



Fox Creek Park Ecological Assessment

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INTRODUCTION

At the request of Allen Dye of the Swannanoa Community Council (SCC), MTS Ecological performed an Ecological Assessment of the Fox Creek Park between October 2022 and May 2023. The study area, operated by the Friends of Fox Creek, includes ~2.35 acres in the central Grovemont Community in Swannanoa, NC Buncombe County (See Map 1, p.2).

The site is in central Grovemont between W. Charleston and Hawthorn Avenues, Summer Street, and Ivanhoe Drive and is bounded by small private tracts on all sides. It sits in the central upper region of a tributary referred by residents locally as “Fox Creek.” Fox Creek headwaters originate 0.3-0.4 miles north of the park at the toe slopes of Four Brothers Knobs (mountain).

Fox Creek drains south/southwest from the park into the Swannanoa River after passing through industrial / commercial zones near Hwy 70 and I-40, where Fox Creek is ditched and not apparent. In the early-to-mid 1900’s, E.W. Grove owned the property and developed a small pond (“Lake June”) which was drained or abandoned in the 1960’s. Most of the pond is filled, but a small portion is currently a wetland, and one primary stream channel with two small tributaries occurs onsite.

The Friends of Fox Creek (**TENTATIVE**) mission is and to care for the scenic, historic, and ecological assets of the property that historically comprised Lake June in Grovemont. The park will serve:

- for the enjoyment of residents and visitors
- as an educational resource showcasing the natural ecology of the western NC Blue Ridge mountains
- to display the beauty and variety of native wild spaces in the region
- to restore and maintain a wild and natural an environment in an urban/suburban interface

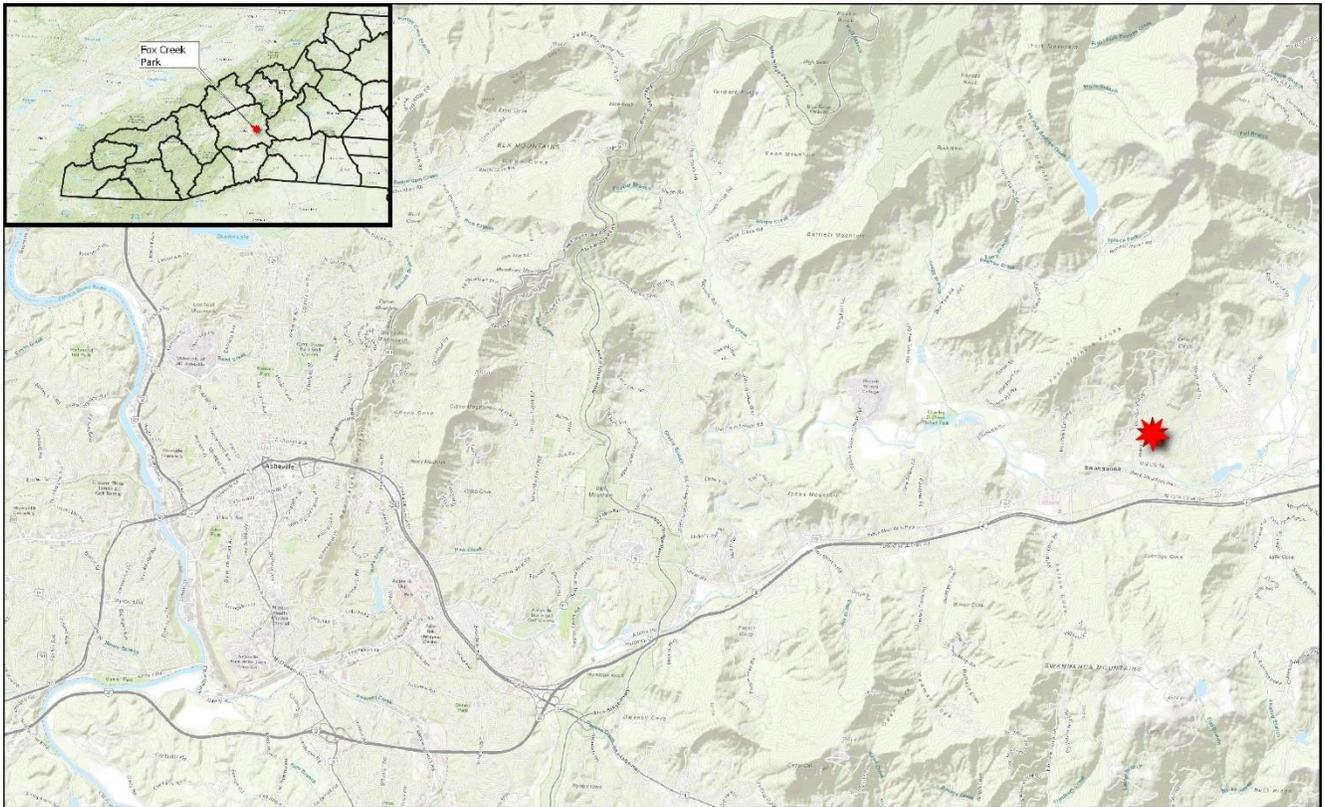


Figure 1: Fox Creek Park Regional Location
Swannanoa, NC / Buncombe Co. Sept-Oct, 2022

