2021 Lake Norman

Aquatic Vegetation Survey

Report submitted by NC State University

Background

Hydrilla (*Hydrilla verticillata*) is a non-native invasive submersed aquatic plant. In North Carolina, this plant was first documented in Wake County in 1980. Initial infestations were confined to small ponds and lakes; however, by 1988 it had spread into Lake Gaston. The plant continued to spread to numerous Piedmont reservoirs across North Carolina and reached the large lakes on the Catawba River system in the early 2000's.

Lake Norman covers 36,472 acres (14,760 ha) and was impounded during 1963. Hydrilla was first detected in this heavily developed reservoir in 2000. The infestation was aggressively treated with herbicides for the next 4 years. In addition to herbicide treatments, approximately 6,120 triploid grass carp were stocked during 2004, and all 444 acres (180 ha) of hydrilla were eliminated within a year[1]. Supplemental grass carp stockings in following years had depleted the tuber bank by 2012, effectively eradicating the infestation and suggesting a successful strategy for future hydrilla management in Piedmont Reservoirs. Since then, a resurgence of hydrilla has occurred in Lake Norman with numerous reports in 2018. In response, additional grass carp have been stocked annually in Lake Norman beginning in 2018 for hydrilla control. To monitor the efficacy of the grass carp for hydrilla control and to monitor changes within the native aquatic plant community, North Carolina State University (NCSU) researchers began annual whole-lake surveys at Lake Norman in 2018.

Methods

The 2021 annual survey was completed in late September by NCSU reserachers. During the survey timeframe, the lake elevation remained around 96.5 feet. This elevation is slightly lower than its target elevation of 98 ft (based on full pool of 100 ft)[2]. Rake samples were collected in water from 4 to 12 ft (1.2 to 3.6 m) deep.

In order to quantify submersed plant abundance and locations, a point intercept method was utilized to determine species presence/absence and provide a basis for comparison in determining future hydrilla spread or reductions. A total of 947 points were sampled south of the Hwy 150 bridges at approximately 1,600 ft (500 m) intervals around the shoreline by NCSU researchers (Figure 1). An additional 913 points were sampled by Duke Energy and other contractors north of the Hwy 150 bridges at approximately 300 ft (91 m) intervals in within the same survey timeframe in September 2021 (Figure 1).

The sample method included visual observation of sample area and 2 rake tosses at each point. Plant abundance was assessed at each point with a 0 to 4 rating scale, (0 = no plants present on the rake; 1 = plants present at low densities < 25% cover (*trace*); 2 = plants present at moderate densities 25-50% cover (*sparse*); 3 = plants present a

moderate to high densities 50-75% cover (*moderate*); 4 = plants present at extremely high densities 75-100% cover (*dense*)).

In addition, hydroacoustic (sonar) data was collected using twin transducers and individual GPS receivers around the Ramsey Creek arm of the lake where hydrilla has historically been documented. The collected sonar data was uploaded to BioBase™ to quantify standing biovolume of submersed aquatic vegetation (SAV) in Ramsey Creek. The collected point-intercept data post-processed in Microsoft Excel and ArcMap to visualize species abundance and distribution within Lake Norman.

Results

Aquatic vegetation was present at 512 (28%) of the 1860 surveyed points at Lake Norman in 2021 (Figure 2). Species present included macroalgae (*Chara spp*.), spikerush (*Eleocharis baldwinii*), riverweed (*Podostomum ceratophyllum*), aquatic moss (*Fontinalis spp*.), filamentous algae (*Spirogyra spp*.), water willow (*Justicia americana*), spatterdock (*Nuphar advena*), benthic filamentous algae (*Lyngbya/Microseria spp*.), maidencane (*Panicum hemitomon*), hydrilla (*Hydrilla verticillata*), variable-leaf pondweed (*Potamogeton diversifolius*), tapegrass (*Vallisneria americana*), and southern naiad (*Najas guadalupensis*) (Figures 2, 4 – 16; Table 1). Many of these species have been documented growing in Lake Norman during previous years, with the exception of 4 species (riverweed, aquatic moss, maidencane, and variable leaf pondweed) that have not been recorded in Lake Norman in the recent past (Table 2).

Chara and spikerush were the two most abundant species present during the 2021 survey (documented at 17% and 11% of surveyed points, respectively (Table 1; Figure 3)). This has been a consistent annual finding since 2018 (Table 2). In 2021, both chara and spikerush were found at an increased presence throughout the lake when compared to previous survey years (Table 2). Note that spikerush is not a highly-preferred species by grass carp, so the population in Lake Norman is not being suppressed through bio-control.

Apart from chara and spikerush, native SAV populations remain relatively low within Lake Norman. The majority of the documented species were present at less than 1% of the surveyed points (Table 1, Figure 3). These findings are not unusual and are likely impacted by the active grass carp population at the lake. Despite the low presence of SAV, it is encouraging to see that species diversity has increased over the years and the populations of native aquatic plants are generally increasing in presence at survey points (Table 2).

The hydrilla population remains very low in Lake Norman as of 2021. It was observed sparsely growing at two point intercept locations in 2021 (Figure 13). These points were located in the upstream riverine section of the lake where it has not been documented in the past. Hydrilla was not documented in any regions of the main lake during the 2021 survey.

Biovolume data collected along the shoreline of the Ramsey Creek arm spanned 25 miles and recorded an average depth of 9.3 feet. The average biovolume recorded was

8.6% in this section (Figure 17). While macroalgae and spikerush was present in this region of the waterbody, it is likely that low water levels influenced biovolume interpolations and some of high biovolume areas are artifacts of shallow areas of the shoreline.

Species diversity is currently highest in the upstream, riverine section of Lake Norman (Figure 2). Some notable species in this region include dense stands of spatterdock, as well as moderate riverweed and trace variable-leaf pondweed populations. These are all important native species that are beneficial to aquatic ecosystems. It is important to continue to monitor this region of the waterbody, especially the sites where hydrilla was documented, to ensure that its presence does not interfere with native SAV establishment.

Conclusions

- The current hydrilla management plan seems to be efficient at controlling hydrilla in Lake Norman. The hydrilla population remains sparse in the lake. Special attention should be applied to the hydrilla growth in the northern region of the lake. Hydrilla has not been documented in this location in the recent past. Its position upstream may potentially facilitate spread down into the main reservoir in future years.
- Macroalage and spikerush are the dominant SAV species in Lake Norman as of 2021. Other Native SAV species were documented in generally sparse populations. Four new species were found in Lake Norman that have not been present during surveys in the recent past.
- Annual monitoring of SAV in Lake Norman should continue to track the presence and abundance of native and non-native species over time.

References:

1. Manuel, K.L., J.P. Kirk, D.H. Barwick, and T.W. Bowen. 2013. Hydrilla management in Piedmont reservoirs using herbicides and triploid Grass Carp: a case study. North American Journal of Fisheries Management 33:488–492.

2. https://lakes.duke-energy.com/index.html#/detail/4/Deta

3. North Carolina State University. 2020. 2020 Lake Norman Aquatic Vegetation Survey. Report submitted to the Duke Energy Aquatic Plant Management Program. Accessed 1/28/2021

4. North Carolina State University. 2019. 2019 Lake Norman Aquatic Vegetation Survey. Report submitted to the Duke Energy Aquatic Plant Management Program. Accessed 1/28/2021.

