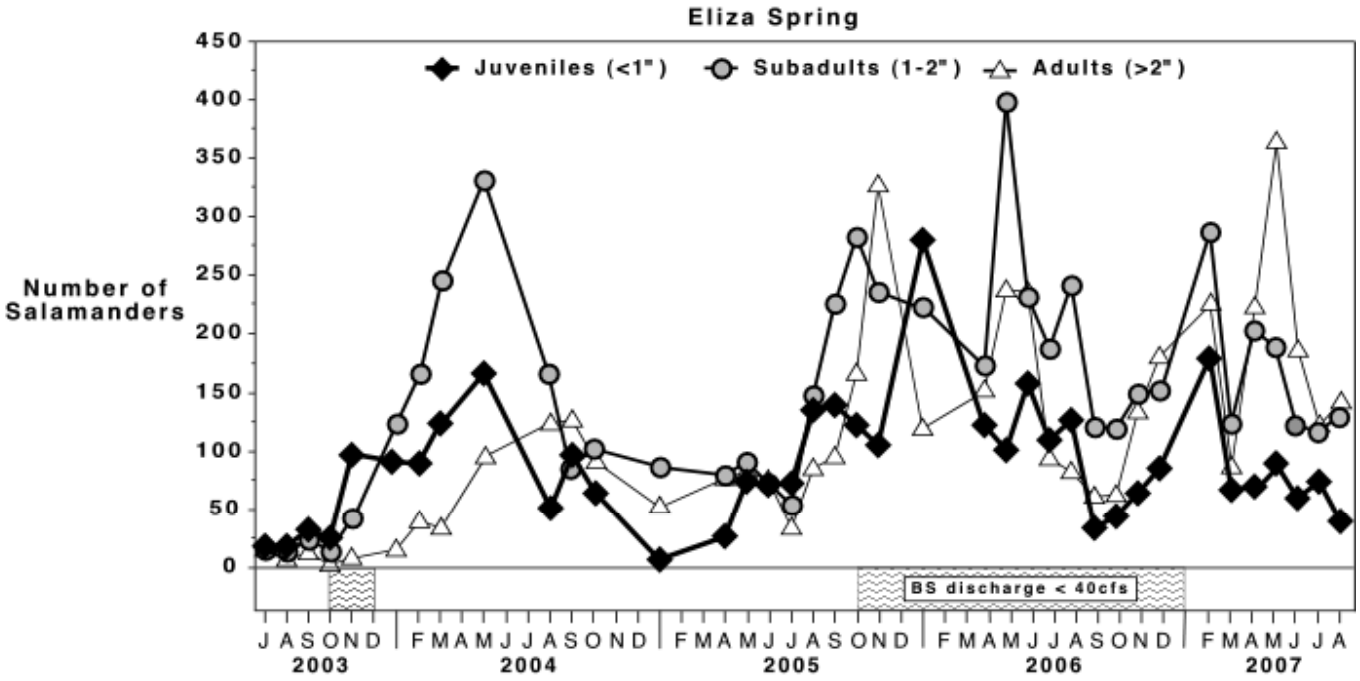




Salamander Recruitment

Recruitment is the addition of animals to a population through reproduction (Ricklefs 1990), and it is an important indicator of short-term population growth and long-term population dynamics. In the Barton Springs complex only the *E. sosorum* population in Eliza Spring shows evidence of continued recruitment. The graph below (Fig. 5) illustrates the changes in number of salamanders of each size class in Eliza Spring following the initiation of habitat reconstruction in 2003. There is a pattern of sequential increases of juveniles, followed by subadults, followed by adults. In addition, the number of juveniles is positively correlated with the number of subadults 3 months later (Spearman Rank rho = 0.486, z = 2.280, p = 0.0228) and the number of subadults is correlated with adults 3 months later (rho = 0.508, z = 2.381, p = 0.0173). These results show that reproduction has been followed by recruitment of juveniles into the adult breeding population, and that this process has continued to occur over the past 4 years. This suggests that the salamander population in Eliza Spring will remain stable and possibly increase in the near future, barring unforeseen anthropogenic events.

Figure 5.



Unfortunately, recruitment does not appear to be occurring in any of the other spring sites. There have been few or no juveniles and subadults in Old Mill Spring since 2004 (Fig. 6). In Parthenia Spring there was a brief period in 2005 where reproduction was evident, and there was a small increase in abundance of adults (Fig. 7). However, this pattern disappeared in the middle of the 2006 drought when abundance of salamanders of all size classes decreased. Finally, in Upper Barton Spring salamanders of all size classes have been present, but juvenile abundance is consistently low (< 5) (Fig. 8). There may be limits on potential for recruitment in this population because of the transitory presence of water.