 Park Location



METHODOLOGY

Data Review - prior to and during the project relevant public and restricted GIS and other data was reviewed including but not limited to National Wetland Inventory (NWI), the 2022 North Carolina Natural Heritage Program (NCNHP) “Element Occurrence” database, USDA Natural Resources Conservation Service (NRCS) soils data, USGS and aerial imagery, previous reports and iNaturalist species information. Data for mapping wetlands, streams, water samples, biological assessment, plot, or other useful permanent locations was collected in the field using handheld GPS and generated in Quantum GIS (QGIS). Acreage and linear footage calculations were calculated in QGIS.

Wetland Delineation - was performed on October 1 and 25, 2022 by Kevin Caldwell and Bob Gale. Delineation timing was based on rainfall to observe the highest water table possible. Field methodology followed the United States Army Corp of Engineers (USACE) 1987 manual served as the delineation basis with using the USACE 2012 Regional Supplement and the 2020 National Wetland Plant List (NWPL).

Site review for wetlands occurred within obvious wetlands and upland zones, with soil samples collected to document wetland or upland status. Streams internal and external to wetlands were mapped at their centerlines using handheld GPS and aerial imagery. Note that the wetland vegetation inventory occurred within a single plot and is not comprehensive to the entire wetland due to time of year; comprehensive wetland vegetation inventories will occur in 2023.

Soils were sampled by Bob Gale using a post-hole digger in two locations, reviewing hydric soil characteristics and presence of water within twenty inches. Soils were documented using the Munsell Soil Chart for wetland and upland soil identification. Data collection sheets from the 2012 Regional Supplement and the 2016 Regional Hydric Plants List were used to document wetland (W1) and upland (U2) plots.

Natural communities - were classified using the National Vegetation Classification (NVC) and NCNHP classification systems developed in tandem by the two organizations. NatureServe, which was developed by the Nature Conservancy, serves as an international conservation leader and is the repository for all state Natural Heritage Program natural community and rare species data in the US. NVC serves as the standard natural community classification system for the United States Forest Service (USFS), the US National Park Service (NPS), Bureau of Land Management (BLM), and most US land management agencies. Natural communities are assessed and ascribed quality rankings as “A to D,” or “excellent” (A) to “poor” (D) and described by state and global rarity or common rank and status.

Plant and Wildlife Identification – Botanical, wildlife, and natural community inventories are targeted towards documenting the greatest possible range of biodiversity within reasonable field effort for the property size with a focus on rare species, rare and high-quality habitats, and critical natural features. Biodiversity inventory targets are plants (native or introduced), wildlife

(particularly breeding bird species, amphibians, and reptiles), in-stream aquatic invertebrates (“the bugs”), and “natural communities,” (aka habitat types).

In the field, handheld GPS is used to locate and document rare species, rare communities, unique or high-quality features, and other key features or locations. Features are described in notes, and digital photos will document all relevant features. Data are entered and mapped into GIS for existing “baseline” conditions, for map production, and for potential / future “restore-to” (or “original”) natural conditions.

Field-unidentifiable and potentially rare plant specimens collected in the field (if suitable numbers existed to allow collection) are keyed using the *Draft Flora of the Southern and Mid-Atlantic States. University of North Carolina Herbarium* (Weakley, 2020). Rare plants refer to the NCNHP *List of Rare Plant Species of North Carolina* (Wichmann, 2021). Natural communities are “classified” to their most similar types in the *Guide to the Natural Communities Fourth Approximation. North Carolina Natural Heritage Program Department Natural and Cultural Resources* (Schafele, 2012).

Plant and wildlife species are listed as encountered until no new species are detected. and described within their natural community types, noting NCNHP-listed rare species, and common, characteristic, endemic, and exotic-invasive species. Breeding bird species, which are relatively easily detectable by song and sight, and which are primary habitat quality indicators will be surveyed in AM hours during peak breeding season (May-early June). Incidental wildlife is recorded as observed. Bat species are detected remotely using acoustic recording devices, with data analyzed in Sonobat and Kaleidoscope programs.