5. North Carolina State University. 2018. 2018 Lake Norman Aquatic Vegetation Survey. Report submitted to the Duke Energy Aquatic Plant Management Program. Accessed 1/28/2021.

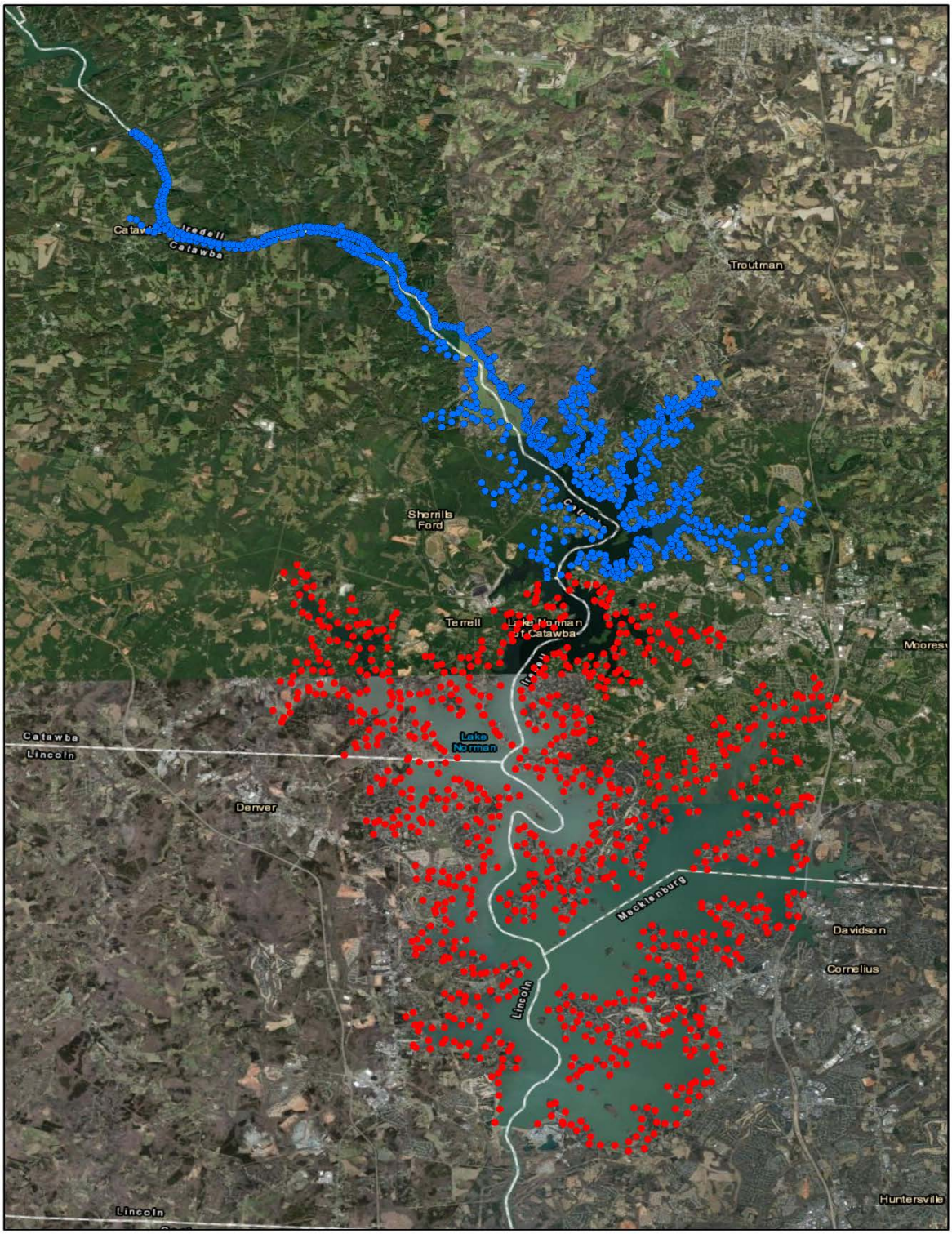


Figure 1: Surveyed points during 2021 SAV survey at Lake Norman. Those surveyed by NCSU are represented in red (947 points) and Duke Energy researchers are represented in blue (913 points).

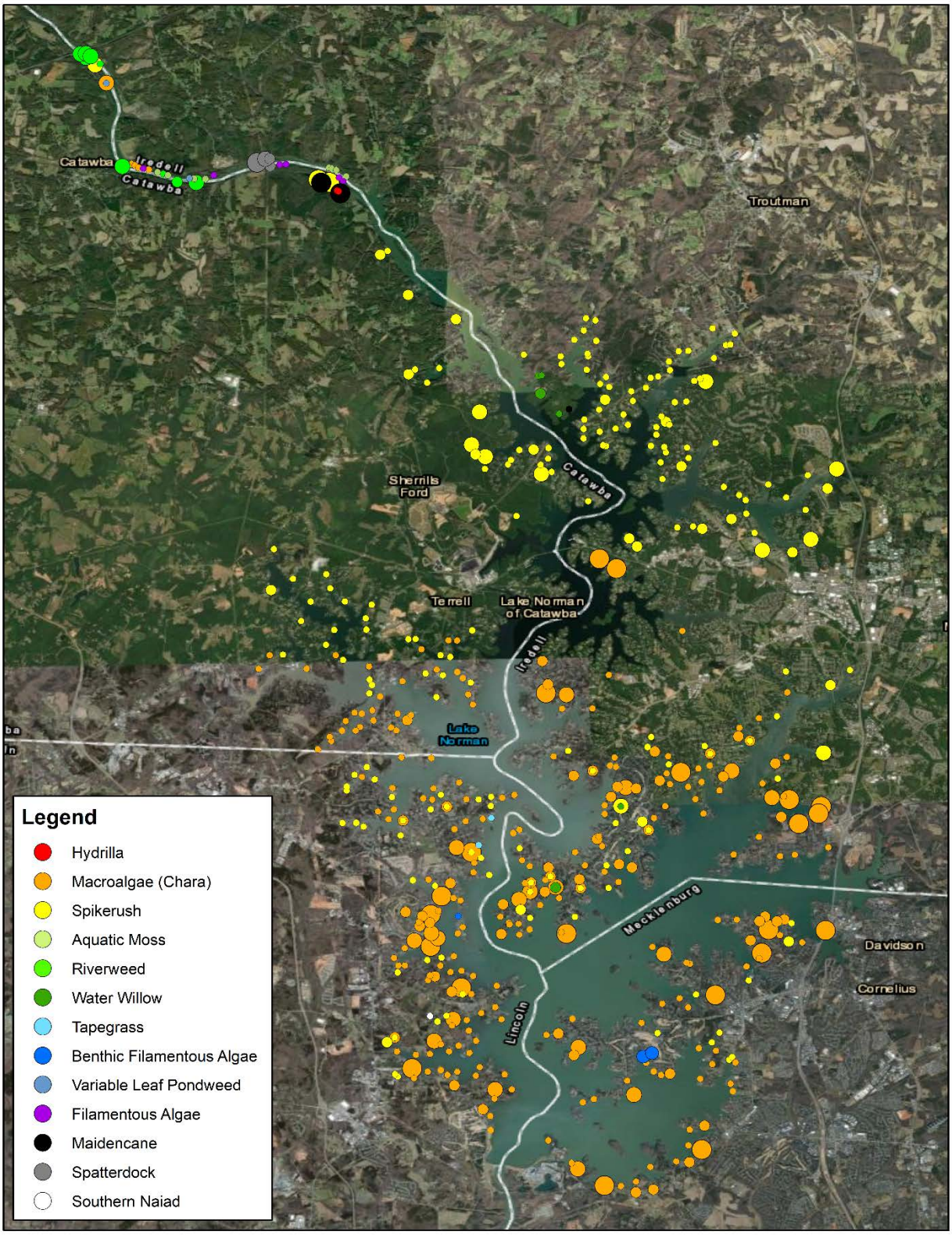


Figure 2: All vegetation recorded at Lake Norman during the 2021 survey.