Figure 6.

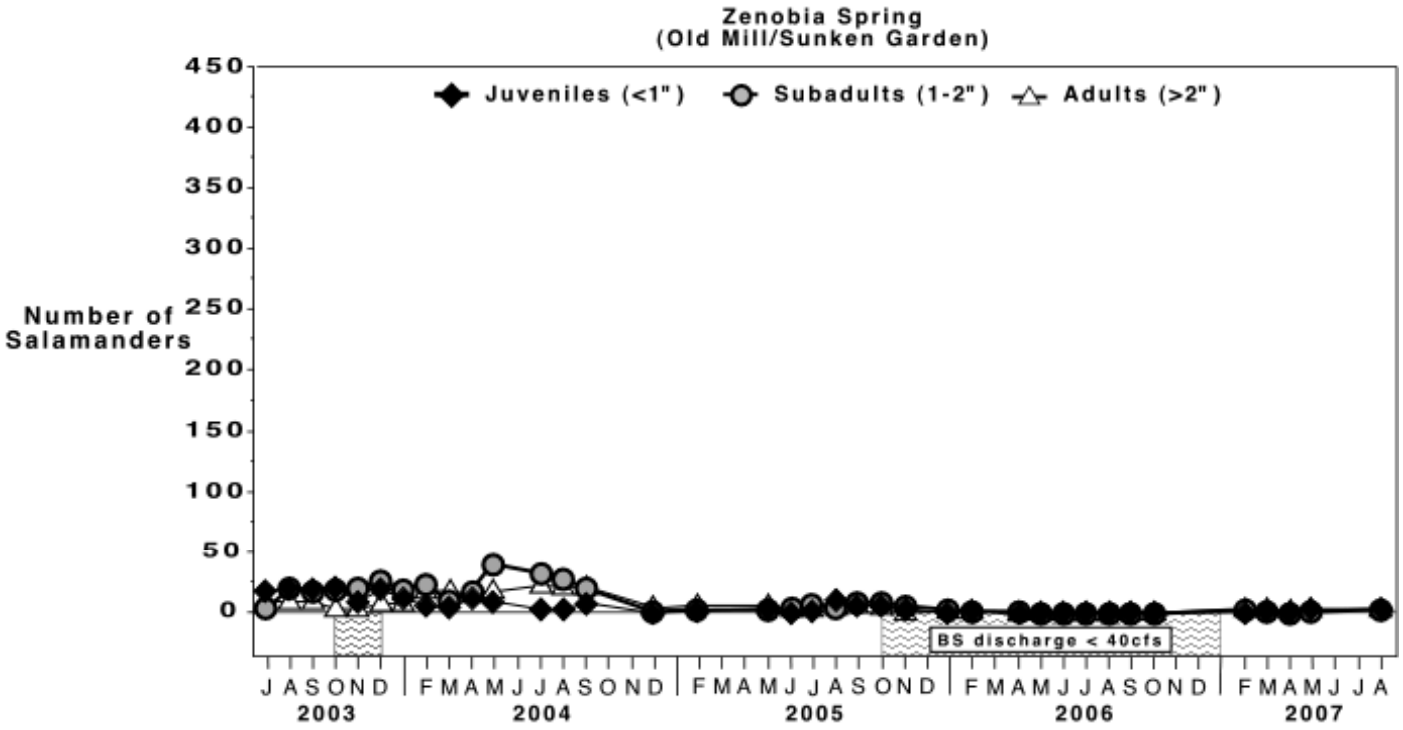


Figure 7.