Water Quality Assessment - performed on ###, 2022/23. The assessment consisted of:

- Chemical and fecal coliform assessment via water samples – two, one per primary stream channel.
- Biological assessment of in-stream aquatic communities (biota) at sample collection points
- Physical assessment of stream and embankment structure, riffle and pool complexes, sedimentation, and embankment collapse or undercut locations
- Photographic documentation of existing stream conditions at entry/egress points and key, repeatable locations within stream corridors

In July 2021, water samples were collected at (### locations / intervals) and submitted to the Environmental Quality Institute (Black Mountain, NC) for analysis following the methods of APHA (2012). Dissolved oxygen was measured at each sample collection site using a Extech DO600 Waterproof ExStik II Dissolved Oxygen Meter. Nutrient, water quality, and physical structure sampling and survey are a subset of methodology outlined by Scott, et al. (2009).

In-Stream Biological Assessment - performed to document aquatic insects which determine and document existing stream health at ### collection points along the stream channel where cobble can be located. Sampling was not performed in the sedimented locations with fill and/or sand

substrates as aquatic insects do not occur in these locations. Each collection point using kicknet and D-net sampling techniques.

SUMMARY OF FINDINGS

Overview: Fox Creek contains a mixture of poor-to-fair and good conditions with great promise for restoration of native habitats. This is due to a strong community group willing to invest time improving the area and making it accessible to neighbors and natural dynamics.

The park and the greater area having been heavily impacted historically via clearing, grazing, agriculture, pond-construction, probable ditching, and ensuing flooding. The primary stream channels are deeply, steep and eroding, and in need of support and restoration. It has many dominant non-native invasive species (NNIS) in process of removal. However, several high-quality features remain including mature Oak Hickory and Swamp Forest habitats –the latter being small but very good condition.

- Natural Communities – the property harbors two small but good quality natural communities including the globally and state “imperiled” (S2/G2) **Swamp Forest/Bog Complex** and **Low Elevation Seep (Typic Subtype)** damaged/modified into a springhouse historically, and the regionally common (S5/G5) **Montane Oak-Hickory Forest (Acidic Subtype)**. Non-forested or “early successional” (unranked) areas are dominated by Kudzu in process of removal.
- Plant and Wildlife Species – Approximately **180 total** observed species, comprising **149 plant and 31 wildlife** species. **DOES NOT INCLUDE ALL I-NAT INSECTS, ETC.**
- Non-Native Invasive Species - **### NNIS** species occur onsite, several being problematic and targets for removal and others being less problematic, established regionally and/or intractable.
- Wetlands – the property contains 0.39 acres of area-based wetland and 415 linear feet of perennial streams in four sections, as jurisdiction of the US Corps of Engineers (USCOE) and the NC Water Resources Division (NCDWR).
- Water Quality Assessment – TBA
- In-Stream Biological Assessment– TBA

DISCUSSION AND SIGNIFICANCE

I. NATURAL COMMUNITIES

Ecological inventories have been performed in part by onsite by residents & park volunteers who have been documenting plant and wildlife species via iNaturalist. cursory habitat designations have been applied by volunteers and these have been translated here to their formal “associations” or “natural community” types via formal NCNHP classifications.

Natural communities are distinct and permanent plant alliances that occur in an “ecoregion” (such as the Blue Ridge or Coastal Plain) defined by NCNHP and NatureServe. While NCNHP defines, stores, and manages data on natural communities and species (i.e., “elements”) in the state, NatureServe (formed by the Nature Conservancy) is the national consortium of all US Natural Heritage Programs and the global and international clearinghouse for all conservation data regarding plant and wildlife species and natural communities.

Rarity Status and Ranking – NatureServe and NCNHP have assigned state and global “ranks” to

The global (or national) conservation ranking system (“G”) ranges on a scale 1 to 5. Ranks of 1-3 the rarest while ranks of 4-5 are “secure”, respectively. Ranks of 1-3 are of the highest conservation value for protection and restoration for government agencies and conservation organizations. Though NCNHP and the NC Plant Conservation Program (NCPCP) formally assess rarity and designate Threatened, Endangered, and other status to rare species, these programs do not formally protect rare or high-quality natural habitats or rare species by law except for federally listed species for projects that acquire federal or state funding. Thus, protection and restoration of these habitats (and species) is usually done on a volunteer basis.

Habitat Descriptions

Wetland cover types consist of open water (ponds), Piedmont Springhead Seeps, and all streams. Piedmont Headwater Stream Forest is a semi-wetland habitat, consisting of both upland and wetland-dependent plant species (“obligate” [OBL] and “facultative” [FACW]) with Seeps embedded.

TBA – Comm Type / Rarity Ranking / Photo / Dynamics Composition (Canopy/Subcanopy/Ground)
Full description per type

- Swamp Forest/Bog Complex (S2/G2)
- Low Elevation Seep (Montane Subtype) (S2/G2)
- Montane Oak-Hickory Forest (Acidic Subtype) (S5/G5)
- Early Successional Habitat (Meadow/Kudzu region; unranked/anthropogenic habitat)

II. PLANT AND WILDLIFE / NNIS SPECIES

Natural Community and Species “Status” includes designations that include Threatened and Endangered (T&E), Special Concern (SC), Significantly Rare (SR), and Watch List (WL).