Table 1: Species abundance recorded during 2021 Lake Norman Survey

Common Name	Scientific Name	Total		Trace		Sparse		Moderate		Dense	
		#	%	#	%	#	%	#	%	#	#
Total Surveyed Points		1860									
Total Vegetated Points		581	31%	432	23%	85	5%	38	2%	26	1%
Macroalgae	*Chara spp.*	321	17%	225	12%	56	3%	19	1%	21	1%
Spikerush	*Eleocharis baldwinii*	204	11%	169	9%	22	1%	11	1%	2	0%
Riverweed	*Podostomum ceratophyllum*	17	1%	10	1%	1	0%	6	0%	0	0%
Aquatic Moss	*Fontinalis spp.*	9	0%	8	0%	0	0%	1	0%	0	0%
Filamentous Algae	*Spirogyra spp.*	7	0%	7	0%	0	0%	0	0%	0	0%
Water Willow	*Justicia americana*	6	0%	4	0%	2	0%	0	0%	0	0%
Spatterdock	*Nuphar advena*	4	0%	0	0%	2	0%	1	0%	1	0%
Benthic Filamentous Algae	*Microseira/Lyngbya spp.*	3	0%	1	0%	2	0%	0	0%	0	0%
Maidencane	*Panicum hemitomon*	3	0%	1	0%	0	0%	0	0%	2	0%
Hydrilla	*Hydrilla verticillata*	2	0%	2	0%	0	0%	0	0%	0	0%
Variable-leaf Pondweed	*Potamogeton diversifolius*	2	0%	2	0%	0	0%	0	0%	0	0%
Tapegrass	*Vallisneria americana*	2	0%	2	0%	0	0%	0	0%	0	0%
Southern Naiad	*Najas guadalupensis*	1	0%	1	0%	0	0%	0	0%	0	0%

Table 2: Change over time of species presence within Lake Norman

Species	2018[5]		2019[4]		2020[3]		2021	
	#	% Change	#	% Change	#	% Change	#	% Change
Chara	134	-	203	51%	227	12%	321	41%
Spikerush	65	-	37	-43%	103	178%	204	98%
Filamentous Algae	6	-	0	-100%	5	N/A	7	40%
Duckweed	0	-	0	N/A	5	N/A	0	-100%
Hydrilla	126	-	2	-98%	2	0%	2	0%
Small Pondweed	38	-	0	-100%	2	N/A	0	-100%
Benthic Filamentous Algae	0	-	0	N/A	2	N/A	3	50%
Spatterdock	0	-	0	N/A	2	N/A	4	100%
Water Willow	0	-	0	N/A	1	N/A	6	500%
Tapegrass	2	-	2	0%	1	-50%	2	100%
Naiad	25	-	7	-72%	0	-100%	1	N/A
Riverweed	0	-	0	-	0	-	17	N/A
Aquatic Moss	0	-	0	-	0	-	9	N/A
Maidencane	0	-	0	-	0	-	3	N/A
Variable-leaf Pondweed	0	-	0	-	0	-	2	N/A
Total Surveyed Points	942	-	888	-6%	2497	181%	1860	-26%

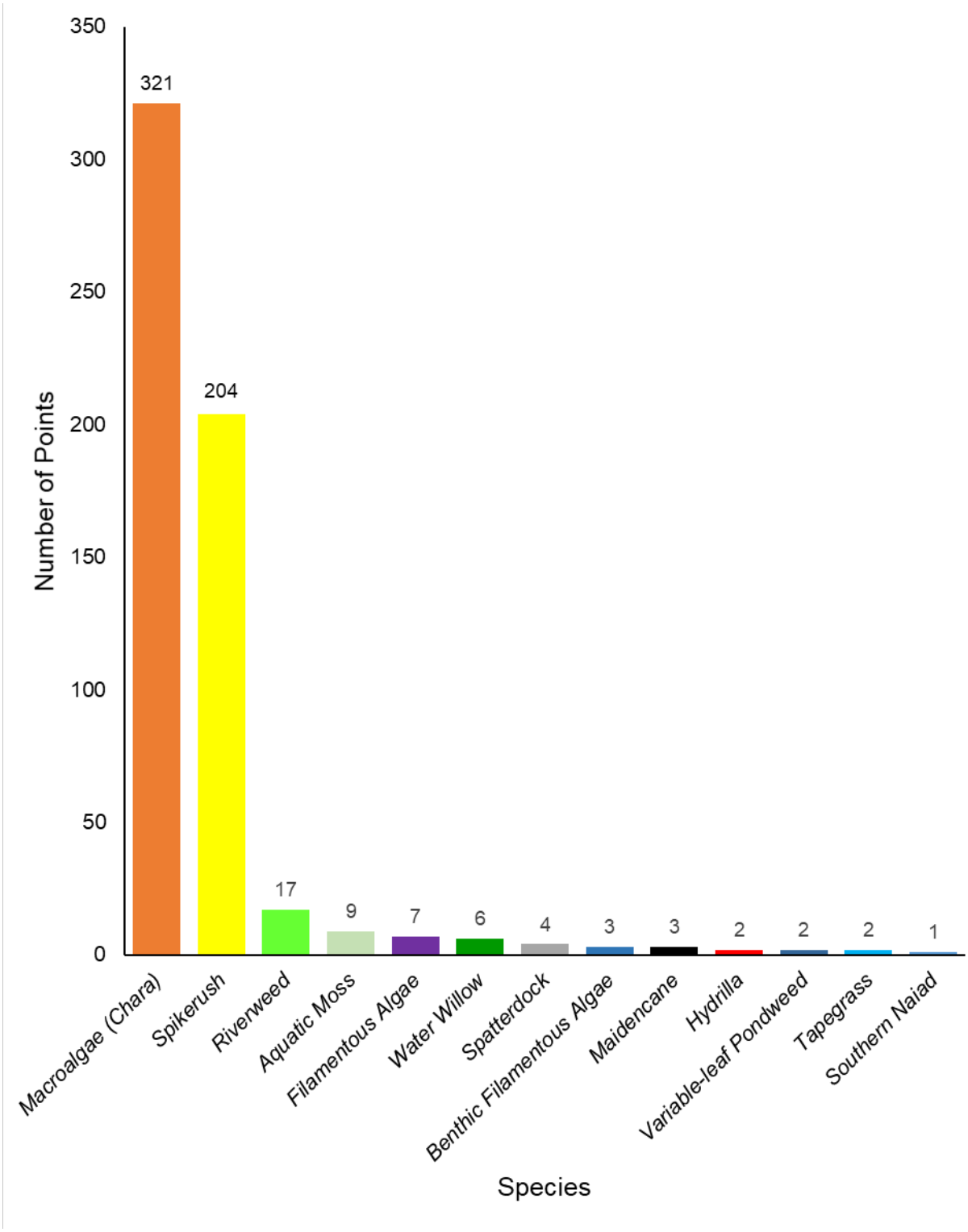


Figure 3: Relative abundance of species recorded during the 2020 survey at Lake Norman