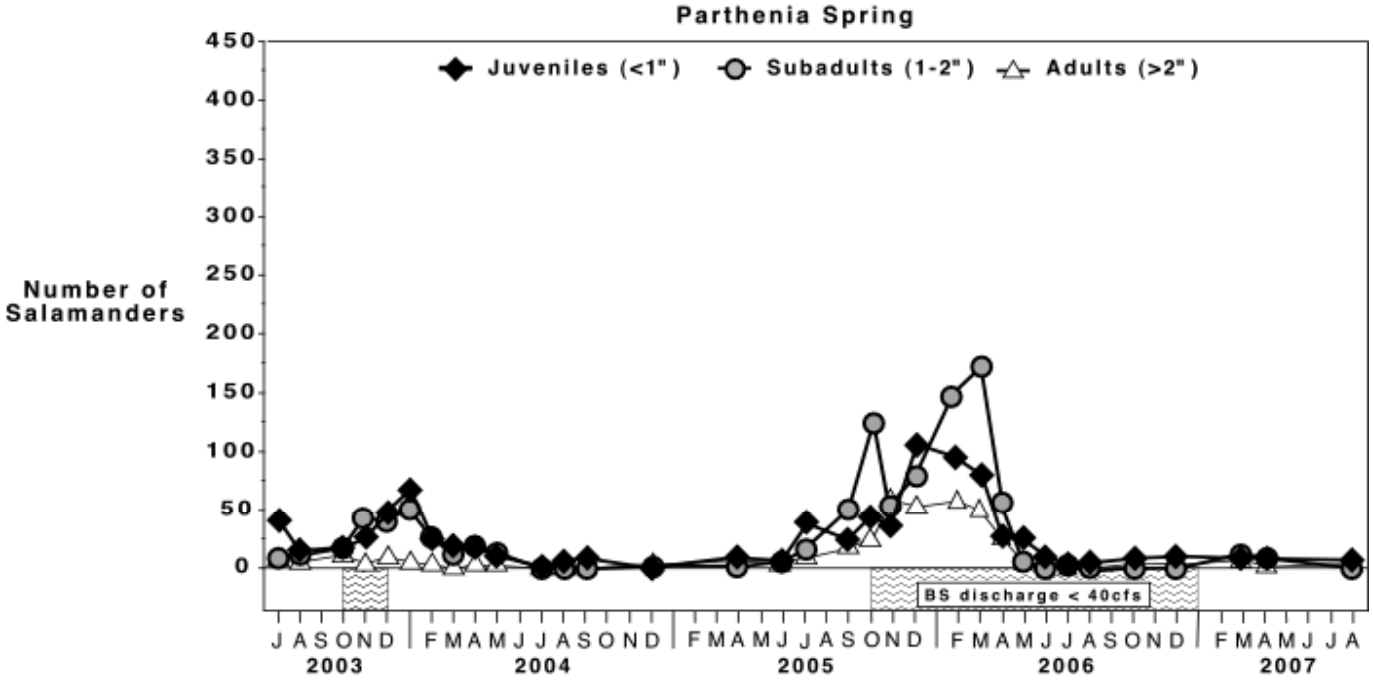
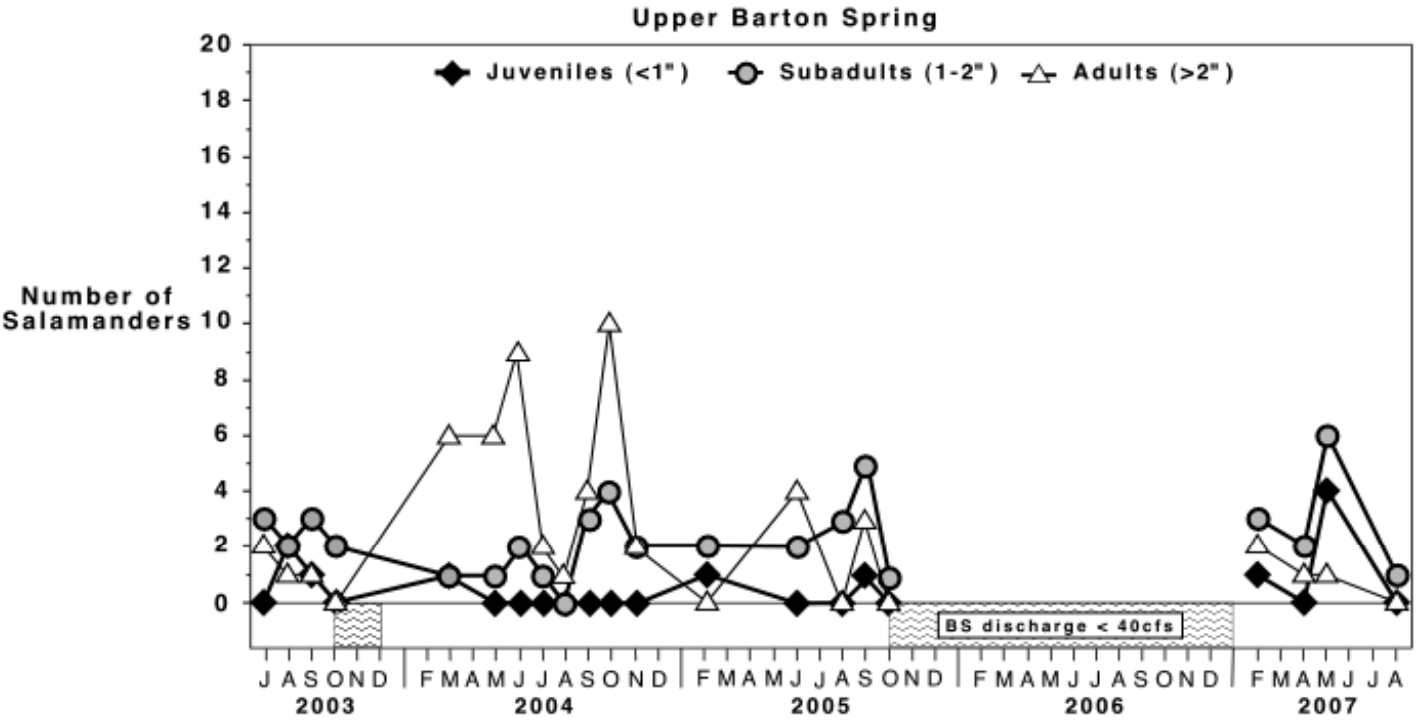