TBA – background, natural community descriptions, rare spp. Descriptions, plant spp listing

Table #. Plant and Wildlife Species, Fox Creek Park 2022

***NNIS Species **Introduced/Naturalized Non-Invasive species

FORM	COMMON NAME	SCIENTIFIC NAME	NC STATUS	GLOBAL STATUS
Tree	American Chestnut	<i>Castanea dentata</i>		
Tree	American Holly	<i>Ilex opaca</i>		
Tree	Black Cherry	<i>Prunus serotina</i>		
Tree	Black Gum	<i>Nyssa sylvatica</i>		
Tree	Black Locust	<i>Robinia pseudoacacia</i>		
Tree	Black Walnut	<i>Juglans nigra</i>		
Tree	Black Willow	<i>Salix nigra</i>		
Tree	Box Elder	<i>Acer negundo</i>		
Tree	Flowering Dogwood	<i>Cornus florida</i>		
Tree	Ironwood	<i>Carpinus caroliniana</i>		
Tree***	Japanese Maple***	<i>Acer palmatum***</i>		
Tree	Mockernut Hickory	<i>Carya alba</i>		
Tree***	Princess Tree***	<i>Paulownia tomentosa***</i>		
Tree	Red Maple	<i>Acer rubrum</i>		
Tree	Red Mulberry	<i>Morus rubra</i>		
Tree	Red Spruce	<i>Picea rubens</i>		
Tree	River Birch	<i>Betula nigra</i>		
Tree	Scarlet Oak	<i>Quercus coccinea</i>		
Tree	Shingle Oak	<i>Quercus imbricaria</i>		
Tree	Sourwood	<i>Oxydendrum arboreum</i>		
Tree**	Sweet Cherry**	<i>Prunus avium**</i>		
Tree	Sycamore	<i>Platanus occidentalis</i>		
Tree	Tree-of-heaven***	<i>Ailanthus altissima</i>		
Tree	Tulip Poplar	<i>Liriodendron tulipifera</i>		
Tree	White Ash	<i>Fraxinus americana</i>		
Tree	White Oak	<i>Quercus alba</i>		
Tree	White Pine	<i>Pinus strobus</i>		

Shrub	Alternate-leaf Dogwood	<i>Cornus alternifolia</i>		
Shrub***	Amur Honeysuckle***	<i>Lonicera maackii***</i>		
Shrub	Black Alder	<i>Alnus serrulata</i>		
Shrub	Burningbush	<i>Euonymus alatus</i>		
Shrub	Doghobble	<i>Leucothoe fontanesiana</i>		
Shrub	Elderberry	<i>Sambucus canadensis</i>		
Shrub	Great Rhododendron	<i>Rhododendron maximum</i>		
Shrub***	Japanese Barberry***	<i>Berberis thunbergii***</i>		
Shrub	Mountain Laurel	<i>Kalmia latifolia</i>		
Shrub	Silky Dogwood	<i>Cornus amomum</i>		
Shrub	Smooth Arrowwood	<i>Viburnum recognitum</i>		
Shrub	Spicebush	<i>Lindera benzoin</i>		
Shrub	Strawberry Bush	<i>Euonymus americanus</i>		
Shrub	Winterberry	<i>Ilex verticillata</i>		
Shrub	Witch Hazel	<i>Hamamelis virginiana</i>		
Vine	Black Raspberry	<i>Rubus occidentalis</i>		
Vine	Common Dewberry	<i>Rubus flagellaris</i>		
Vine	Common Greenbrier	<i>Smilax rotundifolia</i>		
Vine***	English Ivy***	<i>Hedera helix***</i>		
Vine	Glaucous Greenbrier	<i>Smilax glauca</i>		
Vine***	Japanese Honeysuckle***	<i>Lonicera japonica***</i>		
Vine***	Kudzu	<i>Pueraria montana var. lobata</i>		
Vine***	Multiflora Rose***	<i>Rosa multiflora***</i>		
Vine	Northern Fox Grape	<i>Vitis labrusca</i>		
Vine***	Periwinkle***	<i>Vinca minor***</i>		
Vine	Poison Ivy	<i>Toxicodendron radicans</i>		
Vine	Swamp Rose	<i>Rosa palustris</i>		
Vine	Virginia Creeper	<i>Parthenocissus quinquefolia</i>		
Vine	Virginia Virgin-bower	<i>Clematis virginiana</i>		
Herb	American Lotus	<i>Nuphar lutea</i>		
Herb	Arrow Arum	<i>Peltandra virginica</i>		
Herb	Bitter Dock	<i>Rumex obtusifolius</i>		
Herb	Black Nightshade	<i>Solanum nigrum</i>		
Herb	Black-eyed Susan	<i>Rudbeckia hirta var. hirta</i>		
Herb	Bloodroot	<i>Sanguinaria canadensis</i>		
Herb	Calico Aster	<i>Symphotrichum lateriflorum</i>		
Herb	Canada Clearweed	<i>Pilea pumila</i>		
Herb	Cardinal Flower	<i>Lobelia cardinalis</i>		