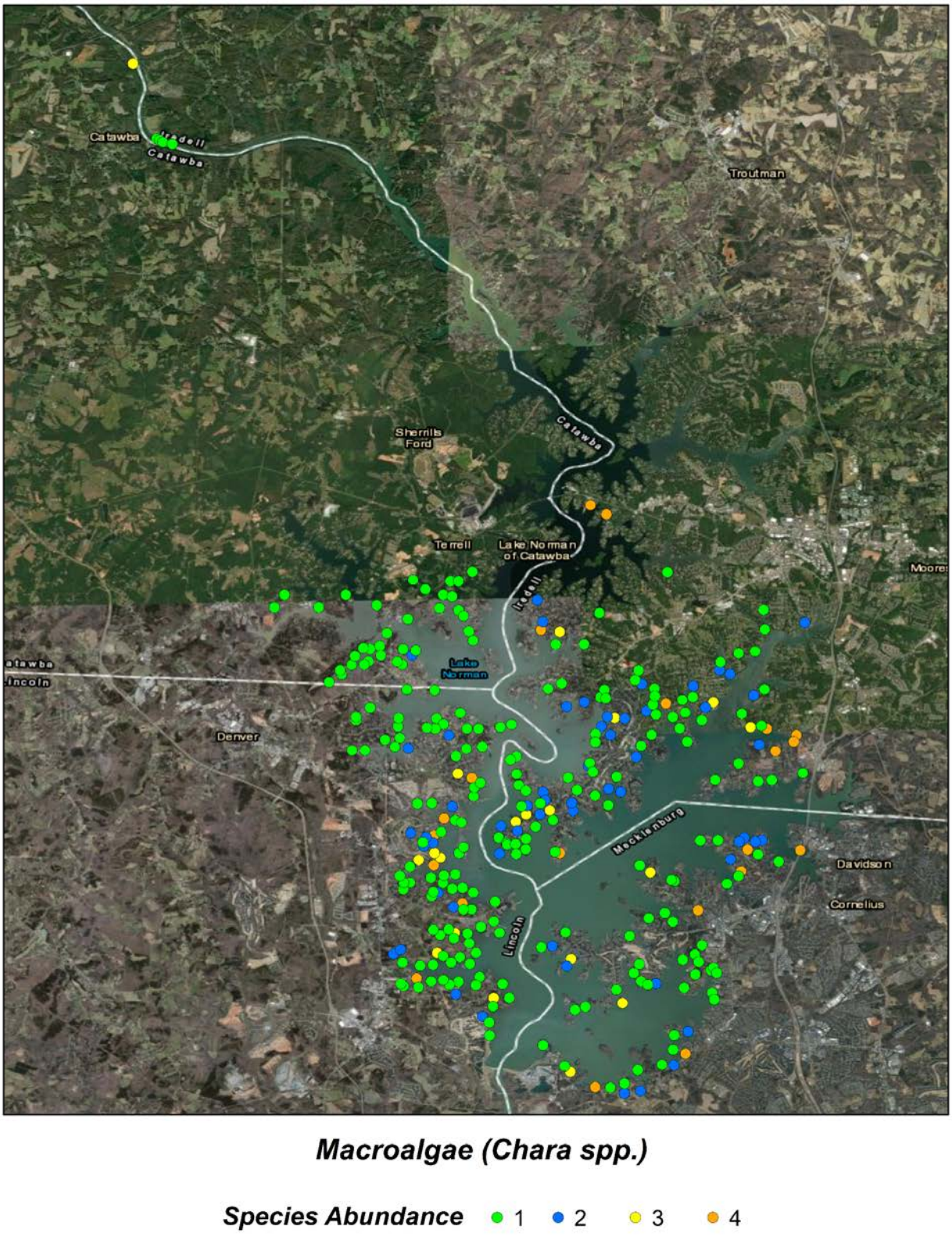


Figure 4: Macroalgae locations and abundance ratings

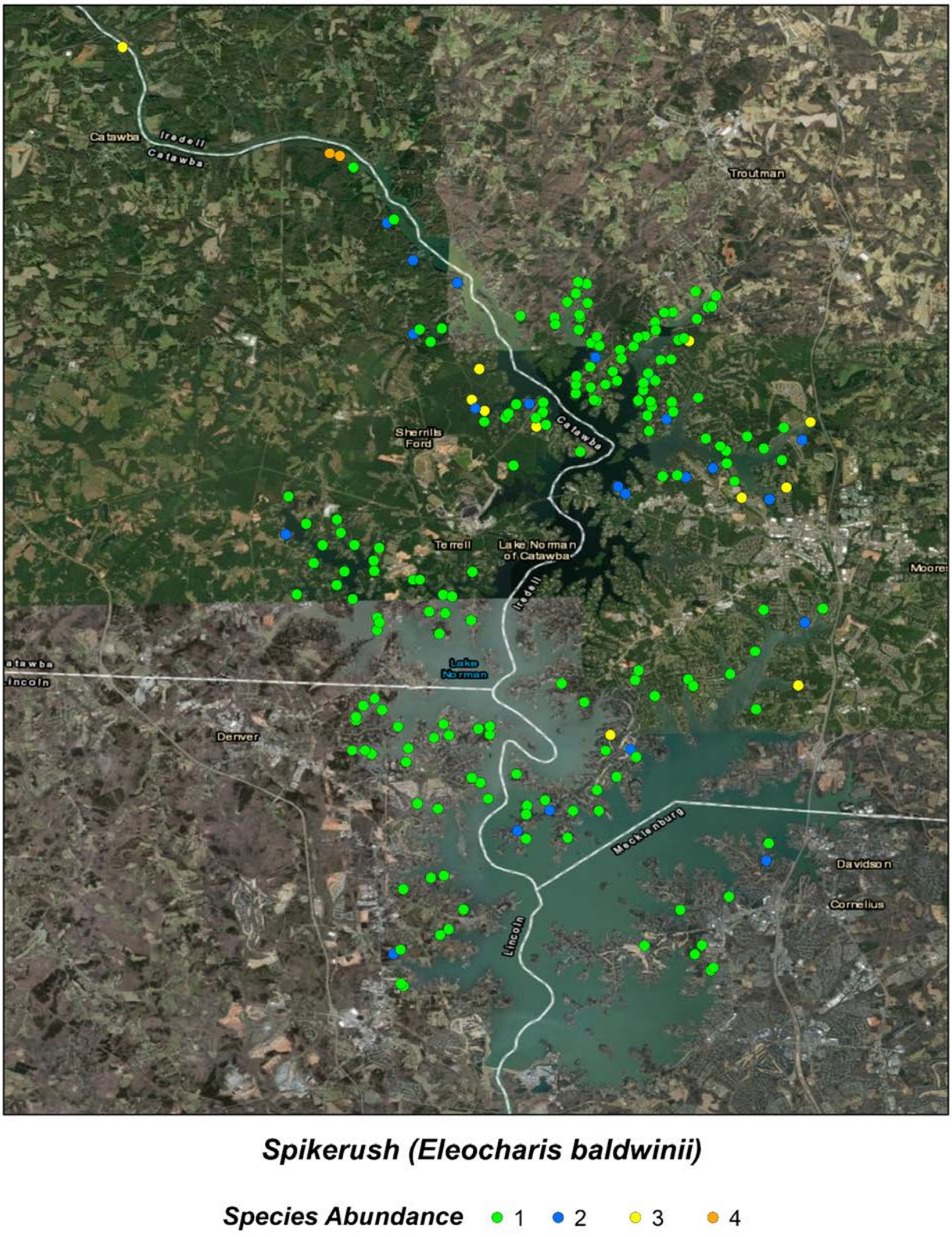


Figure 5: Spikerush locations and abundance ratings