Figure 8.



Pool Maintenance and Management Activities

Barton Springs Pool Drawdowns Oct. 2006 – Sept. 2007

There were 18 separate floods when Barton Creek overtopped the upper dam and entered Barton Springs Pool. There was at least one flood every month of 2007 except April and August. This is a record number of floods comparable only to the period following the drought of record in the 1950s. These floods required numerous drawdowns of the water level in Barton Springs Pool to help floodwater to pass through and scour the substrate. Salamander and water depth data collected during these drawdowns are presented below (Table 1). City biologists were onsite for each drawdown and no stranded salamanders were found at any of the four spring sites as a result of any drawdown this year. One salamander was found dead on January 21, 2007 during cleaning activities. The corpse was preserved and will be deposited in the collections at the Texas Memorial Museum, Austin, Texas. Observed incidental take for 2006-2007 is 1 adult *E. sosorum*.

Table 1. Shown are data on stranded salamanders and other data collected during drawdowns. There were no drawdowns from October through December 2006 because aquifer discharge was below 54 cfs.

Date	Site	Water Level Decrease	Purpose	Aquifer Discharge (cfs)	Number Stranded	Number Re-located	Number Collected Live	No. Died
1/13/2007	BSP	58.75”	Flood	50	0	0	0	1
1/13/2007	Eliza	31.8”	“	“	0	0	0	0
2/19/2007	BSP	55.5”	Spring Cleaning	65	0	0	0	0
2/19/2007	Eliza	No data	“	“	0	0	0	0
3/12/2007	BSP	44.8“	Flood	62	0	0	0	0
3/12/2007	Eliza	9.8”	“	“	0	0	0	0

3/27/2007	BSP	49”	2 Floods	76	0	0	0	0
3/27/2007	Eliza	2.15”	“	“	0	0	0	0
5/3/2007	BSP	54.9”	Flood	100	0	0	0	0
5/3/2007	Eliza	10.5”	“	“	0	0	0	0
5/16/2007	BSP	47.15”	Flood	101	0	0	0	0
5/16/2007	Eliza	5.49”	“	“	0	0	0	0
5/24/2007	BSP	31.52”	Partial Cleaning	99	0	0	0	0
5/24/2007	Eliza	3.18”	“	“	0	0	0	0
5/28/2007	BSP	51.60”	2 Floods	102	0	0	0	0
5/28/2007	Eliza	7.55”	“	“	0	0	0	0
6/3/2007	BSP	~ 5 feet	Flood	101	0	0	0	0
6/3/2007	Eliza	No data	“	“	0	0	0	0
6/25/2007	BSP	~ 5 feet	Flood	106	0	0	0	0
6/25/2007	Eliza	No data	“	“	0	0	0	0
7/3/2007	BSP	~ 5 feet	2 Floods	102	0	0	0	0
7/3/2007	Eliza	No data	“	“	0	0	0	0
7/21/2007	BSP	~ 5 feet	Flood	112	0	0	0	0
7/21/2007	Eliza	No data	“	“	0	0	0	0
7/27/2007	BSP	~ 5 feet	Flood	116	0	0	0	0
7/27/2007	Eliza	No Data	“	“	0	0	0	0
9/11/2007	BSP	48.55”	Flood	117	0	0	0	0
9/11/2007	Eliza	6.26”	“	“	0	0	0	0

