Bryce Canyon National Park



2005 Invasive Non-Native Plant Inventory

Northern Colorado Plateau Inventory and Monitoring Network

Addendum Report

December 2005

Prepared by

Steven Dewey and Kimberly Andersen

Utah State University

Cover photo:

Cirsium vulgare found in Swamp Canyon. Photo by K. A. Andersen.

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ADDENDUM REPORT

Inventory of Invasive Non-native Plants
Conducted during 2005 in Portions of Bryce Canyon National Park,
Northern Colorado Plateau Network of the National Park Service.

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INTRODUCTION

Utah State University conducted an invasive plant inventory project for twelve Parks and Monuments associated with the National Park Service, Northern Colorado Plateau Network, including Bryce Canyon National Park, (BRCA). Funding became available to continue the work on a limited basis during the 2005 field season. This report documents the results of the 2005 invasive non-native plant inventory at Bryce Canyon National Park. The document serves as an addendum to the Final Report for the Bryce Canyon National Park 2004 Invasive Non-native Plant Inventory (Dewey and Andersen 2005). Methods are documented fully in the original report and only summarized in the current report.

OBJECTIVES

The primary objective of this project was to document distribution and abundance of targeted invasive non-native plant species across the range of habitats and areas of management concern in Bryce Canyon National Park. It was anticipated that information from this inventory will be useful in the Park's ongoing efforts to improve strategic planning and to increase the effectiveness and efficiency of field operations associated with invasive plant management.

METHODS

SELECTION OF TARGET SPECIES AND INVENTORY AREAS

Four members of the Utah State University weed mapping crew participated in an inventory of targeted invasive plants in portions of Bryce Canyon National Park in August of 2005. Crew qualifications are documented in Appendix A. All field and office methods used in 2005 were identical to those described in the 2004 Final Report. The same twelve species were identified as high-priority targets in the BRCA inventory (Table 1), and searched for systematically by all inventory crew members. Any other non-native species recognized as relatively new to BRCA and potentially invasive on wildlands in the West were documented if found. Forty-seven species were listed in the GPS data dictionary, representing all species targeted for inventory by the 12 Parks included in this project, plus some additional species of regional or national concern.

Areas inventoried in 2005 were selected in consultation with Kristin Legg, Chief of Resources for Bryce Canyon National Park. The areas included were those most likely to have invasive plant habitat, with priority given to areas of present or anticipated Park development and high visitor use and were designated a management priority. Areas of likely weed seed introduction as well as sites identified as significant known or potential weed seed sources or "vector areas" were also given priority during the selection process.

As in 2004, the primary focus of the 2005 inventory project was NPS lands. However, in some cases a limited number of additional lands near or immediately adjacent to the BRCA border were inventoried. Non-NPS lands inventoried included portions of Cope Canyon, Pasture Wash,

Sheep Creek, Agua Canyon, and Black Birch Canyon. These areas were inventoried as a matter of convenience and efficiency, as crew members were already in the area.

Table 1. List of invasive plant species targeted in Bryce Canyon National Park in the 2005 Non-native Plant Inventory.

Invasive species	Common Name
Bromus inermis	Smooth brome
Bromus tectorum	Downy brome
Carduus nutans	Musk thistle
Centaurea diffusa	Diffuse knapweed
Centaurea maculosa	Spotted knapweed
Centaurea repens	Russian knapweed
Centaurea virgata v. squarrosa	Squarrose knapweed
Cirsium arvense	Canada thistle
Cirsium vulgare	Bull thistle
Elaeagnus angustifolia	Russian olive
Onopordum acanthium	Scotch thistle
Tamarix ramosissima	Saltcedar

DATA CATEGORIES

The data categories included in this inventory were discussed at length and agreed upon by NCPN and USU project leaders prior to initiation of the project. A complete description of the data categories and value options appears in Table 2. Data collection categories and definitions comply with the minimum mapping data standards established by North American Weed Management Association (NAWMA 2003) and include most of the core elements contained in the NPS Intermountain Region Weed Mapping Guidelines (Benjamin 2001, USDI-NPS 1995). .

Data elements were collected by one of several methods: automatically recorded or manually entered into GPS units in the field (GPS-entered); transcribed from field notes; obtained from previously existing GIS data sets during post-processing (GIS-derived), or added manually in the office during post-processing (office). GIS-entered data included the location and size of each infestation, percent canopy cover, phenology of the weedy species, woody growth stage (if a woody species), presence of site disturbance, hydrology, dominant native species present, date, time, and any additional pertinent notes about the site. Data entered in the office during post-processing included ecological status, Park code, record numbers, detection confidence for inventory area polygons, scientific name, ITIS code, lifeform of species, county, state, and country. Additional data elements (e.g. datum, UTM zone, source of data) that pertain to the spatial data set as a whole are provided as metadata files (e.g., datum, UTM zone).

Table 2. Description of data fields used in 2005 Inventory of Invasive Non-Native Plants in Bryce Canyon National Park.

Data Field	Description	Options / Values	Priority	Entry
Species Name	Latin name of species	Pick-list to be provided by Park staff	Required	GPS
Species Code	IT IS		Required	Office
Additional Names	Common name of the species			Office
Date	Date species observed		Required	GPS
Observer	Name of person observing population	First initial of person's last name used in data file name	Required	GPS
Location ID	Unique identifier for species population ("Record #")		Required	GPS
Park Code	Four-letter abbreviation of Park	BRCA	Required	Office
Country	Name of country (e.g. USA)		Required	Office
State	Two-letter state abbreviation		Required	Office
County	County name		Required	Office
UTMN	UTM northing coordinate for population		Required	GPS
UTME	UTM easting coordinate for population		Required	GPS
Elevation	Elevation in meters (and feet)	Meters (or feet)	Required	GPS
Size of Infested Area	Size of population (if a point feature). Based on average diameter of weed infestation.	- 1 to few plants - 0.1 acre - 0.25 acre - 1 acre - 2.5 acres - 5 acres	Required only for points.	GPS
Gross Area		Gross estimate of land area occupied by a weed species	Required in specific situations.	GPS
Cover of infested area	Estimated percent of area infested with weed	trace (<1%) low (1 to 5%) moderate (6 to 25%) high (26 to 50%) majority (51-100%)	Required.	GPS
Distribution	Characterization of density	To be determined by PI		GPS
Phenology	Life stage of majority of population. Use most progressive life stage if population appears evenly split.	- vegetative - bud - flower - immature fruit - mature fruit - seed dispersing - dormant	Required	GPS

Table 2 continued.

Data Field	Description	Options / Values	Priority	Entry
Woody Growth	Predominant growth stage of species. Use for woody weed species only (elm, tamarisk, Russian olive, etc.) If stages are mixed, use most advanced stage. (valuable for planning control efforts)	- seedling - sapling - mature - old-growth	Optional	GPS
Lifeform	Lifeform of species.	-tree -shrub -graminoid -forb	Required	office
Ecological Status	Qualitative description of the level of infestation that identifies ability of site to recover to natural state once the weeds have been removed.	1. No weeds -The management emphasis is preventing weed encroachment. 2. New and/or small infestations - These infestations have good potential for eradication because they are small and there is a good understory of desirable plants. 3. Large scale infestation with 30% or greater understory of residual grasses and good potential productivity – Management of these sites in a way that selects for the recovery of the residual native grasses and shrubs has good potential for control but not eradication of the weeds. May be more that one noxious weed species, but the underlying biologic integrity of the unit is good. 4. Large-scale infestations with few or no (less than 30% cover) desirable grasses in the understory. Infestation often dense and/or multiple weed species. Control will require intense treatment and probably revegetation. Control may be possible but not eradication. In some areas, the infestation may have changed the character of the land so much that attempts for rehabilitation are cost prohibitive.	Required	Field and Office
Dominant Species	Species Latin name for dominant species at site (up to four species can be recorded)	Two to three dominant species need to be provided at each point (list of dominant species provided by Park). If single or few plants, use dominant species in 1/10 acre area.	Required	GPS
Buffer	Buffer needed to encompass population if GPS'ed as a line or polygon feature	Enter number in feet	Required for lines, optional for polygons	GPS

Table 2 continued.

Data Field	Description	Options / Values	Priority	Entry
Hydrology	General hydrologic setting of site. If further specificity is needed in Park, add items as subcategories to existing terms (e.g., wetland - seep).	- upland (above and away from floodplains) - riparian (along rivers or stream channels) - perennial: stream flows continuously in time. - intermittent: stream flows only at certain times of the year (typically on seasonal basis) when it receives water from springs or from melting snow. - ephemeral: stream flows only in direct response to precipitation. Ephemeral streams generally lack obligate riparian vegetation. - wetland (saturated soil for majority of growing season) - playa lakebed (poorly drained depressions)	Required	GPS
Disturbance	Evaluate disturbance at population site	1 - no disturbance apparent 2 - light to moderate disturbance 3 - site heavily disturbed	Required	GPS
Notes	Additional comments	Can include compass bearing for photos, description of non-weed features, etc.	Optional	GPS and field notes
Area ID	Unique identifier for inventory area		Required	GPS
Disturbance Comments	Comments on type and extent of disturbance noted in inventory area. If area is undisturbed, note as such.	-Agriculture/Livestock Grazing -Construction/Development -Fire -Fire Suppression -Flooding -Wind -Geothermal -Animal Disturbance (e.g. gopher mound, buffalo wallow -Irrigation/Ditches -Mining and Quarries -Oil and Gas Exploration/Production -Habitat Improvement Project -Recreation/Visitor Use -Right-of-Way -Construction/Maintenance -Utility -Construction/Maintenance -Trail/Outfitter/ORV use	Required	Field notes

FIELD PROCEDURES

The 2005 invasive non-native plants inventory in Bryce Canyon National Park was conducted from August 9 – August 20 and involved a four-person crew (Table 3). Areas inventoried were the Fairyland Loop Trail, Peekaboo Loop Trail, horse trail, Bridge Canyon, Cope Canyon, Bryce Canyon, Swamp Canyon, Agua Canyon, Ponderosa Canyon, Short Canyon, Yellow Creek, Pasture Wash, Sheep Creek, Below-the-Rim Trail, roads, and burns near Fairyland Point and Paria View. For purposes of planning and data analysis the inventoried lands were divided into fourteen areas. The order in which areas were inventoried in 2005 was determined by the USU crew leader, and potential invasive plant habitat within each targeted inventory area was considered prior to planning each day's travel route.

Field searches were conducted at as fine of a scale as required to be confident that 90 to 100 percent of all invasive plant infestations 0.01 acre or larger within each inventory area were detected. Search swath widths were adjusted as needed based on variations in terrain, walking speed, associated vegetation, and target species. Areas such as Bryce Canyon, Peekaboo Loop Trail, Fairyland Loop Trail, and the burn near Fairyland Point were generally open and visibility was good, allowing relatively broad EDSW's (typically 50 to 100 yards). In areas such as stream corridors or where vegetation cover was heavy such as in portions of Swamp Canyon, Cope Canyon, and Yellow Creek, EDSW's were usually narrower, sometimes less than 25 yards. Whenever inventorying areas wider than a single swath width, multiple parallel passes of a lone crew member (or multiple crew members walking parallel transects or contours) were searched as contiguous or slightly overlapping strips to avoid coverage gaps. In situations of extremely steep or otherwise inaccessible terrain where vegetation could be identified clearly from a distance, crew members sometimes used binoculars to visually scan the area for suspected target species. Daily inventory routes of each crew member were recorded and mapped using the BFP tracking function of the GeoExplorer GPS units. BFP tracking distance settings were adjusted as needed to correspond closely to the EDSW distance for each area.

Each inventoried area within Bryce Canyon National Park was assigned a detection confidence value based on the crew's estimated ability to see infestations of 0.01 acre in size of the least visible target species, taking into account terrain, vegetation cover, and the size and growth stage of the targeted plant species. Detection confidence was broken into three categories: Low (1 to 50 %), Medium (51 to 89 %), and High (90 to 100%).

The locations of all target species were documented by the USU crew using Trimble GeoExplorer 3 global positioning system (GPS) units and GeoExplorer XM GPS units with 2- to 5-meter accuracy. Crews also recorded the location and documented the identity of any other non-target species they encountered if that species has a known history of invasiveness in other regions in the West. Field locations were recorded by GPS as UTM coordinates, and were later differentially corrected in the production of final digital products.

At the end of each day, field crews marked and dated all inventoried areas on USGS 7.5' topographic maps to assist in determining project progress and thoroughness of coverage. Data were downloaded from GPS units onto a laptop computer each day using Pathfinder Office GIS software. Edits (such as eliminating any duplicate features) were made to the data, and any

Table 3: Invasive plant inventory areas, inventory dates, crew members, and acres inventoried during 2005 in Bryce Canyon National Park.

Area Number	Area Description	Dates Inventoried	Crew Members*	Acres Inventoried**	Corresponding Inset Map Names and Letter Codes ***
15	Burn area near Fairyland Point	8/12/05	KA, volunteers	371.9	B – Fairyland Point
16	Prescribed burn near Paria View	8/18/05, 8/20/05	RR, MB	442.6	D- Paria View
17	Fairyland Loop Trail	8/13/05	KA, volunteers	228.1	B – Fairyland Point
18	Cope Canyon	8/16/05	RR, MB	148.0	A – Cope Canyon
19	Pasture Wash	8/19/05	RR, MB	94.1	D – Paria View E – Yellow Creek F – Swamp Canyon
20	Swamp Canyon, Sheep Creek, Short Canyon	8/10/05, 8/19/05	SD, KA	608.1	D – Paria View F – Swamp Canyon
21	Bridge Canyon, Agua Canyon	8/10/05, 8/11/05, 8/19/05	SD, KA	619.8	F – Swamp Canyon G – Natural Bridge Canyon
22	Ponderosa Canyon, Agua Connecting Trail	8/10/05, 8/11/05, 8/17/05	RR, MB	260.3	H – Ponderosa Canyon
23	Black Birch Canyon, Below-the-Rim Trail	8/17/05	RR, MB	299.9	H - Ponderosa Canyon
24	Below-the-Rim Trail, Yellow Creek	8/19/05	RR, MB	353.4	C – Bryce Canyon E – Yellow Creek
25	Peekaboo Loop Trail	8/09/05, 8/16/05, 8/18/05, 8/19/05	KA, volunteers	128.1	C – Bryce Canyon
26	Bryce Canyon, Horse Trail	8/19/05, 8/16/05, 8/18/05, 8/20/05	KA, RR, MB	368.2	C – Bryce Canyon
27	Horse Trail, Bryce Canyon Lodge area	8/09/05	KA, RR, MB	100.8	B – Fairyland Point
28	Main Road	8/13/05, 8/20/05	KA, volunteers	747.1	B – Fairyland Point D – Paria View F – Swamp Canyon G – Natural Bridge Canyon H – Ponderosa Canyon
	TOTALS			4770.4	

* Crew abbreviations: SD = Steve Dewey, KA = Kim Andersen, MB = Melanie Ballard, RR = Ruth Richards.
** An average of 222.9 acres inventoried per person per 10-hr day in 2005.
*** Indicates the key to mapped areas presented later in Figure 2.

additional information (such as infestations drawn by hand on field maps or other data not recorded with a GPS unit) were added at this time. The data was then processed and managed following the protocols described in the original report (Dewey and Andersen 2005).

GENERAL PHOTOGRAPHS

Representative photos are included in this report showing some of the species and habitats inventoried, as well as a sampling of photographs of field crews doing inventory work. Photographs were taken of each new weed species found in the Park. Close-up photographs were intended to serve as a type of voucher specimen for weed species encountered, and landscape photos of weeds are expected to assist in relocating small isolated infestations for future control. The location of each weed infestation documentation photo was recorded as a GPS "photo point". In the case of landscape photographs of a weed and/or its surrounding habitat, the UTM coordinates represent the location of the photographer, and the direction that the camera was facing is noted as a compass bearing (magnetic north reference). The locations of photos taken to show general types of terrain and habitat, or crew activities usually were not documented with GPS points. Photographs were taken with 35-mm digital camera. Pertinent photographs are included with this report (see Appendix G). Digital copies of all photographs were submitted to NCPN as part of the final deliverables.