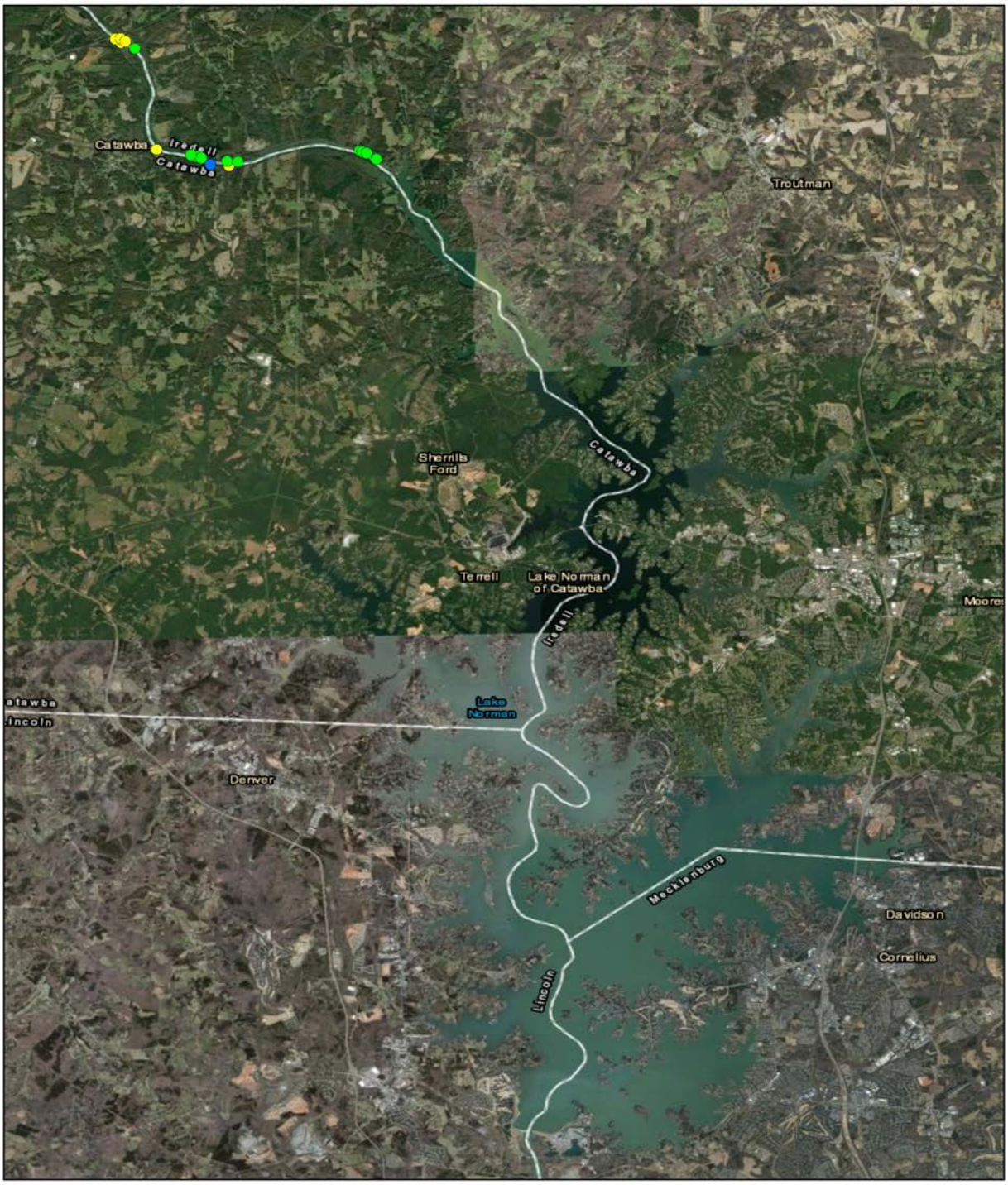


Figure 6: Riverweed locations and abundance ratings

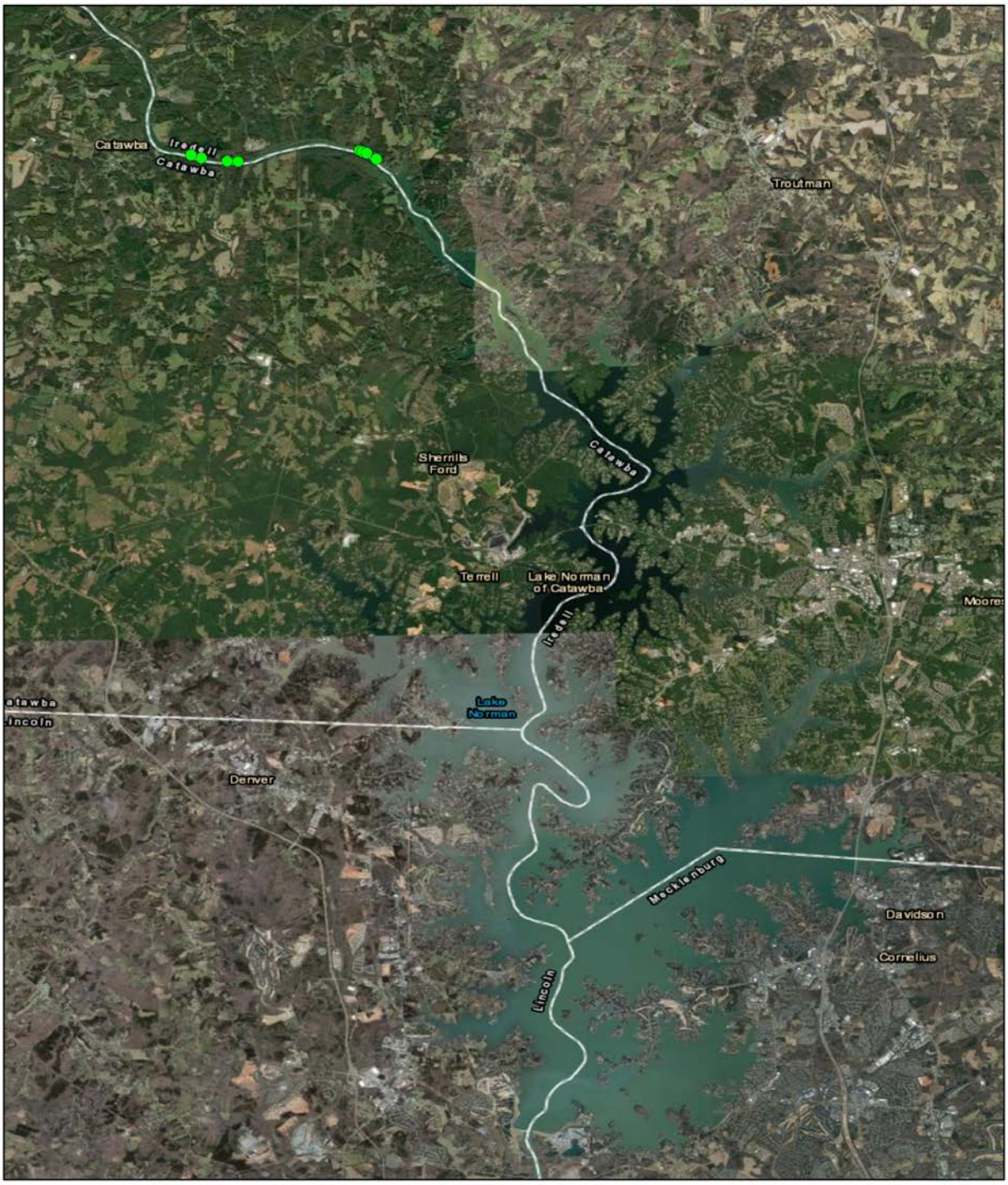


Figure 7: Aquatic moss locations