Herb	Climbing False Buckwheat	<i>Fallopia scandens</i>		
Herb	Common Dandelion	<i>Taraxacum officinale</i>		
Herb	Common Evening-primrose	<i>Oenothera biennis</i>		
Herb	Common Morning-glory	<i>Ipomoea purpurea</i>		
Herb**	Common Plantain**	<i>Plantago major**</i>		
Herb	Common Pokeweed	<i>Phytolacca americana</i>		
Herb	Common Sowthistle	<i>Sonchus oleraceus</i>		
Herb	Common Star-of-Bethlehem	<i>Ornithogalum umbellatum</i>		
Herb	Common Wormwood	<i>Artemisia absinthium</i>		
Herb	Cowbane	<i>Oxypolis rigidior</i>		
Herb	Cranefly Orchid	<i>Tipularia discolor</i>		
Herb	Cutleaf Toothwort	<i>Cardamine concatenata</i>		
Herb	Dwarf Crested Iris	<i>Iris cristata</i>		
Herb**	English Plantain**	<i>Plantago lanceolata**</i>		
Herb	False Nettle	<i>Boehmeria cylindrica</i>		
Herb	Field Garlic	<i>Allium vineale</i>		
Herb	Fireweed	<i>Erechtites hieraciifolius</i>		
Herb	Forest Goldenrod	<i>Solidago arguta</i>		
Herb	Galant Soldier	<i>Galinsoga quadriradiata</i>		
Herb	Galax	<i>Galax urceolata</i>		
Herb	Garden Yellow-rocket	<i>Barbarea vulgaris</i>		
Herb	Garlic Mustard	<i>Alliaria petiolata</i>		
Herb	Golden Ragwort	<i>Packera aurea</i>		
Herb	Great Ragweed	<i>Ambrosia trifida</i>		
Herb	Greater Burdock	<i>Arctium lappa</i>		
Herb	Ground Ivy	<i>Glechoma hederacea</i>		
Herb	Hairy Bittercress	<i>Cardamine hirsuta</i>		
Herb	Indian-tobacco	<i>Lobelia inflata</i>		
Herb	Jack-in-the-pulpit	<i>Arisaema triphyllum</i>		
Herb	Jewelweed	<i>Impatiens capensis</i>		
Herb	Large-flower Trillium	<i>Trillium grandiflorum</i>		
Herb	Little Sweet Trillium	<i>Trillium cuneatum</i>		
Herb	Lyre-leaf Sage	<i>Salvia lyrata</i>		
Herb	Marsh Seedbox	<i>Ludwigia palustris</i>		
Herb	Mayapple	<i>Podophyllum peltatum</i>		
Herb**	Orange Daylily**	<i>Hemerocallis fulva**</i>		
Herb	Pennsylvania Smartweed	<i>Polygonum pennsylvanicum</i>		
Herb	Pink Lady-slipper	<i>Cypripedium acaule</i>		