RESULTS and DISCUSSION

Field crews inventoried 4,770.4 acres in Bryce Canyon National Park during August of 2005 (Table 3), an amount representing approximately 13.3 percent of the entire 35,835-acre Park. An average of 222.9 acres was inventoried per person per 10-hr day in 2005.

The location and size of the fourteen areas inventoried in 2005 are represented in Figure 1. The identification number, name, and acreage of each inventory area are listed in the legend. Each inventory area is also color-coded for ease in identification. Figure 2 serves as an orientation map for the smaller 1:24,000 scale weed-distribution "Inset" maps found in Appendices C and D. Inset maps are distinguished by letters A - H, plus the name of a distinct geographic feature found within its boundaries. The corresponding inventory area numbers from Figure 1 are included in the legend in parentheses behind each inset map name. Eight inset maps are required to cover all fourteen inventory areas, and large inventory areas may span over several subunit maps. For example, different sections of the main road (Inventory Area 28) appear on Fairyland Point, Bryce Canyon, Paria View, Swamp Canyon, Natural Bridge Canyon, and Ponderosa Canyon (Inset maps B, C, D, F, G, and H).

Invasive plants infested a total of 9.887 acres within the mapped areas (Table 4), an amount equal to 0.21 percent of the land inventoried. Of the 12 initial targeted species, crews found only *Bromus inermis*, *Bromus tectorum*, *Carduus nutans*, *Centaurea repens*, *Cirsium arvense*, *Cirsium vulgare*, *Elaeagnus angustifolia*, and *Tamarix ramosissima.* No infestations of *Centaurea diffusa*, *Centaurea maculosa*, *Centaurea virgata v. squarrosa*, or *Onopordum acanthium* were discovered within the 14 inventoried areas. Non-target species found and mapped were *Convolvulus arvensis*, *Erodium cicutarium*, *Lactuca serriola*, *Lepidium perfoliatum*, *Malva neglecta*, *Melilotus officinalis*, *Phragmites australis*, *Salsola kali*, *Sisymbrium altissimum*, and *Verbascum thapsus.*

The most abundant target species found in the Park in 2005 was *Bromus inermis*. The crew recorded 6.964 acres of this species during the project, 0.023 acres of which were located outside the Park boundary. *Bromus inermis* comprised 70.4 percent of the total infested acreage inventoried. Infestations of *Bromus inermis* were generally less than 0.1 acres in size, often consisting of dense patches found scattered in open meadows. *Bromus tectorum* was the second most abundant target species found in the Park and comprised approximately 10.6 percent of the total infested acreage. *Melilotus officinalis* was the third most common target species, making up 7.4 percent of the total infested acreage. The remaining infestations (11.6 percent of the total infested acreage) consisted of the other six targeted species and the nine additional non-native species that were mapped.

Not all non-native species that were found were mapped. For example, species such as *Chenopodium album* and *Lactuca serriola* were noted in many areas but were ignored due to their previously recognized presence in the Park. *Agropyron cristatum* was also present in many areas but ignored.

Deciding which non-target weeds to map was left to the discretion of individual crew members, based on their assessment of the potential threat and relative abundance of each species. Crews were consistent in searching for and recording all infestations of *Convolvulus arvensis* and

Table 4: Acres infested by invasive plant species within inventoried areas of Bryce Canyon National Park and adjacent lands in 2005.

Species	Infested Acres (Inside Park)	Infested Acres (Outside Park)	Total
Bromus inermis	6.941	0.023	6.964
Bromus tectorum	1.045	---	1.045
Carduus nutans	0.010	---	0.010
Centaurea repens	0.010	---	0.010
Cirsium arvense	0.001	---	0.001
Cirsium vulgare	0.433	---	0.433
Convolvulus arvensis	0.131	---	0.131
Elaeagnus angustifolia	0.010	---	0.010
Erodium cicutarium	0.001	---	0.001
Lactuca serriola	0.010	---	0.010
Lepidium perfoliatum	0.003	---	0.003
Malva neglecta	0.001	---	0.001
Melilotus officinalis	0.621	0.110	0.731
Phragmites australis	0.010	---	0.010
Salsola kali	0.013	---	0.013
Sisymbrium altissimum	0.001	---	0.001
Tamarix ramosissima	0.302	0.200	0.502
Verbascum thapsus	0.011	---	0.011
Totals	**9.554**	**0.333**	**9.887**

Verbascum thapsus. Because not all crew members may have chosen to map *Malva neglecta, Lepidium perfoliatum, Sisymbrium altissimum, Erodium cicutarium, Salsola kali, Lactuca serriola,* and *Phragmites australis* the acreage values and corresponding distribution maps for these species should be considered to represent sample surveys rather than complete inventories.

Appendix C contains maps showing the overall distribution and relative abundance of all mapped weeds (no species distinction) within the boundaries of inventoried areas. Appendix D contains maps of individual species occurrences and weed-free areas within all inventoried portions of Bryce Canyon National Park. Following is a summary of the weed situation within individual inventory units of Bryce Canyon National Park.

Burned area near Fairyland Point (Area Number 15; Inset Map B)

This inventory unit consists of an area between the road and the northern Park boundary that had recently burned. Crews inventoried the area by walking 50-m transects through the site. The unit is a mixture of Ponderosa pine forest and open slightly marshy meadows. The most abundant target species was *Bromus inermis*. *Bromus inermis* was found mainly in open meadow sites and along the road. The majority of infestations were small and often less than 0.001-acre in size. Several other infestations were found along the fenceline of the Park boundary. *Cirsium vulgare* was also found within the burned area, most infestations consisting of less than 3 rosettes per

Figure 1. Identification number and acreage of individual areas inventoried for non-native invasive plant speces in Bryce Canyon National Park during 2005.

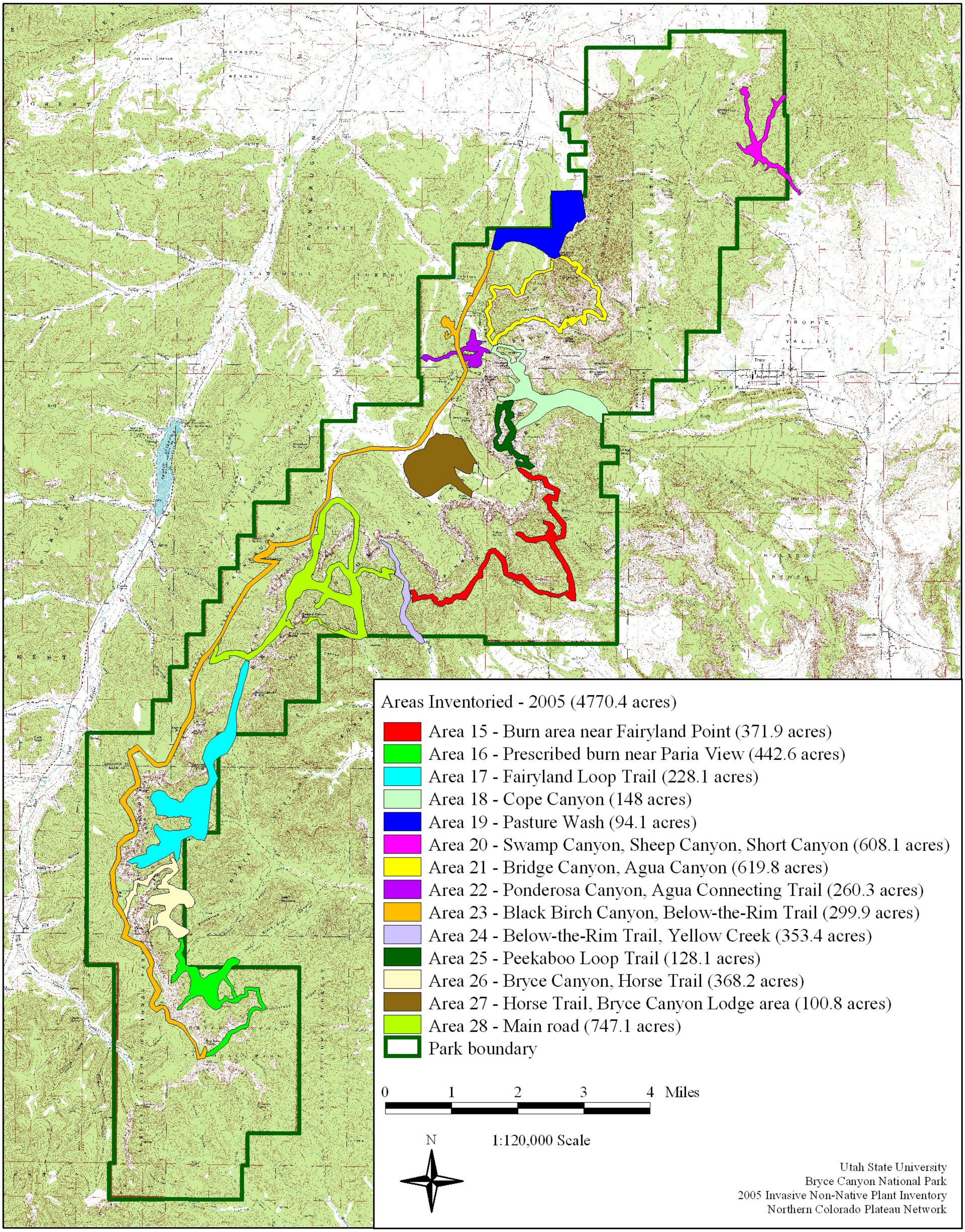
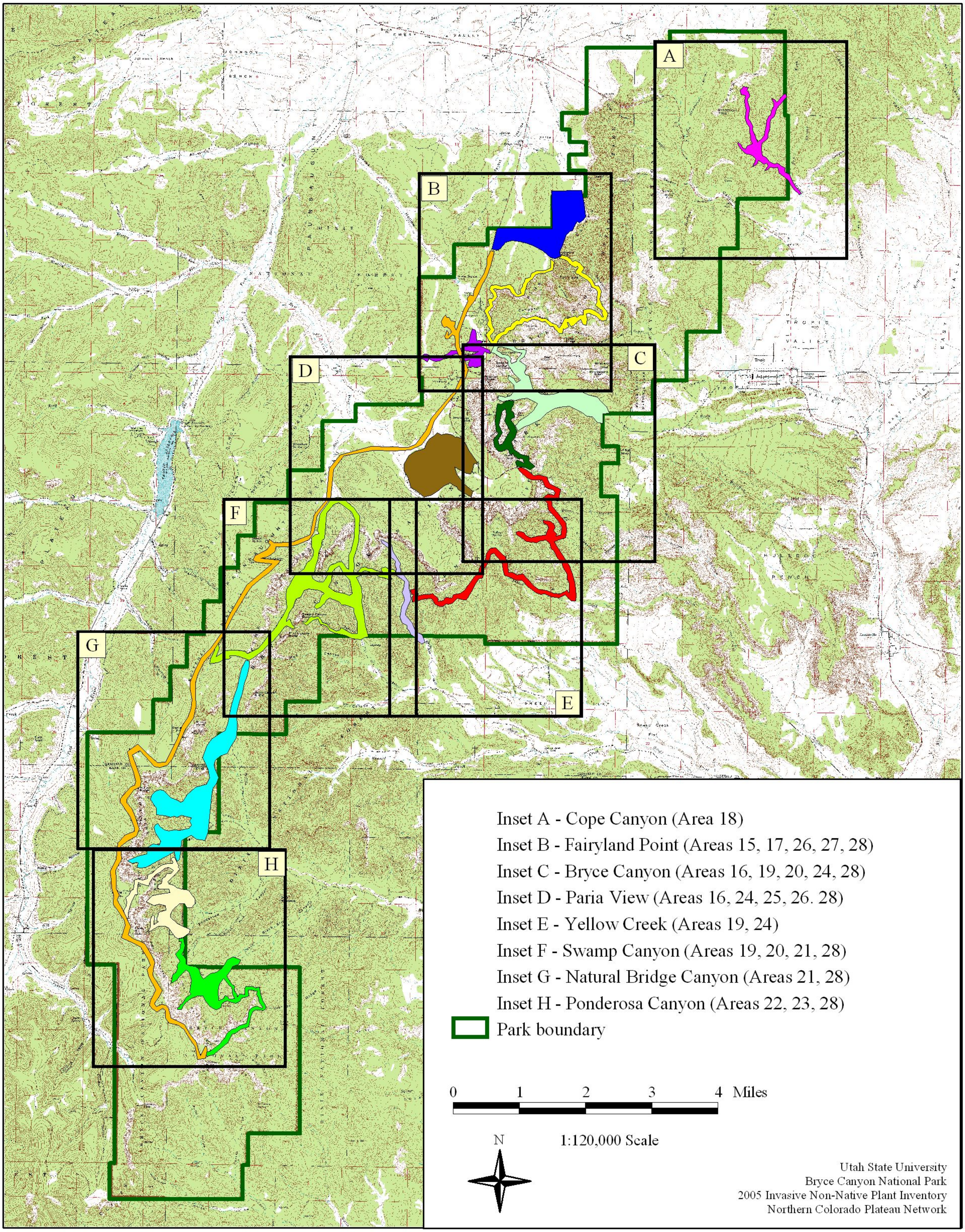


Figure 2. Insets indicating the location, letter code, and name of the 1:24,000 scale maps used in Appendix tables to show weed distribution within individual inventoried areas in Bryce Canyon National Park.



patch. These infestations appeared to most frequently found in areas of bare soil or areas that had been heavily burned by fire. All plants found were at the rosette stage and pulled upon their discovery. A single 0.001-acre patch of *Bromus tectorum* was also discovered in a heavily burned area in the northeast corner of the inventory unit.

Although not targeted species, the crew also mapped infestations of *Melilotus officinalis* and *Verbascum thapsus*. A single infestation of *Melilotus officinalis* was found along the cliff edge on the east side of the unit. Two patches of *Verbascum thapsus* were also found within the burn area. These infestations were also pulled after mapping their locations.

The burned area contained little or no herbaceous ground cover underneath the Ponderosa pine and exhibited evidence of heavy disturbance both from fire and from suppression efforts. Evidences left by fire decreased as you moved east to west across the inventory unit. The meadows contained a high amount of grasses and sedges, as well as a fair amount of *Agropyron cristatum*. The amount of native vegetation also increased from east to west across the landscape within the unit. The crew was confident of finding at least 90 percent of all 0.0-1 acre infestations of the targeted species during the inventory. The area was assigned an ecological status level of two.

Prescribed burn near Paria View (Area Number 16; Inset Map D)

A recent prescribed burn near Paria View was inventoried at Kristin Legg's request. Transects were walked across the burn area at every 50 meters. Two plants of *Carduus nutans* were found near the center of the inventory unit. These plants were pulled upon their discovery. No other targeted species were found in this unit. The native vegetation was fairly thick and included Oregon grape, mountain snowberry, manzanita, and serviceberry as well as several wildflowers. The crew felt confident it conducted its inventory to ensure that they could see at least 90 percent of all 0.01-acre infestations of the targeted species. The fire was the only disturbance noted in the area and the unit was assigned an ecological status level two.

Fairyland Loop Trail (Area Number 17; Inset Map B)

The entire trail was hiked by one crew member and a volunteer on August 13, 2005. A buffer of approximately 100 feet on each side of the trail was used during the inventory. The majority of trail was extremely clean and contained no targeted species and very little non-targeted species. A section of trail along the canyon rim above Fairyland Canyon was the only site containing any targeted species. Several small patches of *Bromus tectorum* were found this section of trail, ranging in size of 0.001 to 0.25 acres. Two small 0.001-acre patches of *Bromus inermis* were also found in this segment of trail. Other species seen but not mapped include *Chenopodium album, Sisymbrium altissimum*, and *Lactuca serriola*.