and abundance ratings

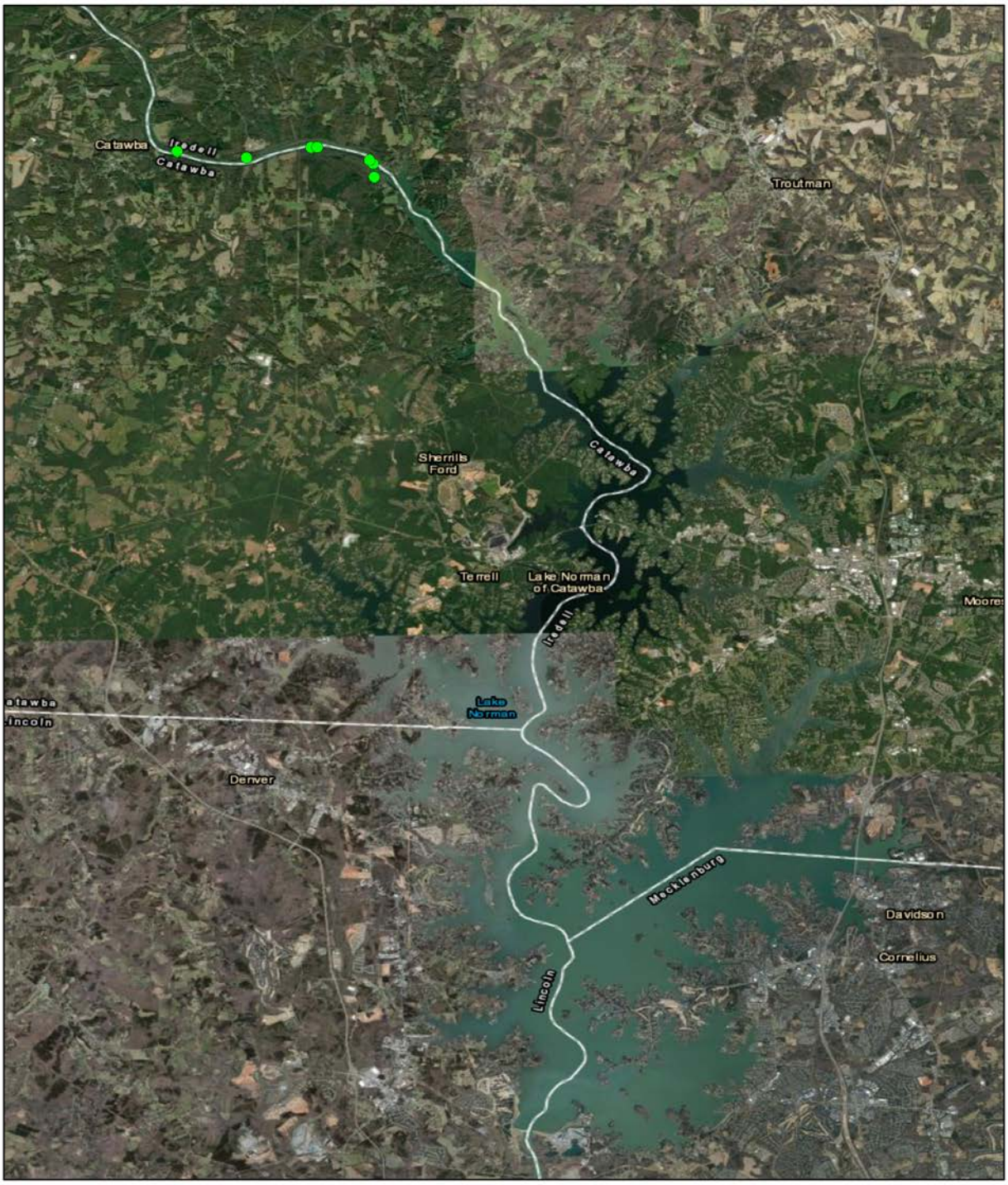


Figure 8: Filamentous algae locations and abundance ratings

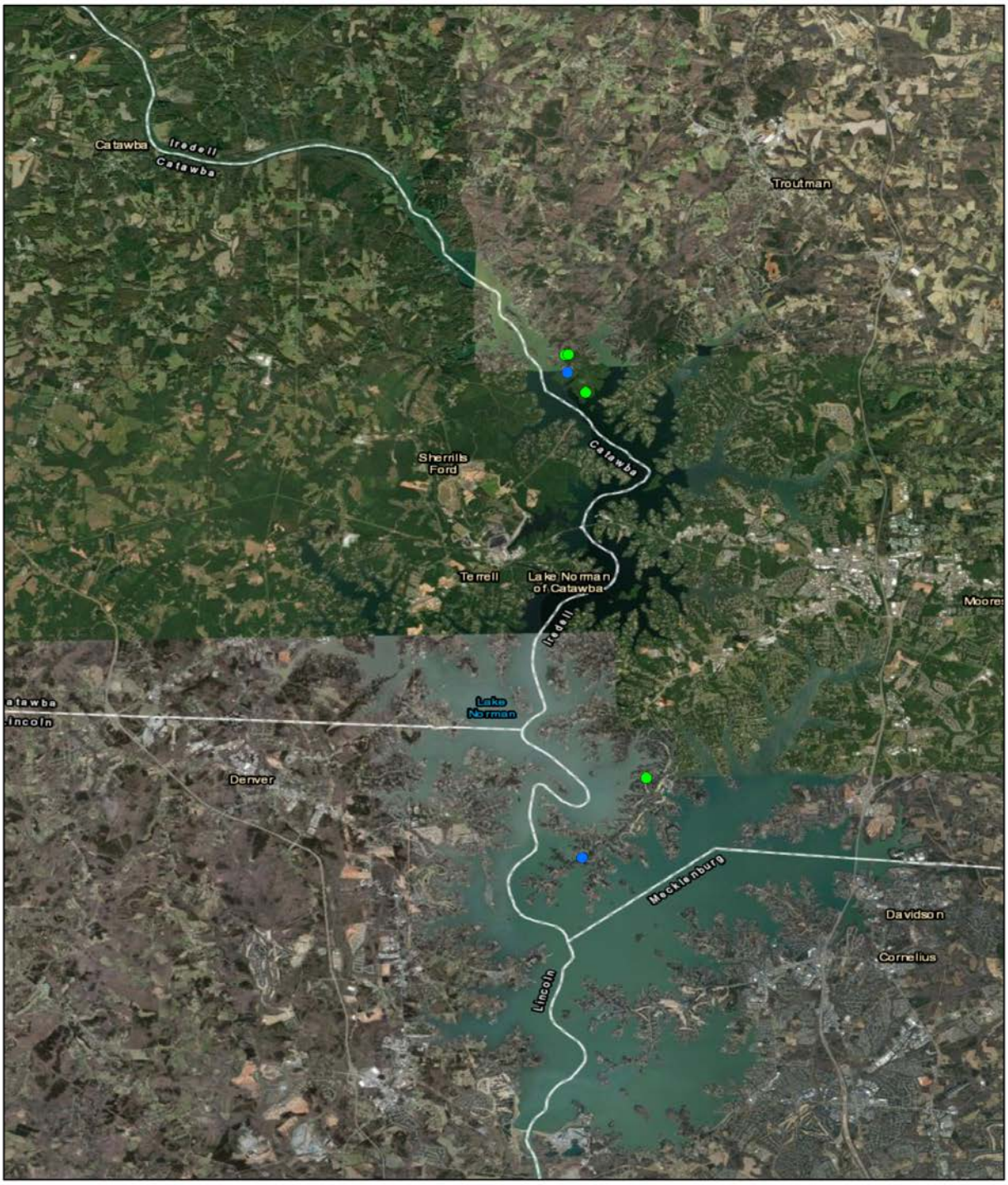