Although we were able to open the dam gates for every flood, the mere presence of dams and less than ideal gate size and placement precluded natural transport of suspended material on downstream out of the Pool (Giller and Malmqvist 1998, Cushing and Allan 2001). Thus, after every flood, staff must manually clean the Pool of deposited silt, gravel and debris. The period of post-flood Pool closure depended on the amount of material deposited (Table 2). City biologists cleaned salamander habitat of silt deposited by the surface floodwater and emanating with the spring outflows. Trash, fine gravel, and excess woody debris were also removed whenever it was necessary. Despite these efforts, salamander habitat has not remained clean of silt for any extended period of time this year. Silt traveling underground through the aquifer continues to exit with the spring water and be deposited in surface salamander habitat (Mahler and Lynch 1999, Massei et al. 2002). The Barton Springs Pool Master Plan includes studies of possible modifications of the downstream dam that would create a more natural flow regime and provide maximum operational flexibility under all conditions. An ideal system would allow the dam to be “invisible” to floodwaters, *i.e.*, present no barrier, allowing natural passage water and material downstream of the Pool. This would also reduce accumulation of material that now requires intrusive dredging to remove. Until a long-term solution is developed, city biologists plan to continue cleaning salamander habitat monthly, with or without drawdown of water level.

Table 2. Shown below are the durations of periods of flood and subsequent cleaning.

Days	1	2	3	4	5	6	7	8	9	
1st Flood	**Pool closed (1/13-1/23)**									
Flooding	**1**									1 day flooding
Cleaning		**2**	**3**	**4**						3 days cleaning
Opened					**5**					Pool opens
2nd Flood	**Pool closed (3/12-3/15)**									
Flooding	**1**									1 day flooding
Cleaning		**2**	**3**							2 days cleaning
Opened				**4**						Pool opens
3rd Flood	**Pool closed (3/27-3/29)**									
Flooding	**1**									1 day flooding
Cleaning		**2**	**3**							2 days cleaning
Opened				**4**						Pool opens
4th Flood	**Pool closed (3/30-4/6)**									
Flooding	**1**									1 day flooding
Cleaning		**2**	**3**	**4**	**5**	**6**	**7**	**8**		7 days cleaning
Opened									**9**	Pool opens
5th Flood	**Pool closed (5/3-5/7)**									
Flooding	**1**									1 day flooding
Cleaning		**1**	**2**	**3**	**4**					4 days cleaning
Opened										Pool opens
6th Flood	**Pool Closed (5/16-5/21)**									
Flooding	**1**									1 day flooding
Cleaning		**2**	**3**	**4**	**5**	**6**				5 days cleaning
Opened							**7**			Pool opens
7th-10th Floods	**Pool Closed (5/28-5/31)**									
Flooding	**1**	**2**								2 days 4 flood events
Cleaning			**3**	**4**						2 days cleaning
Opened					**5**					Pool opens
11th- 12th Floods	**Pool closed (6/3-6/8)**									
Flooding	**1**	**2**								2 days flooding
Cleaning			**3**	**4**	**5**	**6**				4 days cleaning
Opened							**7**			Pool opens
13th Flood	**Pool closed (6/25-6/29)**									
Flooding	**1**									1 day flooding
Cleaning		**2**	**3**	**4**	**5**					4 days cleaning
Opened						**6**				Pool opens
14th Flood	**Pool closed (7/3-7/6)**									
Flooding	**1**									1 day flooding
Cleaned		**2**	**3**	**4**						3 days cleaning
Opened					**5**					Pool opens

15th Flood	**Pool closed (7/7-7/12)**							
Flooding	**1**							1 day flooding
Cleaned		**2**	**3**	**4**	**5**	**6**	**7**	6 days cleaning
Opened							**8**	Pool opens
16th Flood	**Pool closed (7/21-7/25)**							
Flooding	**1**							1 day flooding
Cleaned		**1**	**2**	**3**	**4**			4 days cleaning
Opened						**5**		Pool opens
17th Flood	**Pool closed (7/26-7/30)**							
Flooding	**1**							1 day flooding
Cleaned		**2**	**3**	**4**	**5**	**6**		5 days cleaning
Opened							**7**	Pool opens
18th Flood	**Pool closed (9/11-9/17)**							
Flooding	**1**							1 day flooding
Cleaned		**2**	**3**	**4**	**5**	**6**		5 days cleaning
Opened							**7**	Pool opens