Much of the trail contained a healthy diversity of native vegetation. Little evidence of disturbance could be seen along the trail aside from foot traffic by the hikers themselves. The section of trail containing targeted weeds had been disturbed by fire prior to the inventory. Evidence of fire could be seen between the North Campground and Fairyland Point. It is likely other targeted species could be found in this area, although the burned area was not inventoried this year. The trail had excellent visibility and the crew was confident in its ability to see 90 percent or more of all 0.01-acre infestations of the targeted species. The trail was assigned an ecological status level two.

Cope Canyon (Area Number 18; Inset Map A)

Cope Canyon was inventoried from the Park boundary to the heads of the east and west forks of the canyon. *Tamarix ramosissima* was the most common species found in the canyon. *Tamarix* was found in the heads of both the east and west fork as well as at the Park boundary fence. Infestations were mature in growth and typically either 0.01 or 0.1 acres in size. A single 0.01-acre infestation of mature *Elaeagnus angustifolia* was found near the Park boundary. A 0.01-acre patch of *Cirsium vulgare* was found near the head of the west fork of Cope Canyon. A single 0.01-acre patch of *Centaurea repens* was also found just inside the Park boundary. The crew also noted the presence of Centaurea repens on the private land adjacent to the Park and it is likely that the infestations on private land will continue to serve as additional seed source until they are also controlled. Although not targeted for mapping, Melilotus officinalis was also found throughout Cope Canyon and crews inventoried current infestations. The crew also noted the presence of Convolvulus arvensis on the private lands outside the Park.

The canyon contained many native species including juniper, ponderosa pine, cottonwood, wild rose, buffaloberry, and willow. Visibility was generally good in the canyon and disturbances appeared small. The crew did not the presence of old cow pies in the top of the west fork. Additional disturbance came from flooding events. The crew was confident it could see at least 90 percent of all 0.01-acre infestations of the targeted species. The area was assigned an ecological status level two.

Pasture Wash (Area Number 19; Inset Maps D, E, F)

Pasture Wash was inventoried from its head to the Park boundary by one crew member. No targeted species were found in the wash. The wash itself was dry and cobbly. Large mountain mahogany grew in some spots along the wash. The area near the south boundary seemed most likely to contain weeds, but none were found. The soil crust was well developed in many places, although cow tracks and footprints were found near the southern boundary. The boundary fence was down and sections of it appeared to have been cut. The crew member was confident she would have been able to see at least 90 percent of all 0.01-acre patches of the targeted species had there been any. The area was assigned an ecological status level of one.

Swamp Canyon, Sheep Creek, Short Canyon (Area Number 20; Inset Maps D, F)

Swamp Canyon, Sheep Creek, and Short Canyon were inventoried by two USU crew members. Included in this unit were sections of trail in Swamp Canyon and Sheep Canyon as well as several smaller side canyons such as Short Canyon. *Cirsium vulgare* was the most common target species found in the unit. Infestations of *Cirsium vulgare* were concentrated in the wet meadows at the junction of Swamp Canyon and Sheep Creek. The meadow was impossible to inventory completely due to the thick stands of alder, wild rose, and willow. But it is likely that there are additional infestations of *Cirsium vulgare* throughout the meadow. Other species found in this area of the meadow include three patches of *Melilotus officinalis* and two patches of *Convolvulus arvensis*.

Bromus inermis was found consistently throughout the meadow, leading from the parking lot to the head of Sheep Creek. Infestations were generally 0.25-acre in size, although sizes ranged from 0.01 to 1 acre. A single 0.01-acre patch of *Bromus tectorum* was found on a very steep

hillside at the base of a cliff near the top of Swamp Canyon Butte. Other species seen but not mapped include *Lactuca serriola* and *Chenopodium album*.

This inventory unit was largely undisturbed and contained little weedy species aside from the wet meadows. Vegetation appeared to be both diverse and abundant. The sites contained Ponderosa pine, aspen, alder, willow, oak, juniper, sagebrush, and rabbitbrush. The canyons also contained running springs. Visibility varied from excellent to poor depending on the section of unit being inventoried. Several areas could not be intensively inventoried due to thick brush. However, it is unlikely that large infestations of the targeted species were missed. The crew was confident of its ability to find at least 90 percent of all 0.01-acre infestations of the targeted species for the Park. The area was assigned an ecological status level two.

Bridge Canyon, Agua Canyon (Area Number 21; Inset Maps F, G)
Bridge Canyon and Agua Canyon were inventoried from the Park boundary to the head of each canyon in this unit. Also included in this inventory unit are a section of the Below-the-Rim trail and a section of Willis Creek. The only targeted species found in this unit is a single 0.1-acre patch of *Bromus tectorum* found above a section of the trail as it crossed from Bridge Canyon into the Willis Creek drainage. Although not a targeted species, a single 0.001-acre patch of *Phragmites australis* was also found in and immediately adjacent to the trail along a set of switchbacks in Bridge Canyon.

No other species, target or non-target, were seen in this unit. The area is likely free of targeted species, however, the area has also been subjected to a large amount of recent disturbance. Much of the canyon bottom in both Bridge Canyon and Agua Canyon has been covered by a thick layer of mud that has eroded from the cliff walls above. In several places, the mud was several inches to several feet deep. Any targeted species present would not be visible during the inventory because it would be buried under mud and boulders. However, the crew was confident that it could see at least 90 percent of the 0.01-acre or larger infestations of the targeted species if they were present. The area was assigned an ecological disturbance level two.

Ponderosa Canyon, Agua Connecting Trail (Area Number 22; Inset Map H)
The north and middle forks of Ponderosa Canyon as well as the Agua connecting trail are included in this inventory unit. The crew did not find any of the targeted species during the inventory. This is likely similar to the situation described for Bridge and Agua Canyons. The area had recently been heavily disturbed by mud slides and flash floods and mud covered much of the canyon bottom. If there were other targeted species in the unit, it is likely they were covered by the mud slides. The native vegetation includes ponderosa pine, Douglas fir, oak, manzanita, oak, and several native grasses. The crew was confident it could see at least 90 percent of all 0.01-acre or larger infestations of the targeted species for the Park. The area was assigned an ecological status level one.

Black Birch Canyon, Below-the-Rim Trail (Area Number 23; Inset Map H)
The north, middle, and south forks of Black Birch Canyon, the south fork of Ponderosa Canyon and a section of the Below-the-Rim trail between Rainbow Point and Ponderosa Canyon are included in this inventory unit. A single rosette of *Cirsium vulgare* found at the Park boundary in the south fork of Black Birch Canyon. It was growing in a very wet sandy environment. The rosette was pulled upon its discovery. No other target species were found in this unit.

The inventory unit was described as dry and cobbled by the crew. The crew also noted a majority of the inventoried area did not appear to be likely habitat for invasive plants. Native shrubs were prevalent along the sides of the washes and cottonwoods were also found in the bottoms. The area had recently been disturbed by mud slides and the washes had been scoured by recent flash floods. The crew was confident in its ability to see at least 90 percent of all 0.01-acre infestations. The area was assigned an ecological status level two.

Yellow Creek, Below-the-Rim Trail (Area Number 24; Inset Maps C, E)
This inventory unit includes a section of the Below-the-Rim trail between Bryce Point and Pasture Wash as well as the right fork of Yellow Creek. *Tamarix ramosissima* was the only targeted species found in the unit and it was along Yellow Creek. Infestations were small in size and often mature in their growth stage. A single sapling was found at the head of Yellow Creek and it was pulled. All other infestations require mechanical control. No other targeted species were found in this area. The trail was dry and rocky with sparse vegetation, making visibility very good. The vegetation around Yellow Creek was denser and visibility slightly inhibited. The crew still felt confident in its ability to see 90 percent of infestations 0.01-acre or larger in size. No obvious disturbances were noted and the area was assigned an ecological status level two.

Peekaboo Loop Trail (Area Number 25; Inset Map C)
The Peekaboo Loop Trail was inventoried due to its heavy use by both people and horses. A 100 foot buffer on either side of the trail was used due to the excellent visibility along the trail. A single 0.01-acre patch of *Cirsium vulgare* and a single 0.01-acre patch of *Bromus inermis* were each found in the horse corrals at the spring site below Bryce Point. The patch of *Cirsium vulgare* was pulled when it was discovered. A single 0.001-acre patch of *Bromus tectorum* was also found near Fairy Castle as the trial climbs out of Bryce Canyon.

No other targeted species were found along the trail. The area along the trail was fairly open and the crew had great visibility for much of the trail. They were confident of finding at least 90 or more of the targeted species at least 0.01-acre in size. This trail is heavily used by both people and horses. As stated, two of the targeted species found were near the horse corrals. The trail also crosses several spring sites, which provide an opportunity for additional invasive species to establish. The overall trail was assigned an ecological status level two.

Bryce Canyon, Horse Trail (Area Number 26; Inset Map C)
Bryce Canyon was inventoried from the Park boundary to the Pink Cliffs and includes several large side canyons as well as the horse trail. The portions of Bryce Canyon inventoried were found be free of the targeted species. The horse trail contained numerous patches of targeted and non-targeted species. *Bromus tectorum* and *Bromus inermis* were the only two targeted species found along the horse trail. *Bromus tectorum* was found intermittently but frequently along the trail from Sunrise Point to the canyon bottom. Patches were small, often 0.001-acre or less in size and found within 5 feet of the trail. Two small patches of *Bromus inermis* were found also found along the trail.

Although not targeted species, the crew also noted and mapped infestations of *Erodium cicutarium, Sisymbrium altissimum,* and *Lepidium perfoliatum* because they were infrequent or not seen in other inventory units of the Park. Each infestation of these three species was found

along the horse trail between the day corrals and the canyon bottom. Three 0.001-acre infestations of *Lepidium perfoliatum* were found in this section of trail. A single 0.001-acre patch of *Malva neglecta* was found within 100 yards of the day corrals and a single 0.001-acre patch of *Sisymbrium altissimum* was found approximately a mile down the trail.

The area included in this unit had good visibility and the crew felt confident it could see at least 90 percent of all 0.01-acre infestations that were likely to be present. The area contained a variety of native vegetation including ponderosa pine, Douglas fir, oak, mountain mahogany, and several grasses and forbs. Little disturbance was noted in the bottom of Bryce Canyon aside from recent flash floods. The horse trail receives continual disturbance from horses and people. The area was assigned an ecological status level two.

Bryce Canyon Lodge area, Horse Trail (Area Number 27; Inset Map B)

The area surrounding the Bryce Canyon Lodge as well as a section of the horse trail leading from the night corrals to the day corrals was inventoried in this unit. Pathways around the Lodge and other cabin units were walked as well as the trail the horses walk daily. This area contained a fair amount of targeted species. *Bromus inermis* was the most common targeted species found in this unit. It was most frequently found along the road shoulder and around the cabins, leading us to believe it was used in a seed mixture during revegetation efforts at some point prior to the inventory. Although commonly found, sizes of the infestations mapped were typically small. Several small patches of *Bromus tectorum* were also found, although the majority of these patches were found at the junction of the maintenance road and the main road. Other targeted species found include three small patches of *Cirsium vulgare* growing near the seasonal housing for Lodge employees. A single 0.001-acre patch of *Cirsium arvense* was also found near the Manzanita Lodge.

Although not targeted species, crews also recorded locations of infestations of *Melilotus officinalis, Convolvulus arvensis,* and *Malva neglecta. Melilotus officinalis* was discovered primarily along the stretch of road leading from the main road to the Lodge. All infestations were 0.001-acre or smaller. Three small patches of *Convolvulus arvensis* were found in the cabins south of the Lodge. A single patch of *Malva neglecta* was found on the horse trail within 100 yards of the day corrals. It was mapped as it was not a frequent weed in other areas of the Park. Other species seen but not mapped include *Lactuca serriola, Chenopodium album,* and *Medicago lupulina*.

The area is one that receives daily disturbance from vehicles, people, and horses. Visibility was very good in this unit and the crew was confident in its ability to find at least 90 percent of all 0.01-acre patches of the targeted species. This area should be checked regularly as it is highly probable that new invaders to the Park will show up here first. The area was assigned an ecological status level three.

Main Road (Area Number 28; Inset Maps B, D, F, G, H)

The main road through the Park was inventoried by one crew member and one volunteer from the cab of a truck driving at 15 mph along the road shoulder. A 20-yard buffer from the pavement's edge was used as the cutoff for distance to include in this inventory. Also included in this inventory unit is the residential housing area. *Bromus inermis* was found scattered along the road shoulder in several places. Over a third of the infestations of Bromus inermis were found in the

residential housing area. The remaining two thirds were mostly scattered within the first several miles of the road from the Park entrance. Infestations were primarily small in size and consisted of patches between 0.001 and 0.01 acre. Small patches of *Bromus tectorum* were also found distributed along the road shoulders, although the majority was found at the intersection of the main road and the horse trail. The four infestations found at this intersection were growing along the fence and at the mouth of the drainage culvert. Five separate infestations of *Cirsium vulgare* were also found growing along the road. These infestations were smaller than 0.001-acres but each patch had bolted and was easily visible from the truck. Each infestation found was pulled. Infestations were found near Fairview Point, Agua Canyon Connecting Trail, and the road shoulder above the South Fork of Ponderosa Canyon.

Melilotus officinalis and *Salsola kali* were also inventoried along the road shoulder although neither was a targeted species. Infestations of *Melilotus officinalis* were discovered intermittently along the road shoulder between the Park entrance and the Natural Bridge overlook. Infestations were small and ranged in size from 0.001 to 0.1 acres. Four small infestations of *Salsola kali* were also mapped. Two infestations were found near Shaker Spring, one near East Creek, and one at the intersection of the horse trail and the main road.

It should be noted that small infestations of *Centaurea maculosa* were found in the parking lot of a restaurant near the cut off to the Park from Highway 6. Although these infestations are still approximately 2-3 miles outside the Park, they have a great potential to spread into the Park and should be considered a serious threat.

The road shoulder was heavily disturbed at the time of the inventory due to recent construction along several sections of the road. It is highly likely that additional weedy species will be found in those sections and should be continually assessed for those species. Visibility was generally very good and the crew felt confident they saw at least 90 percent of all 0.01-acre infestations of the targeted species. The inventory unit was assigned a level two for ecological status.

CONCLUSIONS / RECOMMENDATIONS

The primary objective of this project was to document the distribution and relative abundance of targeted non-native invasive plant species across the range of habitats and areas of management concern within Bryce Canyon National Park. As with the information contained in the 2004 report, it is anticipated that this 2005 inventory will be useful in the Park's ongoing efforts to improve strategic planning and to increase the efficiency and effectiveness of all field operations associated with invasive plant management.

During 2005 the USU crew noted that Bryce Canyon National Park continues to implement weed control strategies and practices. The crew leader and P.I had the opportunity to meet with the members of an Exotic Plant Management Team coordinating control work to be done by the Utah Conservation Corp at Bryce Canyon National Park during the month of August. Data collected in the 2004 by Utah State University was used in the planning efforts.

USU continues to urge the Park to develop a comprehensive written management plan for invasive plant species in BRCA, and to review and improve it on a regular basis. Regularly scheduled weed inventories of all managed lands should be a part of the plan. Permanent monitoring sites should be established to evaluate the impact and spread of weeds, and to evaluate the effectiveness of its weed management approaches. Bryce Canyon National Park is encouraged to become an active member of a local Cooperative Weed Management Area.

All NCPN Parks that were inventoried in 2003, 2004, and 2005 are in the enviable situation of still having the majority of their lands free of targeted invasive weeds. In Bryce Canyon National Park 99.8 percent of the inventoried acres in 2005 were free of all targeted species. Furthermore, 99.3 percent of the inventoried acres in the two years combined (2004-2005) were free of all targeted species. And, because areas selected for this inventory were generally considered the sites most likely to be infested, it can be assumed that those BRCA lands not inventoried have an even higher proportion of weed-free acres. Furthermore, 100 percent of all inventoried lands in 2005 were completely free of at least 27 species of great concern to the region (Appendix E).