Figure 9: Water willow locations and abundance ratings

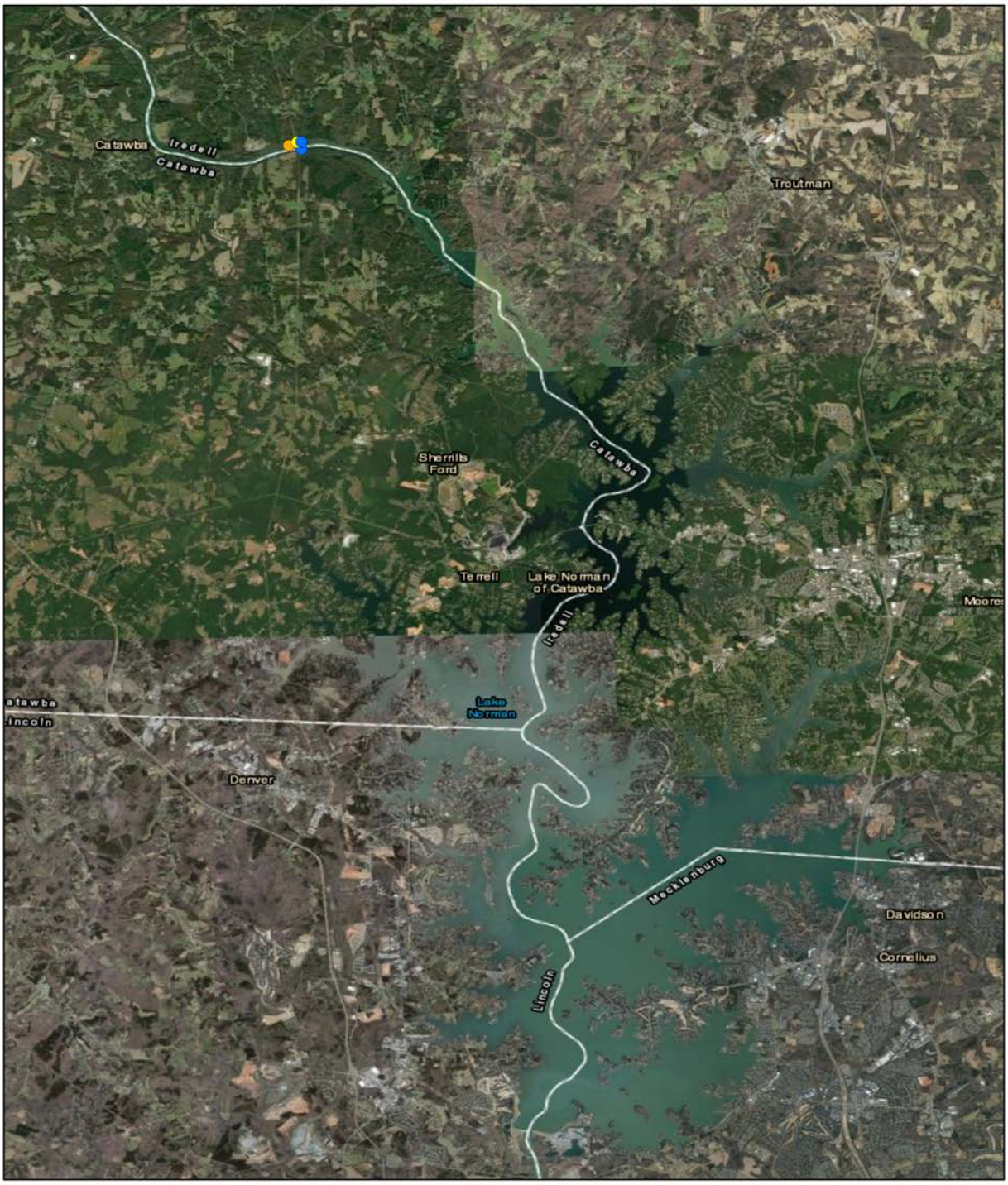


Figure 10: Spatterdock locations and abundance ratings

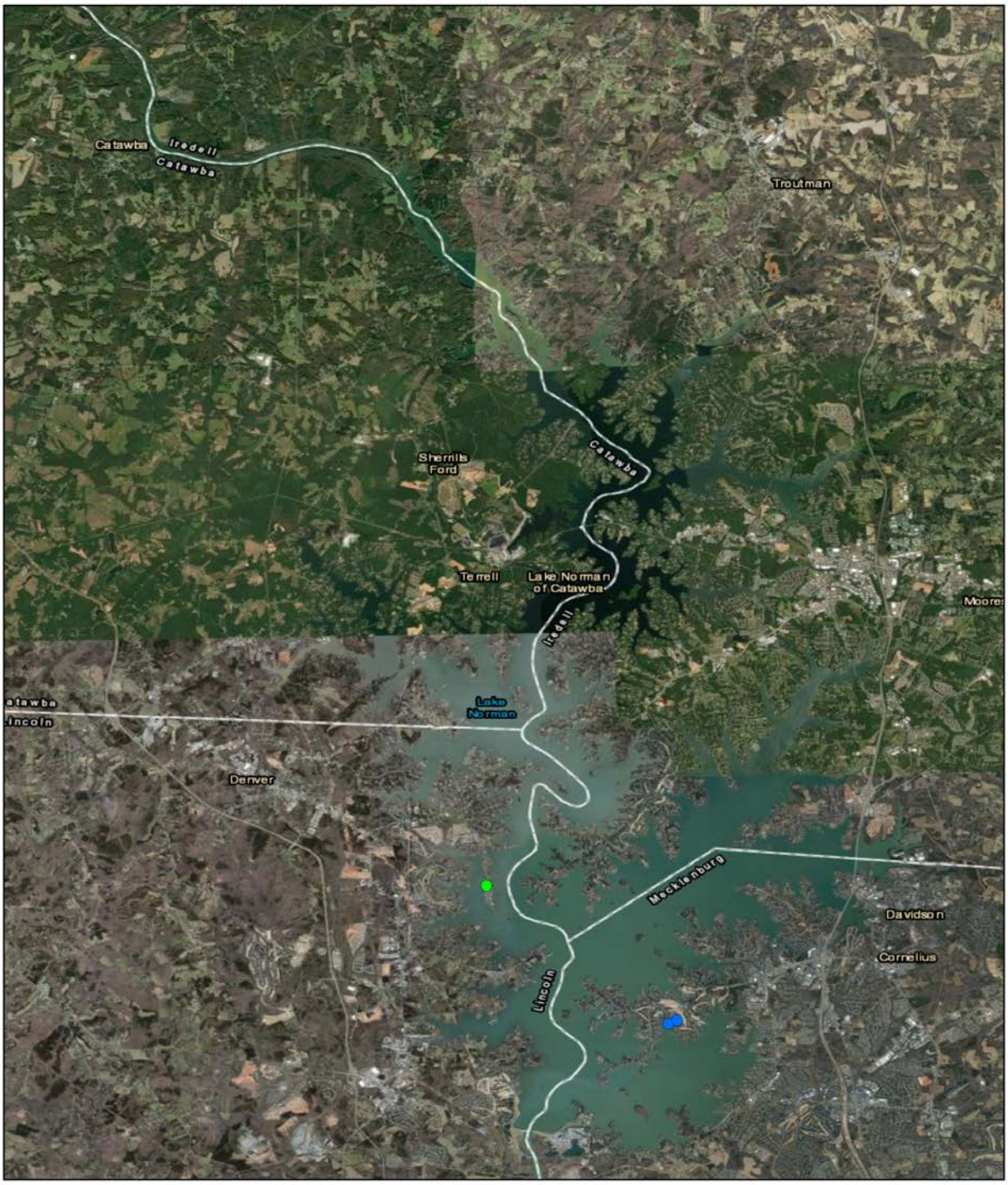