Barton Springs Improvements Master Plan Short-Term Projects

The City of Austin is developing a plan for numerous improvements of Barton Springs and its environs. This plan is intended to guide the City in improving both the water quality within and aging structures around Barton Springs. As of October 2007, the City Council approved a budget of 6.2 million dollars to complete projects for short-term improvements and to develop a plan for long-term improvements. Short-term improvement projects are those we intend to complete in the next three to five years and four have the greatest potential o directly improve habitat for *Eurycea sosorum* and *E. waterlooensis* in Barton Springs Pool (Parthenia) and Old Mill (Zenobia/Sunken Garden) Spring. Two pilot projects will examine the effects of increase velocity of water flow on the benthic environment in salamander habitat in Barton Springs Pool. In Measure 6.1.7c requires the City to maintain the 11,000 square feet of the Beach area as suitable salamander habitat. Unfortunately, the substrate of the Beach area downstream of the main entry stairs accumulates sediment faster than it can be cleaned manually and is a constant source of nuisance algae. The habitat is not suitable for *E. sosorum*, nor have any salamanders been found in this area during sporadic searches during the last 10 years. The current regime in Barton Springs Pool does not produce flow velocities typical of streams on the majority of the Beach; measured the velocities of water flow at the substrate are generally < 0.1 feet/second regardless of Barton Springs discharge. Since flow velocity is a strong factor in optimal respiration of stream-dwelling salamanders (Duellman and Trueb 1986) and a determinant of ecological condition of stream habitats (Lampert and Summer 1997), the first pilot project will examine the effects of increased flow velocity. We will use a small, temporary recirculation system to pump spring water from the downstream dam to the substrate in a small area of the Beach. The recirculated water will be released into the substrate through constricted openings, increasing water velocity from 1 – 2 feet/second. The second pilot project uses the same concept, increasing flow velocity to change the ecological environment, to test the effects of introducing clean baseflow from Barton Creek.

A third pilot project will determine whether ultrasonic control of nuisance algae in the shallow end of the Pool will harm the resident *Eurycea* species, other wildlife, and human health. If this method is harmless, we will examine the feasibility of employing such devices in the shallowest area of the Pool, upstream of aquatic salamander habitat.

The fourth project is a reconstruction of three historical features of Zenobia/Old Mill/ Sunken Garden Springs. We will restore a more natural flow regime in and out from Zenobia Spring by reconstructing the historic gate controlling the water flow for the old Paggi Mill. The Sunken Garden amphitheater was built in 1937 by the Works Progress Administration under the direction of Lyndon Baines Johnson. The site's original name was the Zilker Park Amphitheater and was intended to be a picnic and meeting site, where the City could hold concerts and other outdoor events. This name appears to have been supplanted by Sunken Garden not long after construction was complete. A part of the innermost Sunken Garden wall was built over the location of the old mill gate and its support walls. This area of the Sunken Garden wall was altered in the last 50 years when a pipe was built under the wall to divert spring water underground to Barton Creek. The support structure for this pipe is a large slab of aggregate concrete installed vertically on the Sunken Garden stonework. Subsequent work to restore surface water flow to the outflow stream of the spring has led to severe deterioration of the stonework and erosion of the aggregate concrete. This area of the inner wall will continue to degrade due to the water flowing from the spring pool to the stream.

Alterations in this area of the Old Mill and Sunken Garden walls have also contributed to the shift of aquatic habitat from a shallow, flowing spring-fed stream to a deep, slow moving pond. *Eurycea sosorum*, like its plethodontid relatives, requires flowing, stream-like habitat to thrive (Wiens et al. 2003, Petranka 1998.) To improve salamander habitat we need to improve the flow regime. Removing the aggregate concrete structures and the remains of a portion of the Sunken Garden wall will allow the water to flow more freely, help flush excess sediment and impede its future accumulation, favor the growth of periphyton and an increase in invertebrate diversity, ultimately providing the salamanders with more food and adequate dissolved oxygen. By re-creating the historic outflow from the spring pool and installing a replica of the historic mill gate, we can increase flow velocity and direct along the substrate where its cleansing power is of greatest benefit. This will also providing a means to adjust water level in the spring pool during droughts. The end result will be a semi-natural, beautiful, and functional illustration of history of the spring, from before humans arrived in this area, to the 1800s when residents used the spring for water and power, to the 1930s when the federal government sponsored numerous public projects through the Works Progress Administration.

Brief descriptions of the entire list of short-term projects are presented in Table 3 on pages 27 – 30.