ACKNOWLEDGEMENTS:

We express appreciation to Pam Benjamin at the NPS Intermountain Support Office in Denver, CO, and Angie Evenden and Margaret Beer at the Northern Colorado Plateau Network in Moab, UT, for their vision and efforts in initiating this inventory project. Thanks to Angie and Margaret for their thorough reviews of our data and reports, and to Aneth Wight for always being able to solve our GIS problems. We are grateful to Kristen Legg for her help in logistical planning and coordination. Above all, we thank the dedicated USU crew members who frequently encountered potentially dangerous situations and considerable physical hardship in the intense summer heat and rugged backcountry of southern Utah to collect this information.

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[NAWMA] North America Weed Management Association. 2003. North American Invasive Plant Mapping Standards. (Web page: http://www.nawma.org).

[USDI-NPS] United States Department of Interior, National Park Service. 1995. Natural resource inventory and monitoring guidelines. NPS-75.

Appendix Tables and Figures

Appendix A. Crew Qualifications and Project Quality Assurance for 2005 Invasive Non-native Plant Inventory in Bryce Canyon National Park.

The Utah State University wildland weed mapping team has considerable experience conducting the type of survey required in this NPS project. Previous weed surveys conducted by USU include:

1997	Mt. Naomi Wilderness Area, Cache County, UT
1998	Wellsville Mountains Wilderness Area, Cache and Box Elder Counties, UT
1999	Franklin Basin Recreation Area, USFS Logan Ranger District, Cache County UT
2000	Rich County Public Lands (BLM, USFS), UT
2001	Hardware Ranch WMA, UDWR, Cache County, UT
2001	Bud Phelps WMA, UDWR, Cache County, UT
2002	Hawkins Fire, USFS, Bannock County, ID
2002	Canyon Fire, USFS, Franklin County, ID
2002	Cherry Creek Fire, USFS, Bannock County, ID
2002	West Fork Fire, BLM, Bannock County, ID
2002	Dinosaur National Monument, Green River District, UT

Kim Andersen (crew leader) has considerable experience working on the USU crew in past years. Kim has a Bachelor of Science degree in Fisheries and Wildlife from the College of Natural Resources and is currently working towards a Master's Degree in Weed Science. Kim began work on the USU crew in 1999, and has been crew leader since 2000. Ruth Richards has a Bachelor of Science degree in Crop Science and is currently working towards a Master's Degree in Weed Science. She has worked on the crew in 2003 and 2004. Hillary Hudson has a Bachelor's degree and has worked on an Exotic Plant Management Team in California from 2003 to 2004. She worked on the crew in 2004. She has also worked as a National Park ranger in the Maze District of Canyonlands National Park. Kelsey Benson is currently working towards a Bachelor's degree in Plant Science at Utah State University. She has experience with GPS weed mapping for a county weed program in Idaho.

All USU weed survey crew members were required to pass a written exam in weed identification and mapping skills before being hired. Each also had passed an upper-division university course in weed identification, biology, and management, and/or has extensive practical experience in wildland plant identification. Once hired, USU and NPS crew members also attended a 3-week classroom and outdoor training course in late April and early May in wildland weed mapping techniques taught by Dr. Dewey at Logan and Zion National Park during 2003. A similar training course was offered to the USU crew in 2004 and 2005. Crew members were provided with weed identification field guide book, taxonomic keys, and pressed reference specimens of all targeted weeds. During the course of the summers USU crew members were quizzed periodically with fresh plant specimens provided by the crew leader and/or Dr. Dewey. Dr. Dewey also spent several days in the parks working with individual crew members under field conditions. To further authenticate findings, Dr. Dewey and/or the crew leader re-visited

representative areas in each park that had been previously mapped by the USU crew, using the most recent crew-generated weed infestation maps to compare them against their own field observations.

Appendix B. Project Photographs of Weed Species Detected, Inventoried Landscapes, and Crew Working in Bryce Canyon National Park During the 2005 Invasive Non-native Plant Inventory.

Weeds Detected



Figure 1. *Tamarix ramosissima* seeding in Yellow Creek, BRCA PR-80.



Figure 2. *Tamarix ramosissima* seeding in wash in Yellow Creek, BRCA PR-80.



Figure 3. *Bromus tectorum* and other weedy annuals along the Fairyland Loop Trail, BRCA PR-65.



Figure 4. *Bromus tectorum* along the shoulder of the Fairyland Loop Trail (landscape), BRCA PR-65.

Weeds Detected



Figure 5. *Cirsium vulgare* found blooming in Swamp Canyon, BRCA PR-37.



Figure 6. Wet meadows containing *Cirsium vulgare* in Swamp Canyon, BRCA PR-37.



Figure 7. *Cirsium vulgare* found along a recent cut on the road shoulder, BRCA PR-66.



Figure 8. *Cirsium vulgare* on the road shoulder, BRCA PR-66.

Weeds Detected



Figure 9. *Cirsium vulgare* flower in bloom along road shoulder, BRCA PR-66.



Figure 10. *Cirsium vulgare* rosette in wash in Black Birch Canyon, BRCA PR-82.



Figure 11. *Melilotus officinalis* in bloom along road shoulder, BRCA PR-67.



Figure 12. *Melilotus officinalis* in bloom along road shoulder, BRCA PR-67.

Bryce Canyon National Park Landscapes



Figure 13. *Bromus inermis* in the Inventoried meadows along the Sheep Creek Connecting Trail, BRCA PR-35.



Figure 14. Inventoried area near the head of Sheep Creek.



Figure 15. Inventoried area at the base of Mud Canyon Butte, BRCA PR-41.



Figure 16. Inventoried area in Short Canyon, BRCA PR-39.

Bryce Canyon National Park Landscapes



Figure 17. Looking down into the head of Swamp Canyon, BRCA PR-44.



Figure 18. Kim Andersen inventorying the Agua Connecting Trail.



Figure 19. Meadow between the junction Agua Canyon and Bridge Canyon, BRCA PR-50.



Figure 20. Typical site in the inventoried portions of Agua Canyon, BRCA PR-49.

Bryce Canyon National Park Landscapes



Figure 21. Recent mud slides throughout Agua Canyon, BRCA PR-51.



Figure 22. Typical vegetation cover in upper Willis Creek, BRCA PR-58.



Figure 23. Looking south into Bridge Canyon from the Below-the-Rim Trail, BRCA PR-56.



Figure 24. Inventoried drainage near Piracy Point and above Willis Creek, BRCA PR-57.

Bryce Canyon National Park Landscapes



Figure 25. Inventoried portion of the right fork of Yellow Creek.



Figure 26. Inventoried meadows in Pasture Wash, BRCA PR-76.



Figure 27. Pasture Wash, BRCA PR-75.



Figure 28. Head of Black Birch Canyon, BRCA PR-74.

Bryce Canyon National Park Landscapes



Figure 29. Inventory area along the Fairyland Loop Trail, BRCA PR-63.



Figure 30. Section of the Fairyland Loop Trail, BRCA PR-64.



Figure 31. Looking into the inventoried portions of the main Bryce Canyon amphitheater.



Figure 32. Inventoried meadows in a recent burned area near Fairyland Point, BRCA PR-60.

Crew

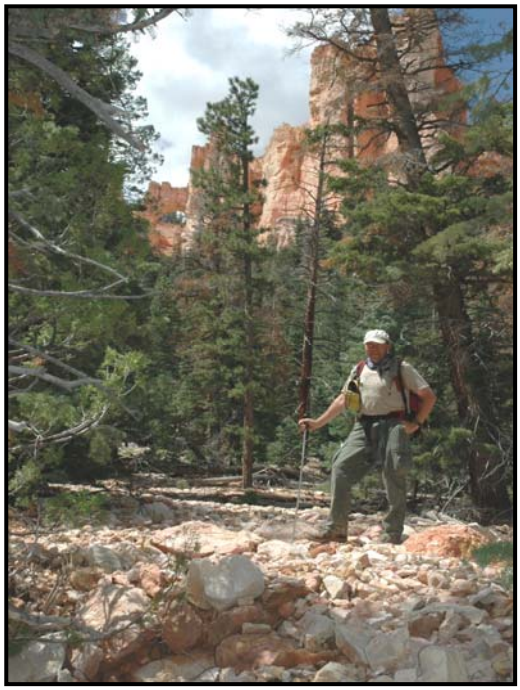


Figure 33. Steve Dewey in Bridge Canyon, BRCA PR-59.



Figure 34. Kim Andersen inventorying a portion of the Below-the-Rim Trail above Willis Creek, BRCA PR-57.



Figure 35. Lindsey Andersen (volunteer) walking transects in a meadow near Fairyland Point.

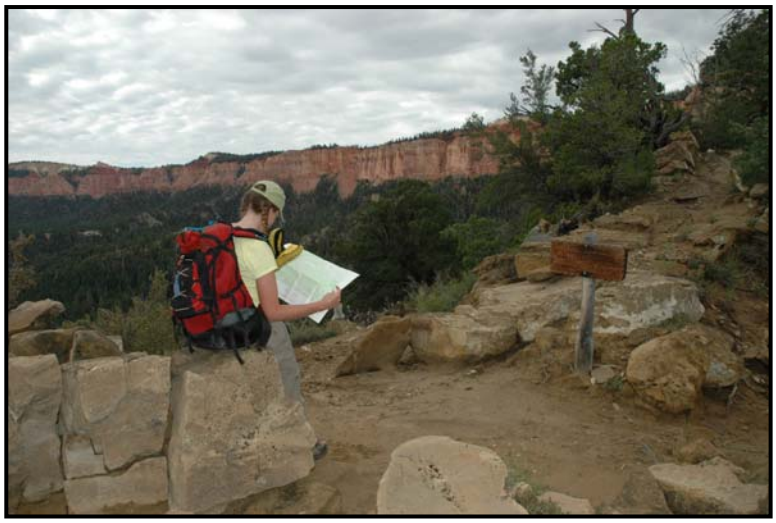


Figure 36. Kim Andersen checking coordinates at the junction of the Below-the-Rim Trail and the Agua Connecting Trail, BRCA PR-47.

Crew



Figure 37. Melanie Ballard preparing for a hike into Cope Canyon.



Figure 38. Lindsey Andersen taking a compass bearing for walking transects through a meadow near Fairyland Point.



Figure 39. Ruth Richards inventorying a section of Yellow Creek.



Figure 40. Melanie Ballard inventorying a wash in the Bryce Canyon amphitheater.

Crew



Figure 41. Lindsey Andersen (volunteer) inventorying a recent burn near Fairyland Point.



Figure 42. Melanie Ballard downloading data at the end of the day in camp.



Figure 43. Ruth Richards searching along the Below-the-Rim Trail near Pasture Wash.



Figure 44. Crew inventorying the Fairyland Loop Trail.

Crew



Figure 45. Kim Andersen on the Below-the-Rim Trail near Agua Canyon.



Figure 46. Crew searching along the Fairyland Loop Trail.



Figure 47. Melanie Ballard searching a portion of road and spring sites near the road.



Figure 48. Melanie Ballard searching for invasives in Pasture Wash.

Crew



Figure 49. Kim Andersen pulling Cirsium vulgare on the road shoulder.



Figure 50. Ruth Richards pulling a seedling of Tamarix ramosissima found in Yellow Creek, BRCA PR-78.

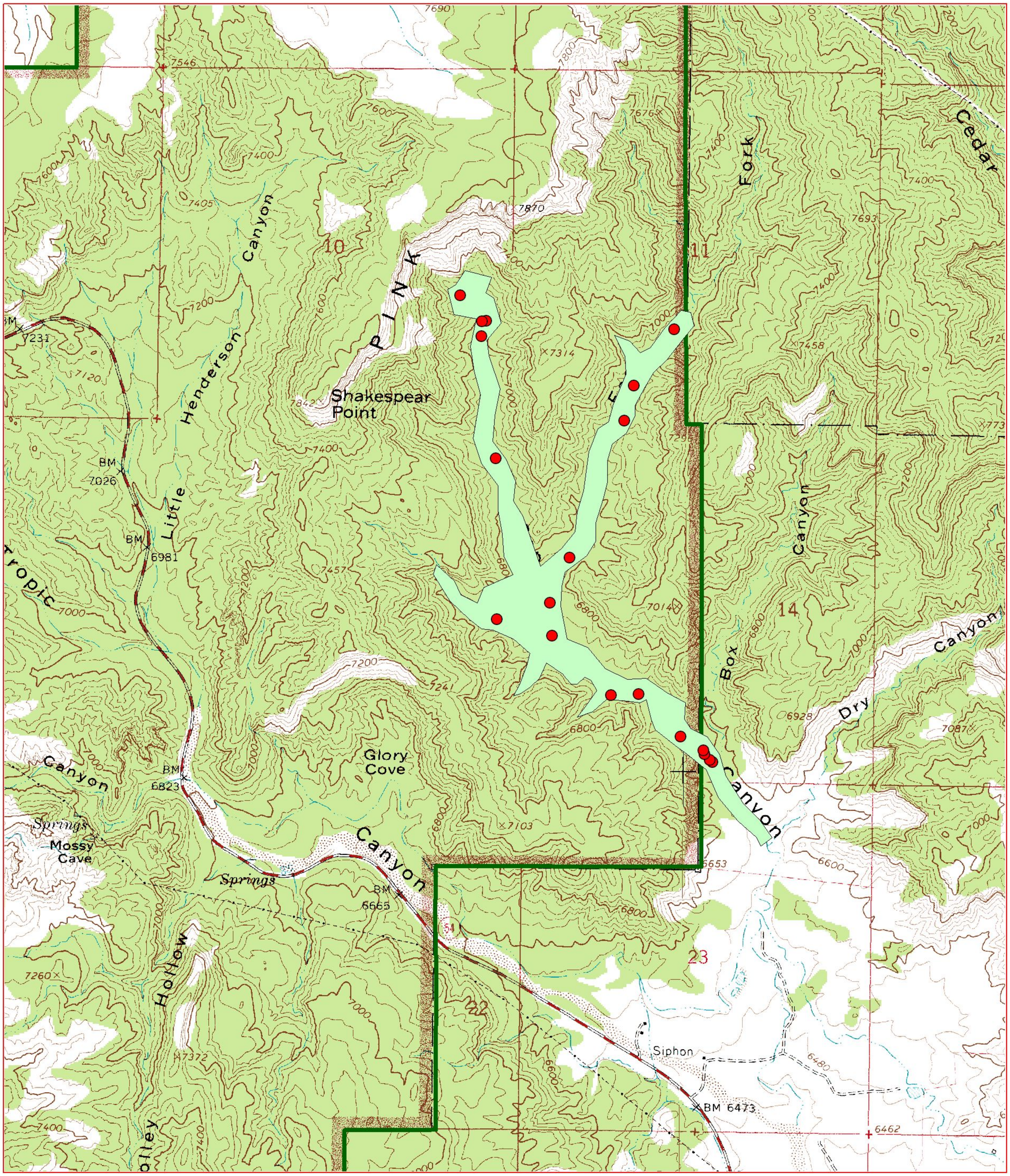


Figure 51. Ruth Richards downloading data at the end of the day in the Resource Office.



Figure 52. Melanie Ballard marking maps of the areas inventoried that day.