Herb	Purple-stem Aster	<i>Symphyotrichum puniceum</i>		
Herb	Slender St. Johnswort	<i>Hypericum mutilum</i>		
Herb	Small White Aster	<i>Symphyotrichum racemosum</i> var. <i>racemosum</i>		
Herb	Solomon's Plume	<i>Maianthemum racemosum</i>		
Herb	Solomon's Seal	<i>Polygonatum biflorum</i>		
Herb	Spotted Water-hemlock	<i>Cicuta maculata</i>		
Herb	Squaw-root	<i>Conopholis americana</i>		
Herb	Striped Wintergreen	<i>Chimaphila maculata</i>		
Herb	Tall Rattlesnake-root	<i>Prenanthes altissima</i>		
Herb	Tearthumb	<i>Persicaria sagittata</i>		
Herb	Thimble-flower	<i>Anemone virginiana</i>		
Herb	Venus'-looking-glass	<i>Triodanis perfoliata</i>		
Herb	Watercress	<i>Rorippa nasturtium-aquaticum</i>		
Herb	White Avens	<i>Geum canadense</i>		
Herb	White Goosefoot	<i>Chenopodium album</i>		
Herb	White Turtlehead	<i>Chelone glabra</i>		
Herb	White Wood Aster	<i>Eurybia divaricata</i>		
Herb	White-top Fleabane	<i>Erigeron annuus</i>		
Herb	Wild Geranium	<i>Geranium maculatum</i>		
Herb	Wingstem	<i>Verbesina alternifolia</i>		
Herb	Wood Violet	<i>Viola sororia</i>		
Herb	Yellow Cow-lily	<i>Nuphar advena</i>		
Herb	Yellow Flag	<i>Iris pseudacorus</i>		
Herb	Yellow Jewelweed	<i>Impatiens pallida</i>		
Herb	Yellow Trout-lily	<i>Erythronium americanum</i>		
Herb	Yellow Wood-sorrel	<i>Oxalis stricta</i>		
Ferns & Allies	Christmas Fern	<i>Polystichum acrostichoides</i>		
Ferns & Allies	Sensitive Fern	<i>Onoclea sensibilis</i>		
Sedge	A Sedge	<i>Carex gynandra</i>		
Grass	Bluegrass	<i>Poa cuspidata</i>		
Grass	Bull Paspalum	<i>Paspalum dilatatum</i>		
Grass***	Chinese Silvergrass***	<i>Miscanthus sinensis***</i>		
Grass	Deertongue Grass	<i>Dichanthelium clandestinum</i>		
Grass**	Green Bristle Grass**	<i>Setaria viridis**</i>		
Grass	Nimble Muhly	<i>Muhlenbergia schreberi</i>		
Grass	Orchard Grass	<i>Dactylis glomerata</i>		

Grass	Red Fescue	<i>Festuca rubra</i>		
Grass	Riverbank Wild Rye	<i>Elymus riparius</i>	W7	
Grass	Silver Bluestem	<i>Andropogon ternarius</i>		
Grass	Slender Manna Grass	<i>Glyceria melicaria</i>		
Grass	Wood Reed-grass	<i>Cinna arundinacea</i>		
Sedge	Bladder Sedge	<i>Carex intumescens</i>		
Sedge	Fringed Sedge	<i>Carex crinita</i>		
Sedge	Shallow Sedge	<i>Carex lurida</i>		
Sedge	Stalk-grain Sedge	<i>Carex stipata</i>		
Sedge	Three-way Sedge	<i>Dulichium arundinaceum</i>		
Amphibian	Mud Salamander	<i>Pseudotriton montanus</i>		
Amphibian	Wood Frog	<i>Lithobates sylvaticus</i>		
Bird	American Crow	<i>Corvus brachyrhynchos</i>		
Bird	American Goldfinch	<i>Spinus tristis</i>		
Bird	American Robin	<i>Turdus migratorius</i>		
Bird	Blue Jay	<i>Cyanocitta cristata</i>		
Bird	Carolina Chickadee	<i>Poecile carolinensis</i>		
Bird	Carolina Wren	<i>Thryothorus ludovicianus</i>		
Bird	Dark-eyed Junco	<i>Junco hyemalis</i>		
Bird	Eastern Bluebird	<i>Sialia sialis</i>		
Bird	Eastern Towhee	<i>Pipilo erythrophthalmus</i>		
Bird	Field Sparrow	<i>Spizella pusilla</i>		
Bird	Gray Catbird	<i>Dumetella carolinensis</i>		
Bird	Great Blue Heron	<i>Ardea herodias</i>		
Bird	House Finch	<i>Haemorhous mexicanus</i>		
Bird	Mourning Dove	<i>Zenaida macroura</i>		
Bird	Northern Mockingbird	<i>Mimus polyglottos</i>		
Bird	Pileated Woodpecker	<i>Dryocopus pileatus</i>		
Bird	Red-bellied Woodpecker	<i>Melanerpes carolinus</i>		
Bird	Red-shouldered Hawk	<i>Buteo lineatus</i>		
Bird	Ruby-throated Hummingbird	<i>Archilochus colubris</i>		
Bird	Song Sparrow	<i>Melospiza melodia</i>		
Bird	Tufted Titmouse	<i>Baeolophus bicolor</i>		
Bird	White-breasted Nuthatch	<i>Sitta carolinensis</i>		
Mammal	American Black Bear	<i>Ursus americanus</i>		
Mammal	Coyote	<i>Canis latrans</i>		
Mammal	Raccoon	<i>Procyon lotor</i>		
Mammal	Red Fox	<i>Vulpes</i>		
Mammal	Virginia Opossum	<i>Didelphis virginiana</i>		

Mammal	Woodchuck	<i>Marmota monax</i>		
Reptile	Common Gartersnake	<i>Thamnophis sirtalis</i>		

III. WETLAND DELINEATION RESULTS

The following is derived from the initial Fox Creek Park Wetland Assessment document developed in Oct 2022 for USCOE to formally delineate wetlands on the property.

Summary of wetland report here, key findings.