Table 3. Barton Springs Improvements Master Plan Short-Term Projects

PROJECT	PROBLEM	PROPOSED SOLUTION	Estimated Budget	Lead Department
Pilot study: water recirculation on designated *Eurycea sosorum* habitat of "the beach"	Beach area on north bank of Pool is designated *Eurycea sosorum* habitat, but habitat quality is poor due to excess sediment and nuisance algae. The area harbors few salamanders and is a source of floating nuisance algae.	WPDRD to increase flow velocity through the substrate and determine if habitat quality improves. We will use the existing pump on the downstream dam to re-direct spring water through submerged pipe system that introduces flow of 0.5 - 2.7 feet/second to substrate.	WPDRD Staff Time	WPDRD
Pilot study: safety and effectiveness of ultrasonic algae control	Nuisance algae growing in the shallow end of pool produces a slippery surface, it is difficult and time consuming to remove.	WPDRD and PARD to purchase equipment, which is advertised to kill and prevent the growth of algae. Research potential effects on human health. Test in lab to determine possible effects on *Eurycea sosorum* and other aquatic life. If safe, test effectiveness on small area of shallow end of Pool.	WPDRD Staff Time + $5000 for equipment	WPDRD
Pilot study: Effects of upstream Barton Creek flow on water quality and algae growth in shallow end of Pool	Nuisance algal growth in shallow end of Pool is a safety concern. The algal community is characteristic of low-flow, pond environments. Quality of Barton Creek water during baseflow may not be suitable for re-introduction to the Pool. Creek water inflow may detrimentally alter the basic water chemistry downstream salamander habitat.	Conduct a pilot study to determine the quality of Barton Creek during baseflow, and the effects of its introduction to the shallow end of the Pool on water chemistry in *Eurycea sosorum* habitat. Determine whether increased flow velocity in shallow end inhibits nuisance algal growth, or changes algal community composition.	WPDRD Staff Time	WPDRD
Assessment and treatment of trees in the grounds surrounding Barton Springs Pool	Many trees in the Pool grounds are a safety concern for patrons because they are aging and losing limbs.	Assess and treat aging trees as necessary, plant replacement trees to increase species diversity and achieve desired aesthetics.	$250,000	PARD

Replace all overhead wiring with underground wiring and add new lighting. Provide additional electric power for cleaning equipment.	Overhead electrical wires are potentially dangerous to Pool patrons because of their proximity to water and susceptibility to damage from falling tree limbs. Overhead wires and existing light poles and lamps are unsightly. There is also insufficient electric supply to power solely electric cleaning equipment on both sides of the Pool.	Bury all electric lines, replace existing light poles, and lamps to increase safety and improve aesthetic environment. Upgrade power supplies to both north and south side of Pool so all cleaning equipment can be electric-, rather than gasoline-powered.	$400,000 (Austin Energy Donation)	PARD
Topographic survey and cross-sections of Barton Creek upstream of Pool, Pool grounds, and Bathymetric Survey within Barton Springs Pool,	Insufficient topographic data for various modeling and construction projects.	Collect new detailed data upstream of Pool, inside Pool, and at Sunken Garden for various modeling efforts and grounds improvements.	$106,275	WPDRD
Gravel bar removal	Gravel deposited by floods has built up in the deep end of the pool and previous removal effort could only remove material smaller than 6" in diameter and was only moderately successful.	Use some type of floating mechanical dredge to remove all sizes of flood debris from deep end of the Pool. Develop methods to remove debris from BSP grounds once it's removed from water. Develop methods to protect water quality within Barton Springs Pool and in downstream Barton Creek during project.	$905,600	WPDRD & PARD
Replace and improve Barton Creek bypass grate	Current grate clogs easily and this reduces the efficiency of the bypass making flooding of pool more likely	Design new grate that allows small debris to pass through, thereby improving its efficiency.	$233,478	WPDRD
Barton Creek bypass joint repairs	Several joints in bypass culvert are failing, allowing storm water from the bypass to enter the pool and causing further deterioration of bypass structure.	Repair all bypass joints except those in AWU project for 2-3 joints associated with flow to Eliza Spring. Use specifications from existing AWU repair project for remaining joints. Work requires low flow in creek upstream of pool and 2-3 weeks of work.	$285,362	WPDRD & PARD