Appendix C. Overall Weed Distribution in Inventoried Areas - Cope Canyon (Inset A)



Weed Points

Area Inventoried

Park boundary

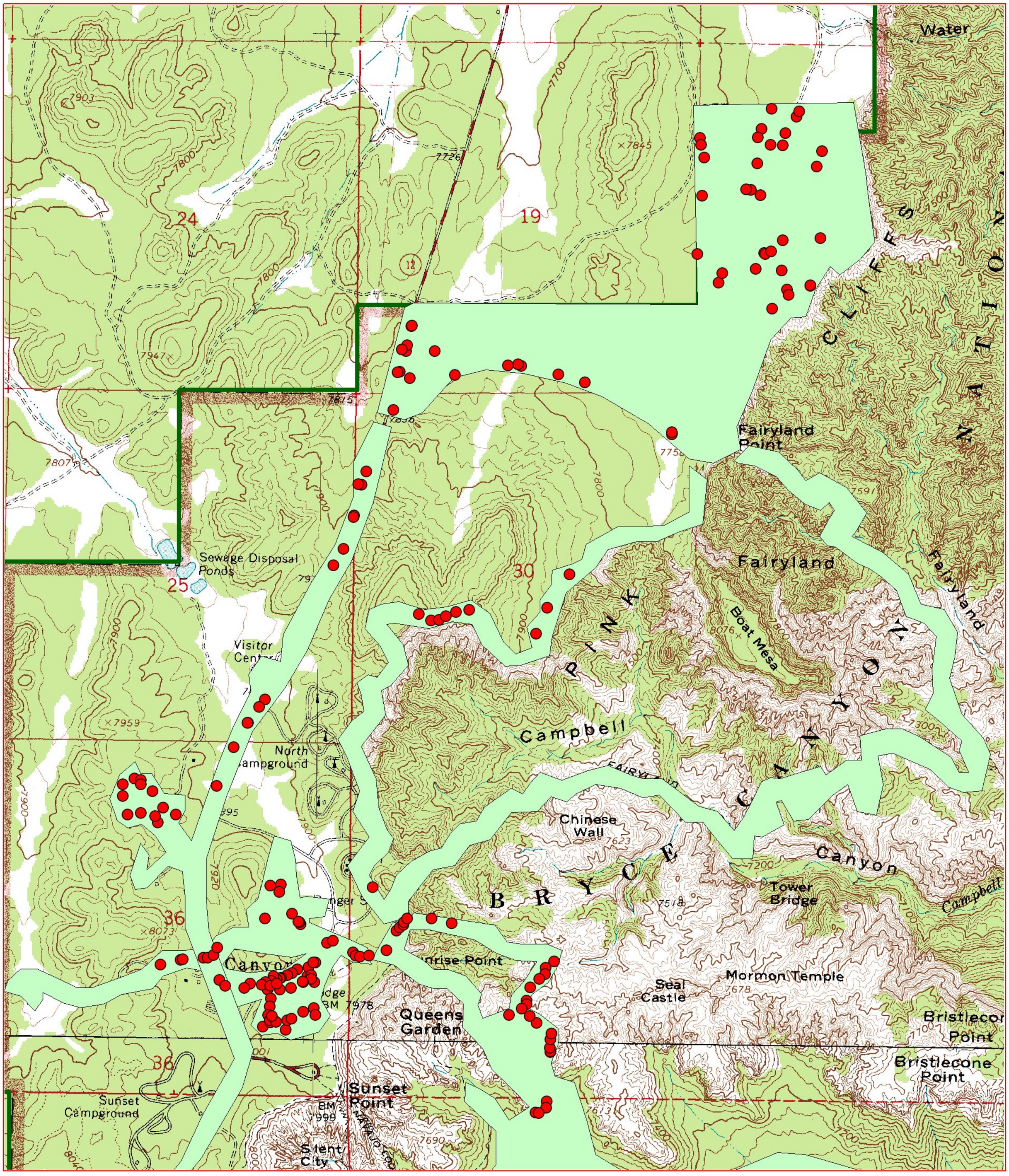
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1:24,000 Scale

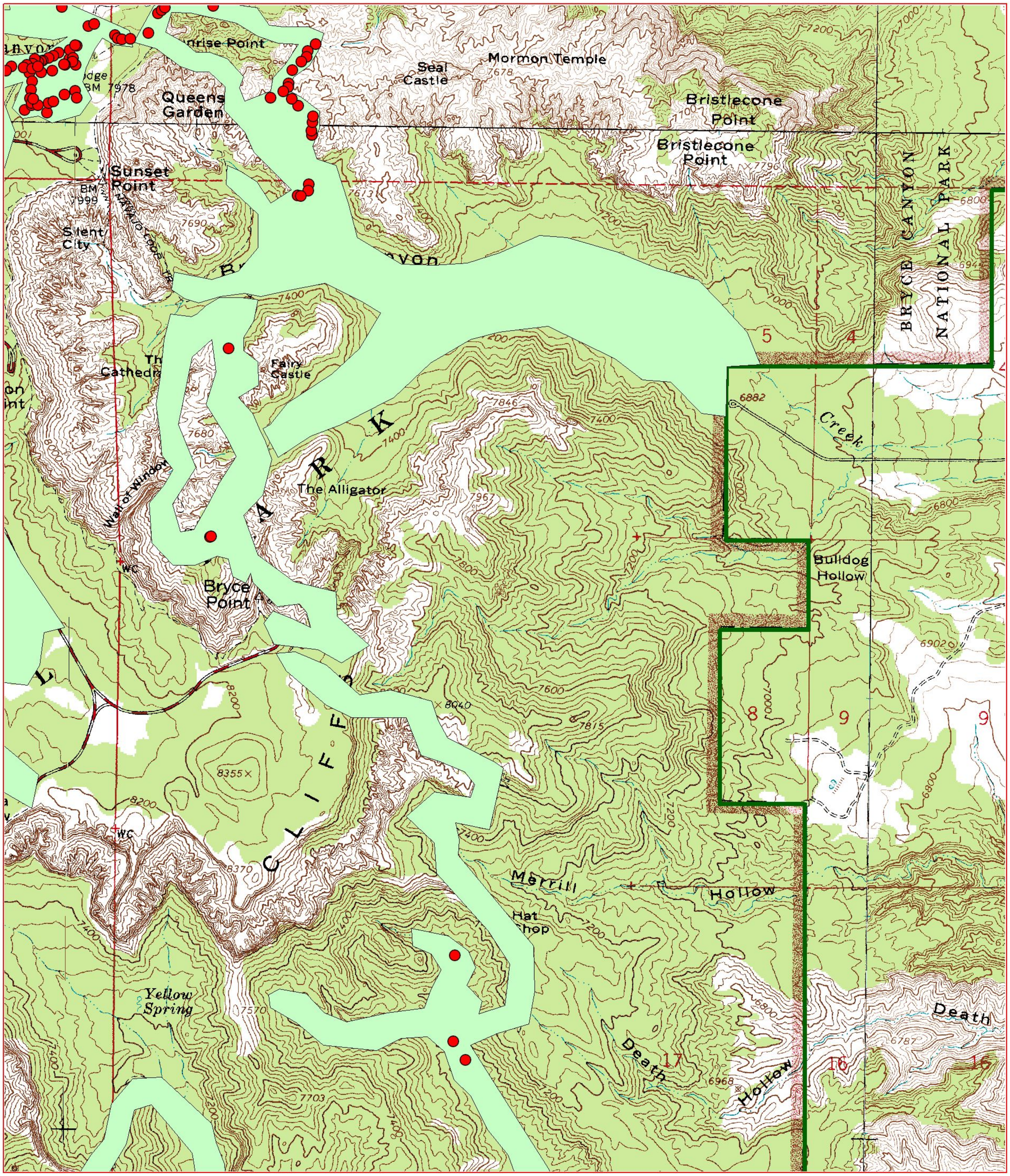
N

Inset A
Bryce Canyon National Park
Utah State University
2005 Invasive Non-Native Plant Inventory
Northern Colorado Plateau Network

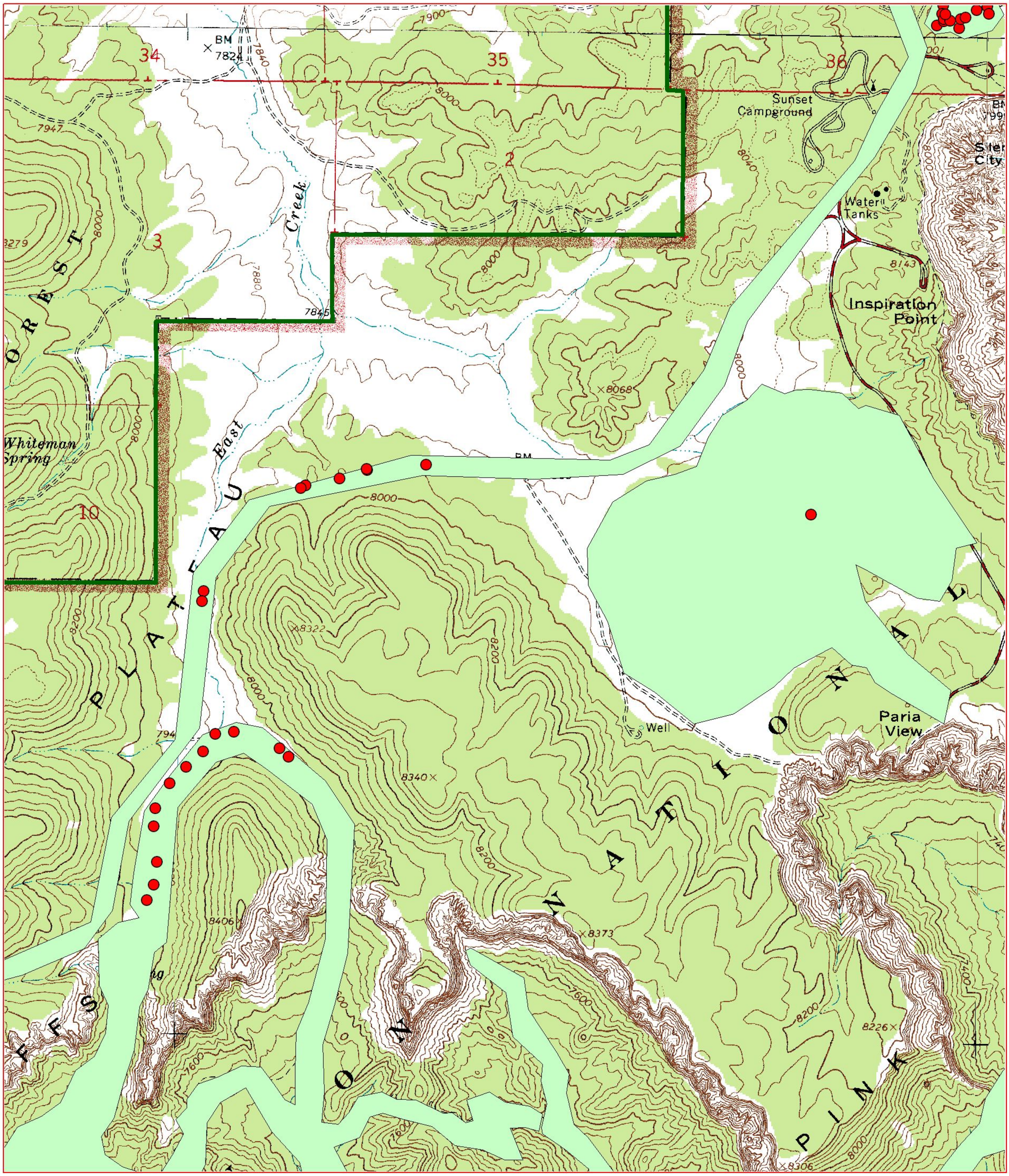
Appendix C. Overall Weed Distribution in Inventoried Areas - Fairyland Point (Inset B)



Appendix C. Overall Weed Distribution in Inventoried Areas - Bryce Canyon (Inset C)



Appendix C. Overall Weed Distribution in Inventoried Areas - Paria View (Inset D)



Weed Points

Area Inventoried

Park boundary

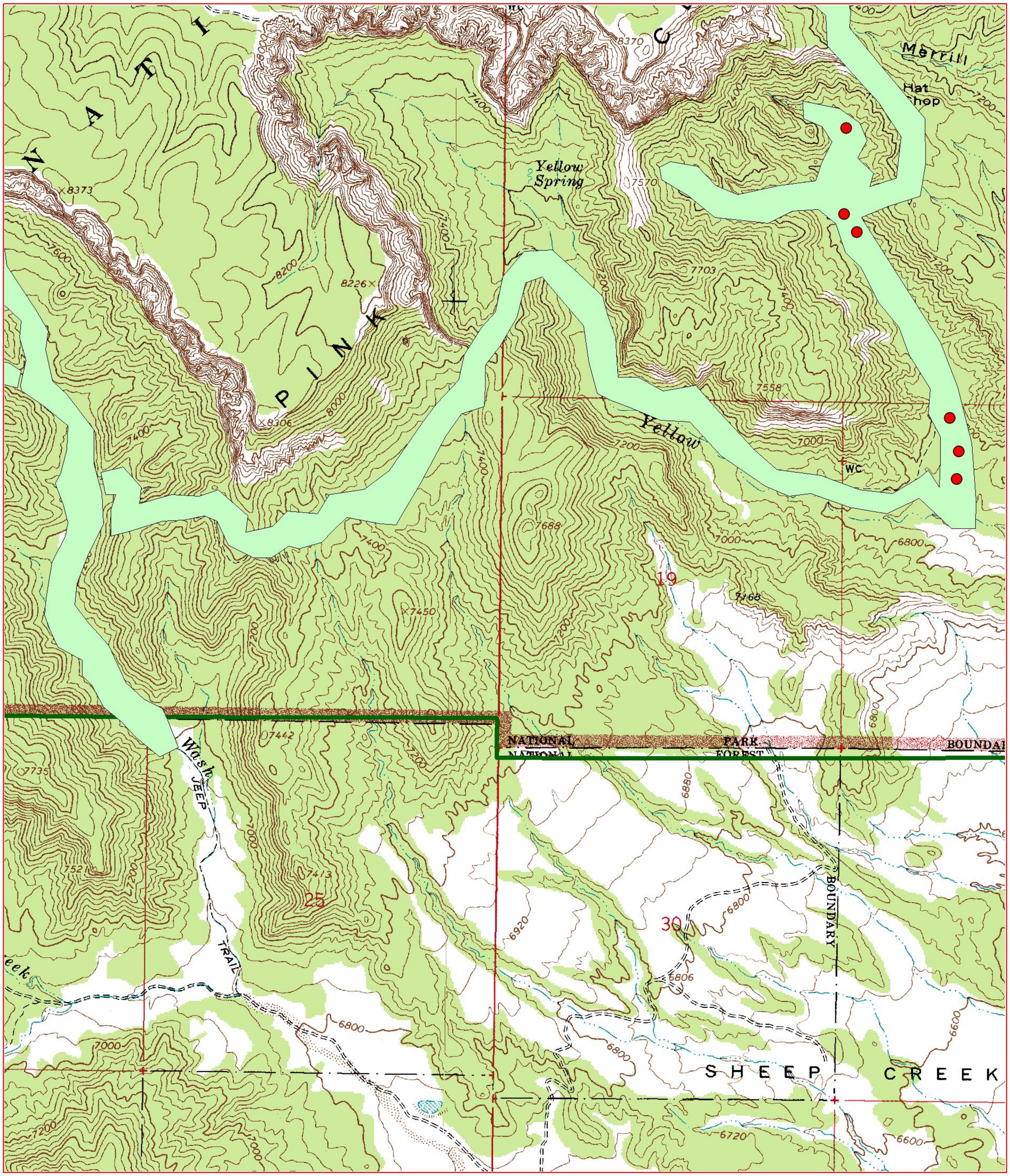
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1:24,000 Scale