- Jurisdictional Wetlands
- Jurisdictional Streams
- Soil Sample Points
- 4 Ft. Contours

**Figure 2: Jurisdictional Wetlands, Fox
Creek Park
Swannanoa NC / Buncombe Co.
Sept-Oct, 2022**



IV. WATER QUALITY ASSESSMENT

All North Carolina streams are classified according to their water quality. Fox Creek is classified as ###.

Water samples were collected in ## to document existing conditions of primary in-stream nutrient and water quality measurements, and to alert the SCC of any potential issues that may arise from adjacent ownership inputs. To establish trends, sampling would need to occur on a routine basis, however the following parameters and results provide a snapshot of stream water quality.

A Nutrient and Water Quality Results

Sampled nutrient and water quality parameters are listed below with water sample data from five sample sites listed in Table 1 below:

Table 1: Water Sample Nutrient and Chemical Findings, Fox Creek Park 2023

Site #	NH3	NO2/NO3	PO4	E. Coli	Turb	TSS	D.O.	Cond	Alk	pH
	mg/L	mg/L	mg/L (PO4)	Cfu/100ml	NTU	mg/L	mg/L	umhos/cm	mg/L	
1										
2										
3										
4										
5										

Ammonia (NH3) measurements are normal, and close to the regional average for the western Piedmont. NH3 is the principal form of toxic ammonia. NH3 is toxic to freshwater organisms at concentrations between 0.53 to 22.8 mg/L. Toxic NH3 is both pH and temperature dependent: toxicity increases as pH and temperature decrease. Plants are more NH3 tolerant than wildlife, and aquatic invertebrates have greater tolerance than fish. In toxic conditions, hatching and growth rates of fish may be affected as well as structural development such as flaws in gills, liver, and kidneys tissues.

Nitrites (NO2) and Nitrates (NO3) - Measure of the Nitrogen present as Nitrite and Nitrate. NO2 and NO3 are very low in Fox Creek which is excellent and atypical of most drainages in horse-country which are overloaded. As part of the nitrogen cycle, bacteria first convert Ammonia to Nitrite (NO2) before other bacteria convert Nitrite to Nitrate. Nitrite in elevated levels is toxic to aquatic organisms and usually indicate contamination from fertilizer run-off.

Bacteria convert Ammonia to Nitrite (NO2) and then Nitrite to Nitrate (NO3) as part of the natural nitrogen cycle. Nitrate becomes toxic to most aquatic life at extremely elevated levels (>10 mg/L – far higher levels than found in Fox Creek). NO3 is also a necessary nutrient for plant and algae

growth, but high nitrate levels in water are an indicator of fertilizer run-off contamination from adjacent lands or from elevated levels of wastewater. They are almost always associated with algal blooms, excess plant growth and oxygen depletion (which kills aquatic life).

Orthophosphate (PO4) - the bioavailable form of phosphorus, used by plants and algae for growth - is well below recommended base levels of 0.15 mg/L (or 0.05 mg/L P only) which is excellent and unexpected in horse country.

E. Coli – measurements fell far below measurable “safe” CFU’s (colony forming units) in all samples. Acceptable levels of E. coli commonly include both a 30 day mean (126 cfu/100mL) and a single-sample number (235 cfu/100mL – 575 cfu/100mL). Thus, samples ranging between 36 and 61 cfu/100mL are well below the safe threshold.

Turbidity – Turbidity, a measure of water clarity, is measured in Nephelometric Turbidity Units (NTU’s). Low NTUs signify relatively clear water during or after rain events while higher numbers represent less water clarity and higher levels of suspended solids. NTU levels of ten or lower are characteristic of relatively clean, clear water with low sedimentation.

Total suspended solids (TSS) – like Turbidity but a slightly more accurate measurement, TSS measures the actual dry-weight of solids larger than 2 microns within a 1-liter sample rather than light penetration through water (turbidity). Thus, sites ranged from a low of#### mg/L at site ##to a high of #### at site ##.

Dissolved Oxygen is ### ranging from ### to ###, being (above / below) the ### mg/L required for fish to survive.

Conductivity, Alkalinity, and pH are easily within range for a natural, forested stream in the western Piedmont with few stressors.

Nutrients and Water Quality Findings

The following section highlights primary NC Freshwater Standards with findings from Fox Creek, per Regulation 61-68 (p.29).