Provide new pump system to increase water pressure for facilitate cleaning.	Insufficient water pressure to run fire hoses for cleaning deep end of pool. Chlorinated City drinking water used for fire hoses and power washers.	Install new pump along with associated piping along north side to draw spring water from the Pool to increase water pressure and allow use of multiple fire hoses. Install connection with City water lines for use during droughts.	$258,848	PARD
Structural testing of existing dams	Insufficient structural information on capacity of existing dams.	Test structural integrity of existing dams, including strength of concrete and the friction between the dam and underlying rock. Use this information to determine which modifications are feasible with current dams.	$141,700	WPDRD & PARD
Conduct flow modeling of pool; flooding, base flow without openings in upstream and downstream dams, base flow with openings in upstream and downstream dams. Conduct flood modeling upstream of the Pool.	Impoundment of Barton Springs has altered the natural aquatic ecosystem from a free flowing spring-fed creek to a pond, slowing water velocity and increasing water depth in most areas of the pool. This reduces quality of *Eurycea sosorum* habitat, encourages growth of nuisance algae, and promotes continuous accumulation of excess sediment and periodic accumulation of rocks during floods. Storm events producing flows greater than 500 cfs overwhelm the current upstream dam and bypass system, flooding the Pool. Frequency and severity of flooding of the Pool reduces the amount of time the Pool is open to patrons.	Conduct physical and/or numerical modeling of water flow direction and velocity in the Pool with current infrastructure. Model potential modifications to upper and lower dams that would restore more natural flow regime while providing maximum operational flexibility. Measure topography and calculate flood elevations upstream of the Pool to help determine if frequency of flooding of the Pool can be reduced by raising the elevation of the upstream dam. Determine if raising the upstream dam is consistent with efforts to improve flow regime through the Pool or beneficial for aquatic habitat.	$250,809	WPDRD

Disposal system for silt & algal debris from routine and post-flood cleaning	Silt and algal debris produced during routine and post-flood cleaning is currently routed downstream of Pool to Barton Creek, which is a violation of City's U.S. FWS PRT-839031, Measure 29.	Develop feasible system to move cleaning debris off site for composting or other disposal.	$35,000	WPDRD & PARD
Interpretive plan for Barton Springs	Pool area needs additional interpretive and educational information.	Develop plans for interpretive materials for springs and surrounding grounds, including south entrance to the Pool. Install new materials and implement additional educational programs. Develop and implement plan for public communication during planning and implementation of Barton Springs Pool Improvements.	$121,862	WPDRD & PARD
Restore more natural water outflow from Zenobia Spring to stream, install adjustable outflow gate, reveal historic Paggi's Mill walls, and Sunken Garden walls,	Part of the inner wall around Zenobia Spring has been altered by the addition of a now defunct concrete pipe and wall support. The remains of the pipe block some of spring water outflow and a surface migration path for *Eurycea sosorum* to the stream. The increased water pressure within the spring pool contributes to water infiltration through small cracks in other areas of the inner wall, contributing to its instability. All of these conditions contribute to our inability to contain water in the spring pool during sever drought. The historic walls of Paggi's Mill and the original opening for the gate are hidden by the pipe structures and part of the Sunken Garden inner wall. Finally, parts of the upper three stonewalls of Sunken Garden amphitheater	Remove pipe and concrete support structure, replace deteriorated inner wall with replica of adjustable gate. The gate will provide a mechanism of regulation of spring outflow during drought, while illustrating the history of the manmade structures. Repair cracks and holes in inner wall of Sunken Garden, restore collapsed area of second wall.	$278,495	WPDRD & PARD

	have collapsed, are unstable, or have numerous cracks and holes, degrading their stability.			
Temporary skimmer system to remove the surface nuisance algae	Floating nuisance algae is an aesthetic problem for swimmers, particularly during droughts, its growth on the pool floor can cover salamander habitat and it is difficult to remove**.**	Pilot system in drought of 2006 was successful in removing floating algae. A temporary system will be installed along sections of the south wall of the pool during drought. The system would rely on wave and wind action to push algae into skimmer and gravity to transport them through dam and into Lower Barton Creek.	$278,495	PARD
Grounds improvements (landscaping, fences, irrigation, seating)	Pool area grounds need improvements, including manageable, drought-tolerant landscaping, a more visually pleasing fence.	Replace pool fence, plant native grasses in appropriate areas, and add seating to facilitate sense of community.	$1,010,975	PARD

Improve access to pool to comply with Americans with Disabilities Act.	Enhance access from north side. In addition there is no access from south side for citizens with disabilities; City must be in compliance with Federal ADA regulations.	Improve existing access ramps and construct path from south gate to pool sidewalk. South access could potentially follow existing tributary drainage on south side; require clearing of invasive species of trees, and fencing new area into pool grounds.	$571,106	WPDRD & PARD
Phase 1 rehabilitation of main bathhouse	Historic bathhouse needs repairs and upgrades to meet current health and safety codes and prevent further deterioration.	Repairs to various parts of facility to meet current codes, including roof and mechanical systems.	$476,875	PARD

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