N

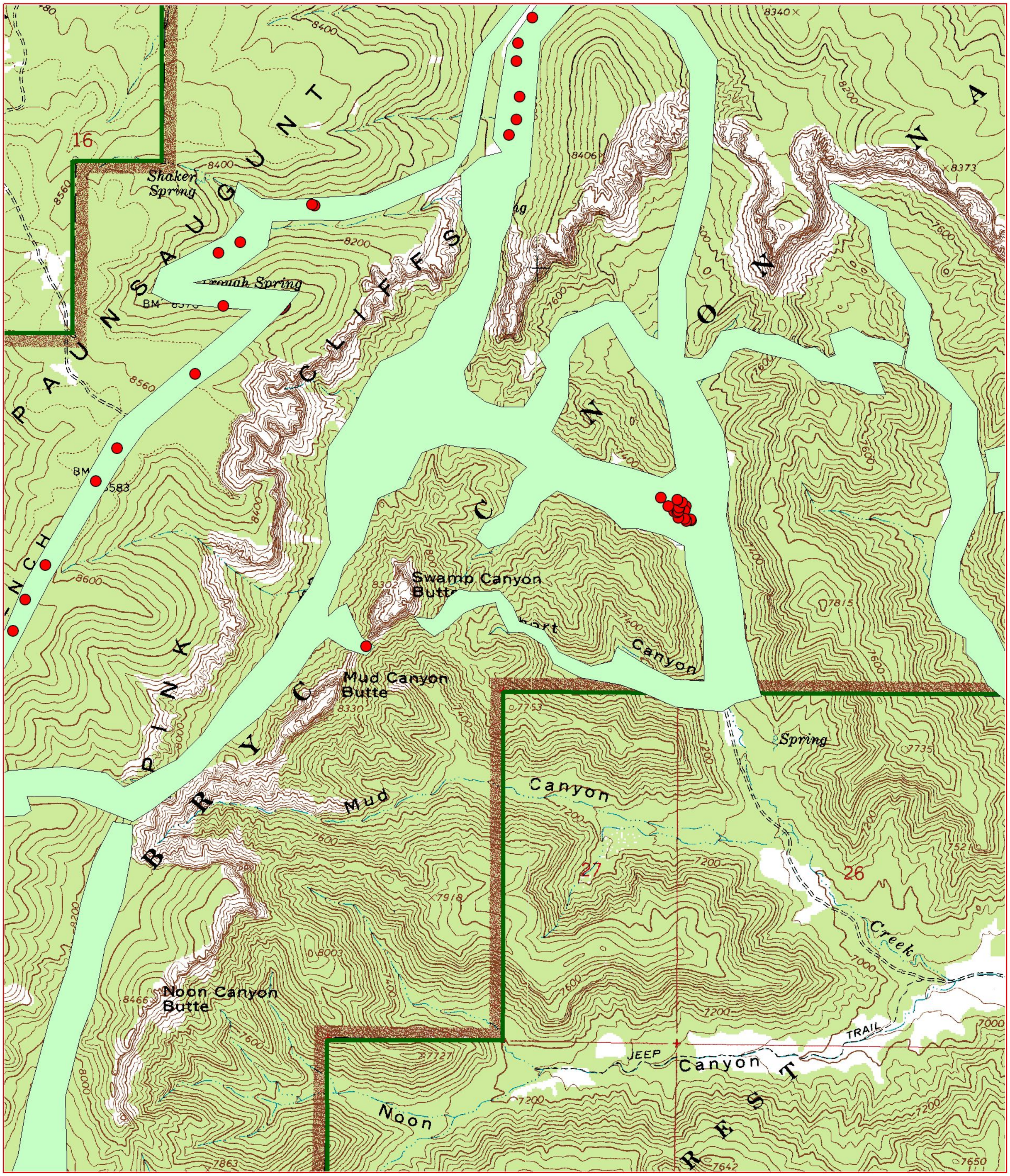
Inset D
Bryce Canyon National Park
Utah State University
2005 Invasive Non-Native Plant Inventory
Northern Colorado Plateau Network

Appendix C. Overall Weed Distribution in Inventoried Areas - Yellow Creek (Inset E)



Inset E
Bryce Canyon National Park
Utah State University
2005 Invasive Non-Native Plant Inventory
Northern Colorado Plateau Network

Appendix C. Overall Weed Distribution in Inventoried Areas - Swamp Canyon (Inset F)



Weed Points

Area Inventoried

Park boundary

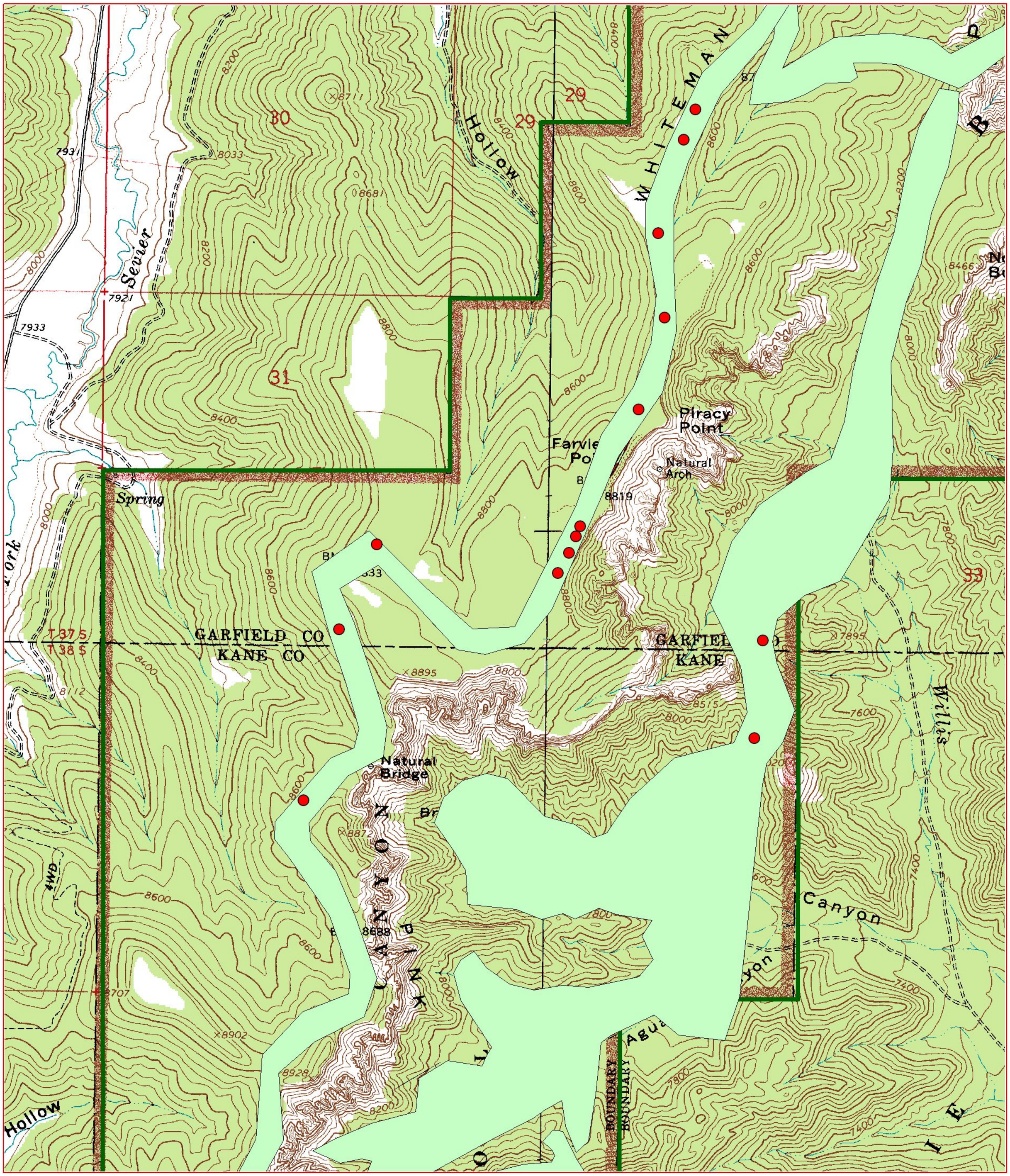
0 0.5 1 Miles

1:24,000 Scale

N

Inset F
Bryce Canyon National Park
Utah State University
2005 Invasive Non-Native Plant Inventory
Northern Colorado Plateau Network

Appendix C. Overall Weed Distribution in Inventoried Areas - Natural Bridge Canyon (Inset G)



Weed Points

Area Inventoried

Park boundary

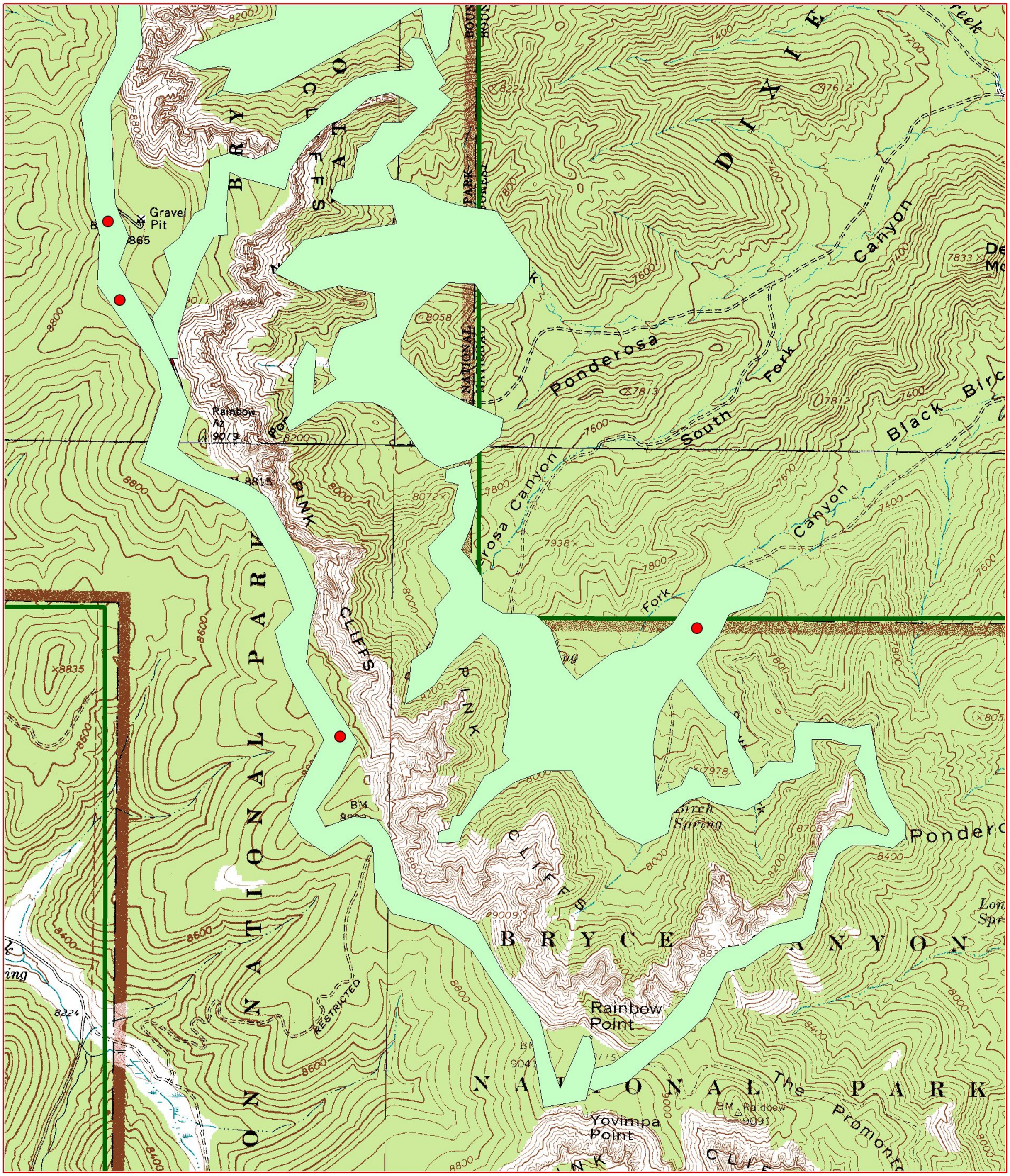
0 0.5 1 Miles

1:24,000 Scale

N

Inset G
Bryce Canyon National Park
Utah State University
2005 Invasive Non-Native Plant Inventory
Northern Colorado Plateau Network

Appendix C. Overall Weed Distribution in Inventoried Areas - Ponderosa Canyon (Inset H)



0 0.5 1 Miles

1:24,000 Scale

N

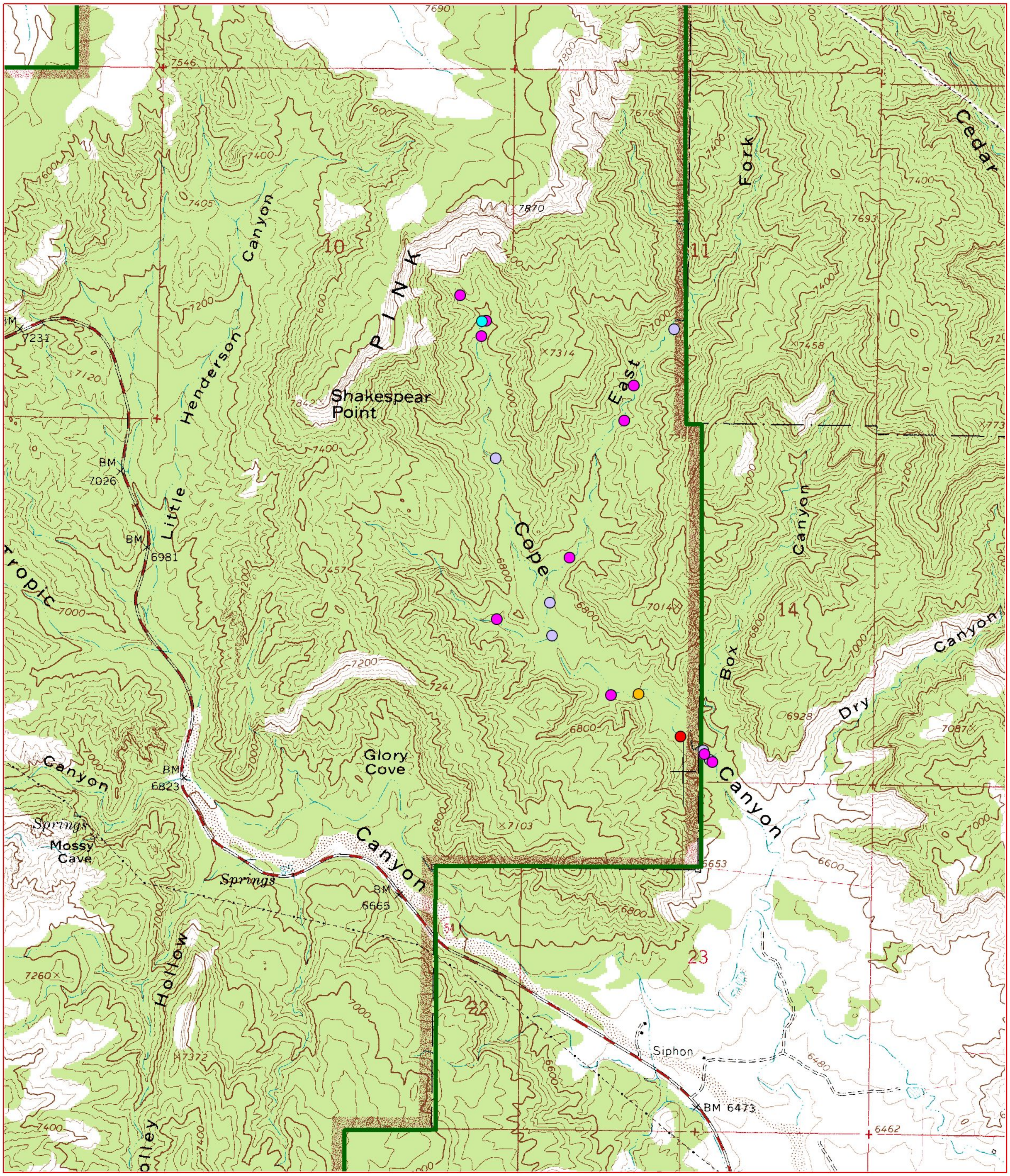
Weed Points

Area Inventoried

Park boundary

Inset H
Bryce Canyon National Park
Utah State University
2005 Invasive Non-Native Plant Inventory
Northern Colorado Plateau Network

Appendix D. Weed Species Detected in Inventoried Areas - Cope Canyon (Inset A)



- *Centaurea repens*
- *Cirsium vulgare*
- *Elaeagnus angustifolia*
- *Melilotus officinalis*
- *Tamarix ramosissima*
- Park boundary