Table 2: Freshwater Standards and Existing Fox Creek Conditions

ITEMS	SC STANDARDS	FOX CREEK EXISTING CONDITIONS (2021)
a. Garbage, cinders, ashes, oils, sludge, or other refuse	None allowed	
b. Treated wastes, toxic wastes, deleterious substances, colored or other wastes except those given in a. above.	None alone or in combination with other substances or wastes in sufficient amounts to make the waters unsafe or unsuitable for primary contact recreation or to impair the waters for any other best usage as determined for the specific waters which are assigned to this class	
c. Toxic pollutants listed in the	As prescribed in Section E of this	

appendix	regulation	
d. Stormwater, and other nonpoint source runoff, including that from agricultural uses, or permitted discharge from aquatic farms, concentrated aquatic animal production facilities, and uncontaminated groundwater from mining	Allowed if water quality necessary for existing and classified uses shall be maintained and protected consistent with antidegradation rules	
e. Dissolved oxygen	Daily average not less than 5.0 mg/l with a low of 4.0 mg/l	
f. E. coli	Not to exceed a geometric mean of 126/100 ml based on at least four samples collected from a given sampling site over a 30-day period, nor shall a single sample maximum exceed 349/100 ml	
g. pH.	Between 6.0 and 8.5.	
h. Temperature	The water temperature of all Freshwaters which are free flowing shall not be increased more than 5 degrees (F) above natural temperature conditions and shall not exceed a maximum of 90 deg (F)	
i. Turbidity	Not to exceed 50 NTUs provided existing uses are maintained	

V. IN-STREAM BIOLOGICAL ASSESSMENT

Summary - Using the Izaak Walton League’s formula for calculating biotic values (see attached), which weights sensitive species over pollution-tolerant ones, Fox Creek scored a total index value of ###. The IWL (2020) considers any index value over twenty-two to be an indicator of “Excellent” water quality.



Figure 1: CHANGE TO 2023 PIC; Stream Invertebrate Sampling on Fox Creek,

Biological Assessment includes review of the presence and numbers of stream

“macroinvertebrates” or insects, crayfish, salamanders, and other life forms (i.e., “biota”) at suitable sample points. Three representative sample points – ### - having ### substrates where insects and their predators may thrive were sampled. Biological monitoring of streams using benthic macroinvertebrates is a well-established technique that assesses the condition of water bodies using aquatic insects as bioindicators, or “canaries in the coalmine.” (Voshell, 2002)

Water temperature ranged from ## to ### degrees. Visibility per sample site was ##.

The primary Fox Creek stream channel deeply incised throughout but is more stable and natural in the northern section. Ironically, kudzu dominance does not protect embankments or prevent incision or widening because its root structure is spread out, allowing surficial erosion to continue around root systems. Sample sites were (DESCRIBE)...

Results – In total, we collected ### macroinvertebrates at three sampling locations along Fox Creek including ## individuals at Sites #, ##, ### (LIST)

Table 3. Aquatic Invertebrate Community, Fox Creek Park, 2023

Invertebrate type	Site 1	Site 2	Site 3	subtotal
Water Temperature				
Tipulidae - crane fly larva				
Cambarus - crayfish				
Eurycea – two-lined salamander				

Ophiogomphus - dragonflies				
Hydropsyche - caddis larva				
Maccaffertium sp. - mayflies				
Stenacron sp. - mayflies				
Perlesta sp. - stoneflies				
Tallaperla sp. - roach stoneflies				
Isoperla sp. - stoneflies				
Lymnaeid - gilled snails				
Chimarra - caddisfly larva				
Annelida - annelid worm				
Psephenidae - Water penny				
TOTAL				

Of those, ### types of macroinvertebrates (LIST) are considered sensitive bioindicators of stream health by the Izaak Walton League and most water quality agencies.

of these species are considered somewhat, or less, sensitive to pollution (LIST). Only ## type of macroinvertebrate collected on Fox Creek is pollution-tolerant (LIST SPP AND ## INDIVIDUALS).

In addition to the macroinvertebrate fauna, several vertebrates were found while seining. LIST TYPES IF ANY

Additionally, our survey collected / observed (spp - Sali / frog / fish) and is considered ### in general species richness. As a family, roach stoneflies “will be present only in streams and rivers of good to excellent water quality,” according to Steven R. Beaty of NCDEQ’s Biological Assessment Branch.

PHYSICAL STREAM CONDITIONS – structure, substrate, sinuosity, etc.

Overview: The Fox Creek headwaters are poor to fair condition overall...

Stream Physical Structure – TBA

Substrate / Erosion

Embankments - Embankment structure is mostly fair to poor with ~60% of embankments being steep and eroding, and 40% being relatively intact and vegetated.

Substrate -

Erosion -

Pollutants -



Figure 2: EXAMPLE - Typical stream banks; **REPLACE**

MANAGEMENT RECOMMENDATIONS AND PLANNING

- (((Plan elements / interests TBA following discussion)))
- Park Development: trails, structures, etc
- Restoration for wetlands, streams, existing & future forests or meadow / open
- NNIS removals
- Timing! Avoid April 20-30th through June 30 to protect songbirds.

REFERENCES – ADD PER VEG/WILDLIFE/WETLANDS UPDATES

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