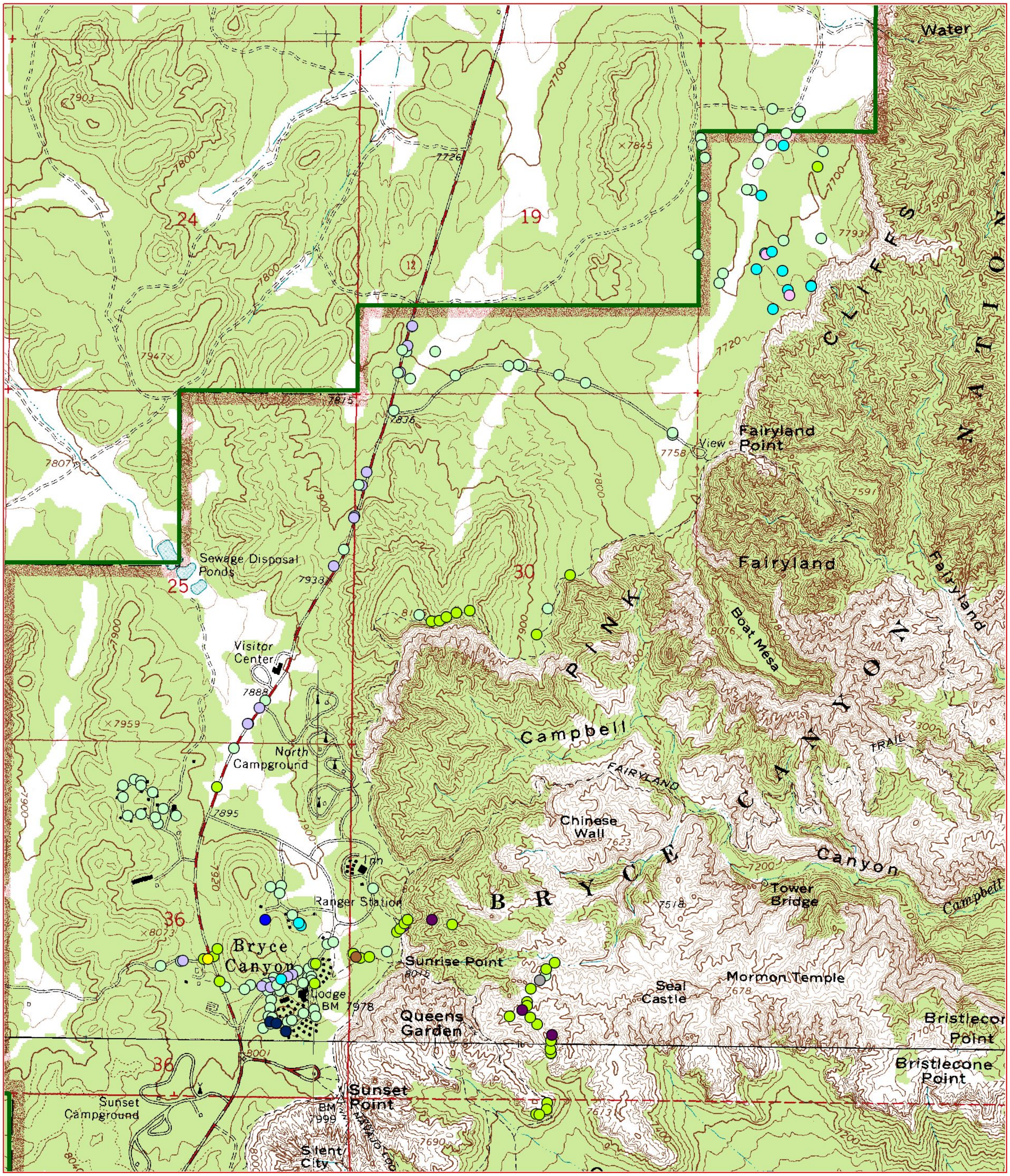
0 0.5 1 Miles

1:24,000 Scale

N

Inset A
Bryce Canyon National Park
Utah State University
2005 Invasive Non-Native Plant Inventory
Northern Colorado Plateau Network

Appendix D. Weed Species Detected in Inventoried Areas - Fairyland Point (Inset B)



- *Bromus inermis*
- *Bromus tectorum*
- *Carduus nutans*
- *Cirsium arvense*
- *Cirsium vulgare*
- *Convolvulus arvensis*
- *Erodium cicutarium*
- *Lepidium perfoliatum*
- *Malva neglecta*
- *Melilotus officinalis*
- *Verbascum thapsus*
- Park boundary

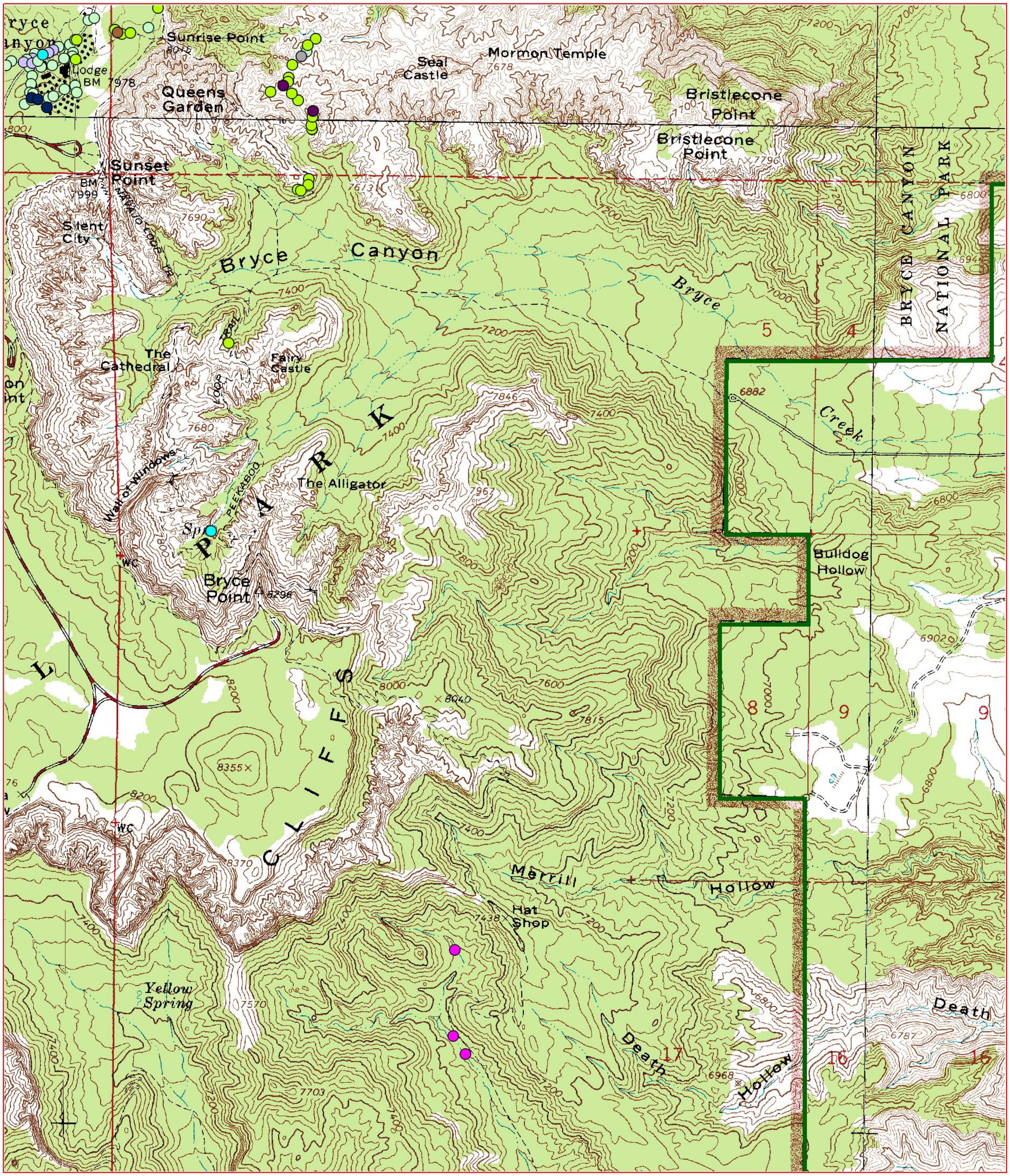
0 0.5 1 Miles

1:24,000 Scale

N

Inset B
Bryce Canyon National Park
Utah State University
2005 Invasive Non-Native Plant Inventory
Northern Colorado Plateau Network

Appendix D. Weed Species Detected in Inventoried Areas - Bryce Canyon (Inset C)



- *Bromus inermis*
- *Bromus tectorum*
- *Cirsium vulgare*
- *Convolvulus arvensis*
- *Erodium cicutarium*
- *Lepidium perfoliatum*
- *Malva neglecta*
- *Melilotus officinalis*
- *Tamarix ramosissima*
- Park boundary

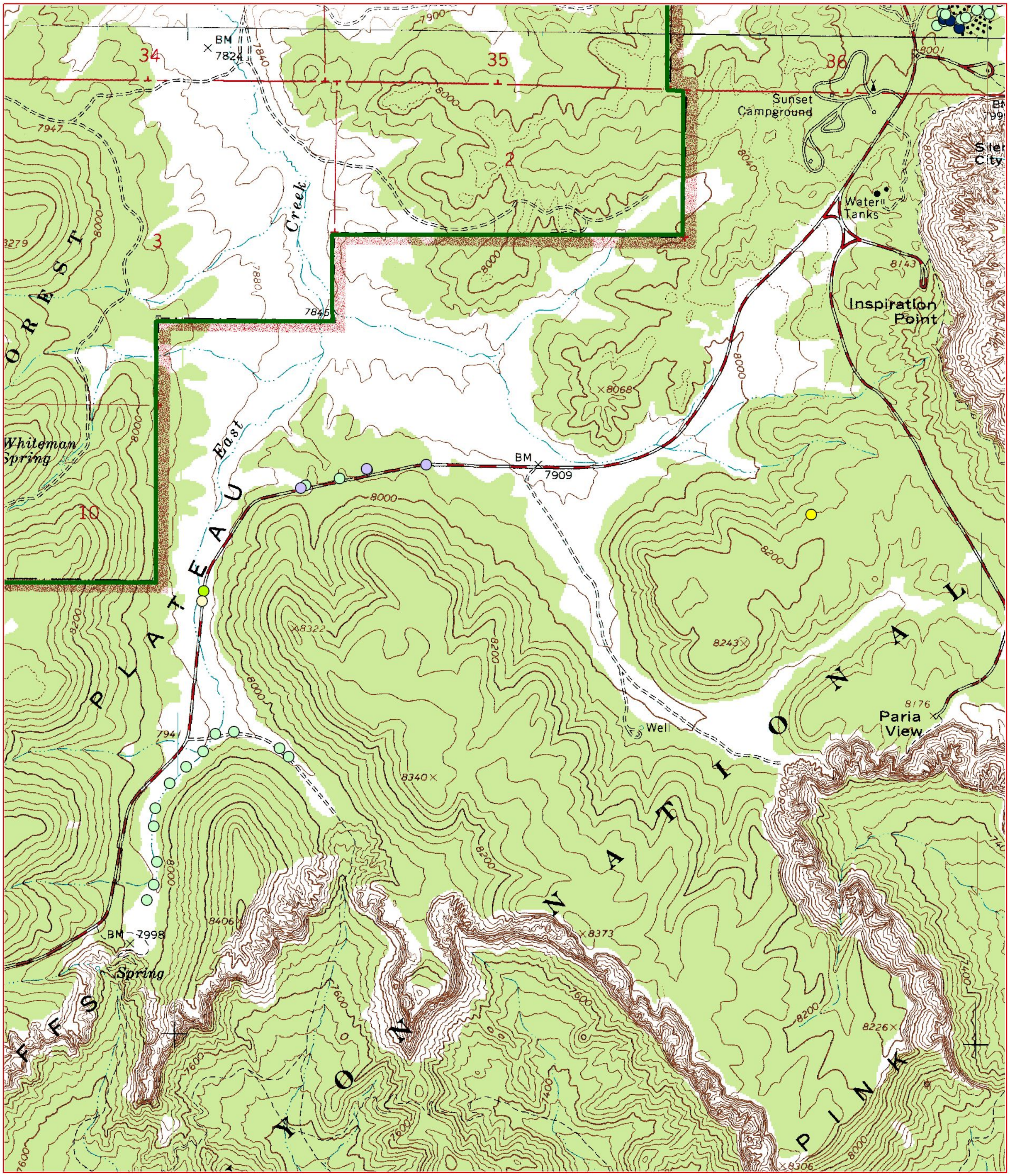
0 0.5 1 Miles

1:24,000 Scale

N

Inset C
Bryce Canyon National Park
Utah State University
2005 Invasive Non-Native Plant Inventory
Northern Colorado Plateau Network

Appendix D. Weed Species Detected in Inventoried Areas - Paria View (Inset D)



- *Bromus inermis*
- *Bromus tectorum*
- *Carduus nutans*
- *Convolvulus arvensis*
- *Melilotus officinalis*
- *Salsola kali*
- Park boundary

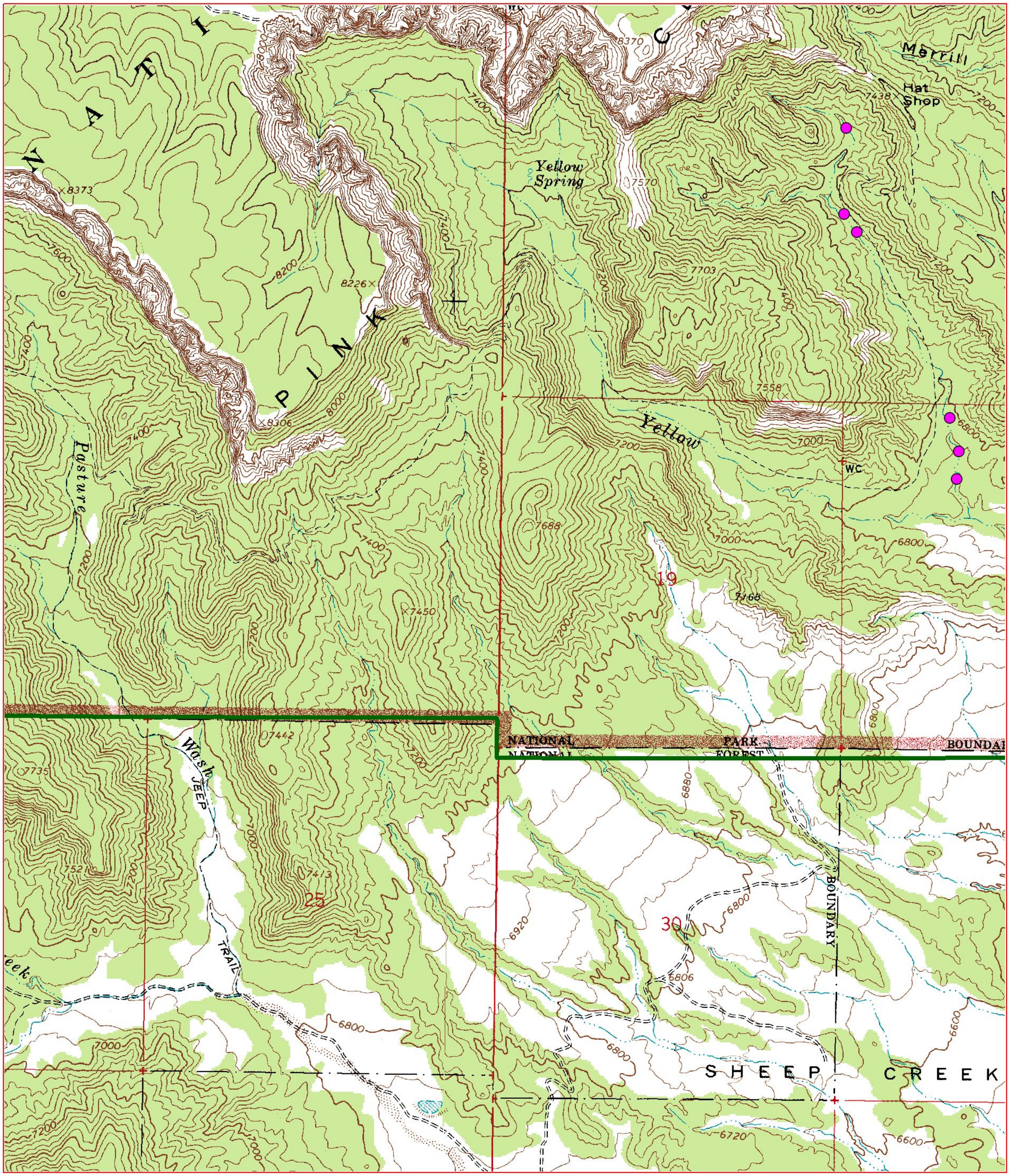
0 0.5 1 Miles

1:24,000 Scale

N

Inset D
Bryce Canyon National Park
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2005 Invasive Non-Native Plant Inventory
Northern Colorado Plateau Network

Appendix D. Weed Species Detected in Inventoried Areas - Yellow Creek (Inset E)



0 0.5 1 Miles

Tamarix ramosissima

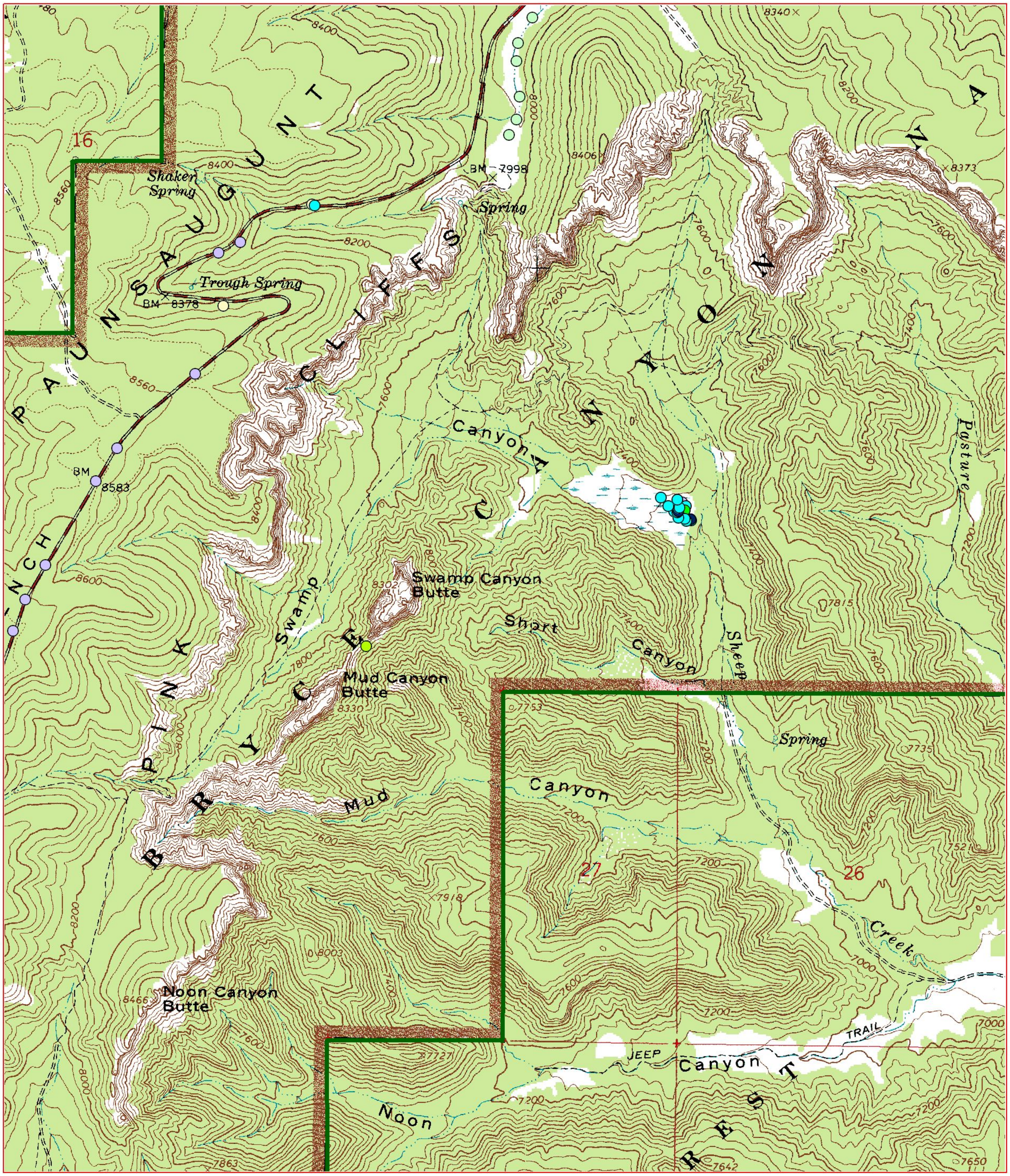
Park boundary

N

1:24,000 Scale

Inset E
Bryce Canyon National Park
Utah State University
2005 Invasive Non-Native Plant Inventory
Northern Colorado Plateau Network

Appendix D. Weed Species Detected in Inventoried Areas - Swamp Canyon (Inset F)



Bromus tectorum

Bromus tectorum

Cirsium vulgare

Convolvulus arvensis

Lactuca serriola

Melilotus officinalis

Salsola kali

Park boundary

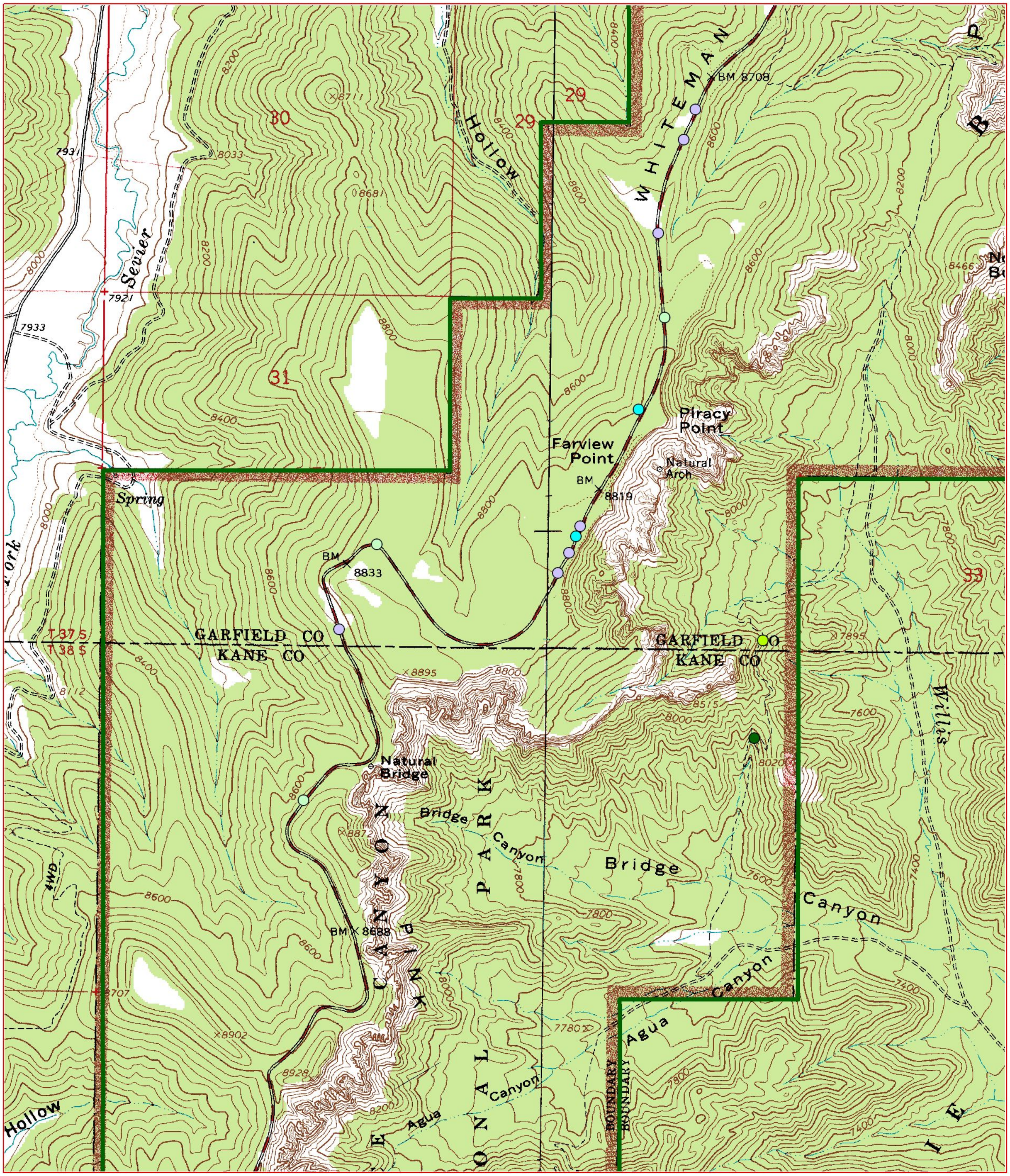
0 0.5 1 Miles

1:24,000 Scale

N

Inset F
Bryce Canyon National Park
Utah State University
2005 Invasive Non-Native Plant Inventory
Northern Colorado Plateau Network

Appendix D. Weed Species Detected in Inventoried Areas - Natural Bridge Canyon (Inset G)



Bromus inermis
Bromus tectorum
Cirsium vulgare
Melilotus officinalis
Phragmites australis
Park boundary

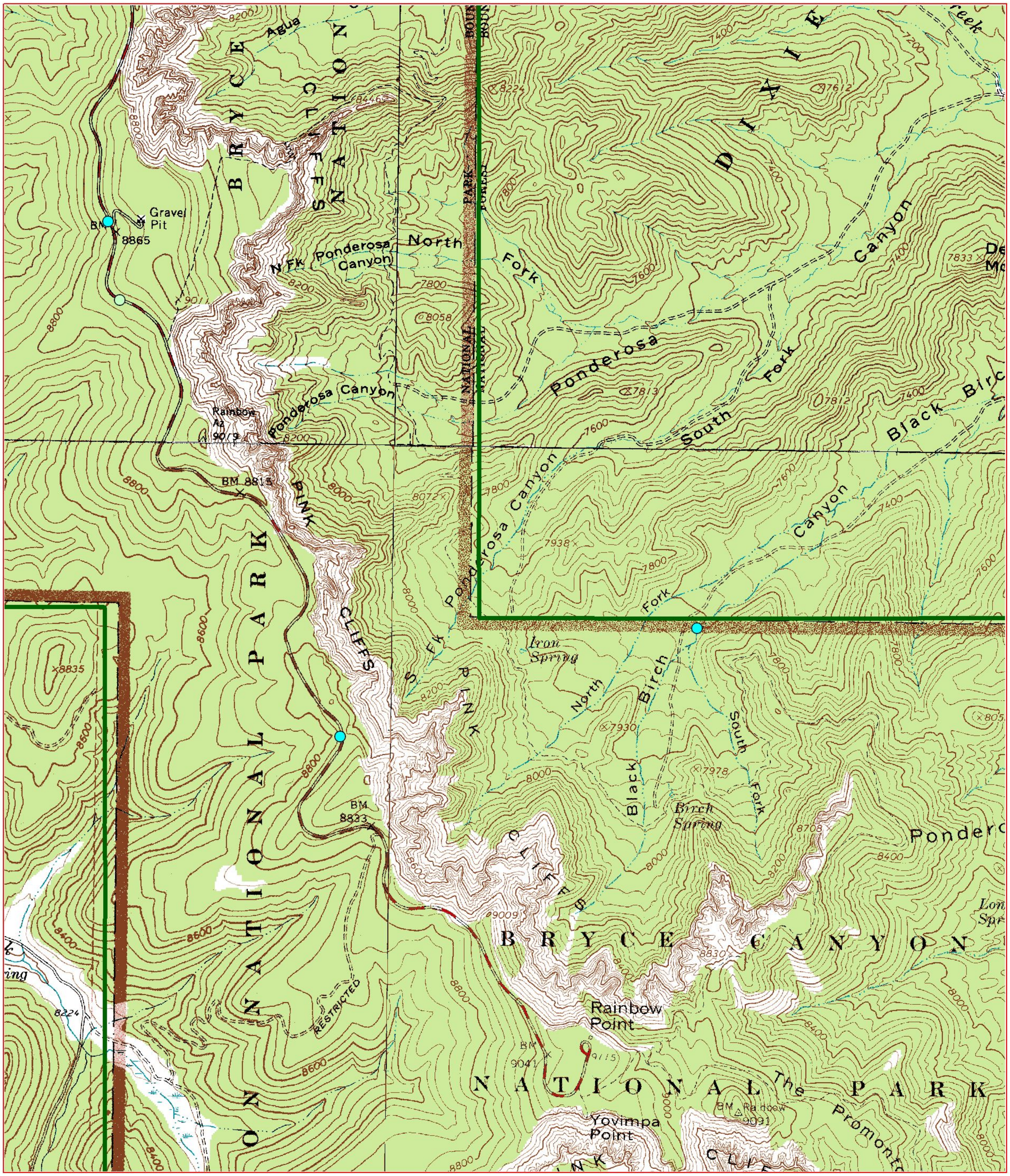
0 0.5 1 Miles

N

1:24,000 Scale

Inset G
Bryce Canyon National Park
Utah State University
2005 Invasive Non-Native Plant Inventory
Northern Colorado Plateau Network

Appendix D. Weed Species Detected in Inventoried Areas - Ponderosa Canyon (Inset H)



Inset H
Bryce Canyon National Park
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Appendix E. Summary of occurrence and inventory status of the 47 non-native species listed in the GPS data dictionary, plus any additional species noted in the 2005 inventory of invasive plants in Bryce Canyon National Park.

GPS Species	A	B	C	D	E	GPS Species	A	B	C	D	E
Agropyron cristatum			X			*Lepidium latifolium*				X	
Ailanthus altissima				X		*Linaria dalmatica*				X	
Alhagi pseudalhagi				X		*Linaria vulgaris*				X	
Anthemis L.					X	*Lythrum salicaria*				X	
Arctium minus				X		*Marrubium vulgare*				X	
Arundo donax				X		*Moluccella laevis*				X	
Asparagus sp.					X	*Onopordum acanthium*				X	
Brassica tournefortii					X	*Phleum pratense*				X	
Bromus inermis	X					*Rubus discolor*				X	
Bromus tectorum	X					*Rumex crispus*					X
Cardaria draba				X		*Salsola kali*		X			
Carduus nutans	X					*Sorghum halepense*				X	
Centaurea diffusa				X		*Tamarix ramosissima*	X				
Centaurea maculosa				X		*Tragopogon dubius*					X
Centaurea repens	X					*Tribulus terrestris*					X
Centaurea solstitialis				X		*Verbascum thapsus*	X				
Centaurea virgata				X		*Ulmus pumila*				X	
Chenopodium album			X								
Cirsium arvense	X					**Other:**					
Cirsium vulgare	X					*Erodium cicutarium*		X			
Conium maculatum				X		*Lactuca serriola*		X			
Convolvulus arvensis	X					*Malva neglecta*		X			
Cynoglossum officinale				X		*Melilotus officinalis*		X			
Dactylis glomerata				X		*Phragmites australis*		X			
Elaeagnus angustifolia	X										
Euphorbia esula				X							
Halogeton glomeratus				X							
Hyoscyamus niger				X							
Isatis tinctoria				X							
Iva xanthifolia					X						

A = Present - Full inventory
B = Present – Partial inventory
C = Present – Not Mapped
D = Searched For - Absent
E = No Information