Figure 11: Benthic filamentous algae locations and abundance ratings

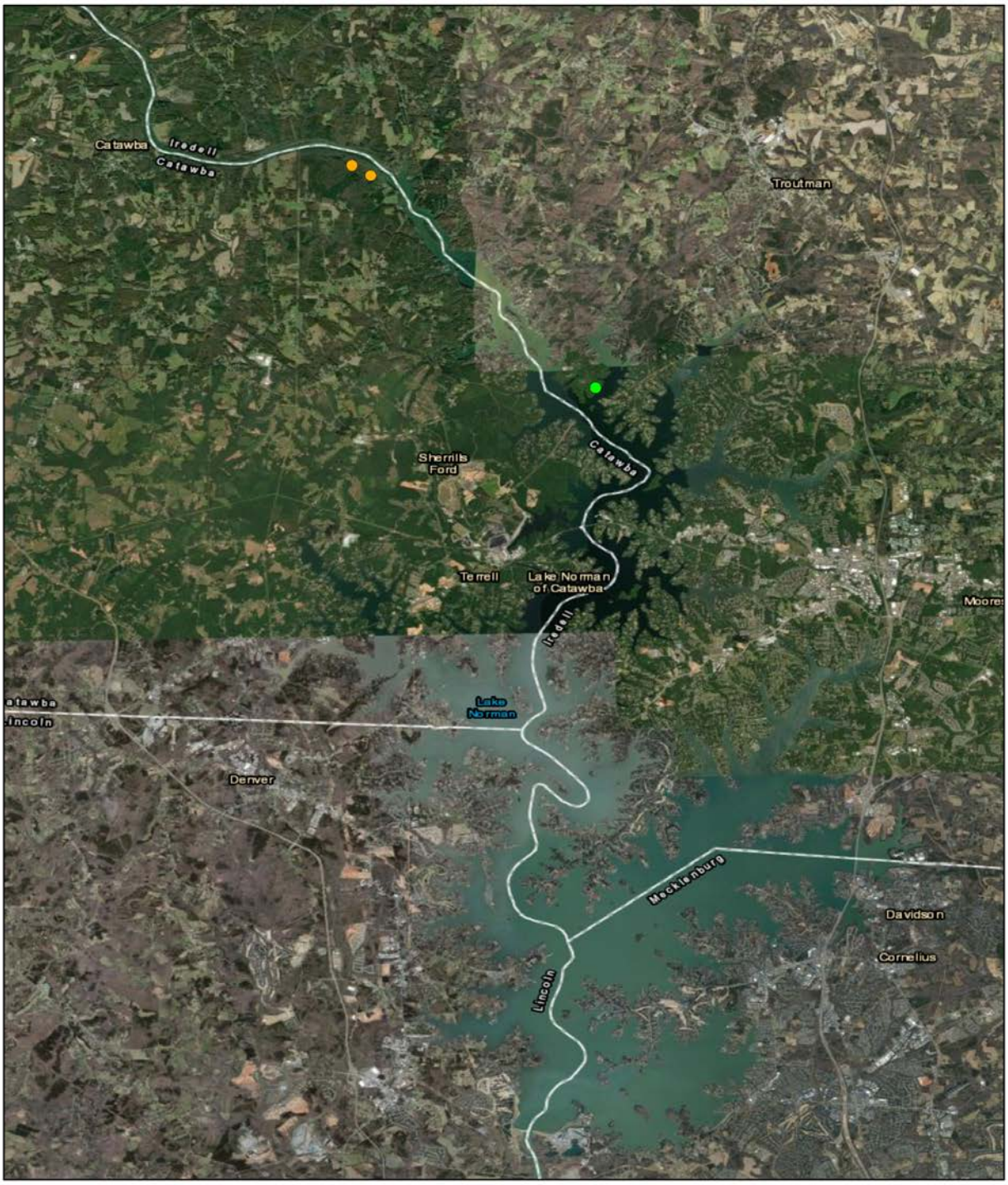


Figure 12: Maidencane locations and abundance ratings

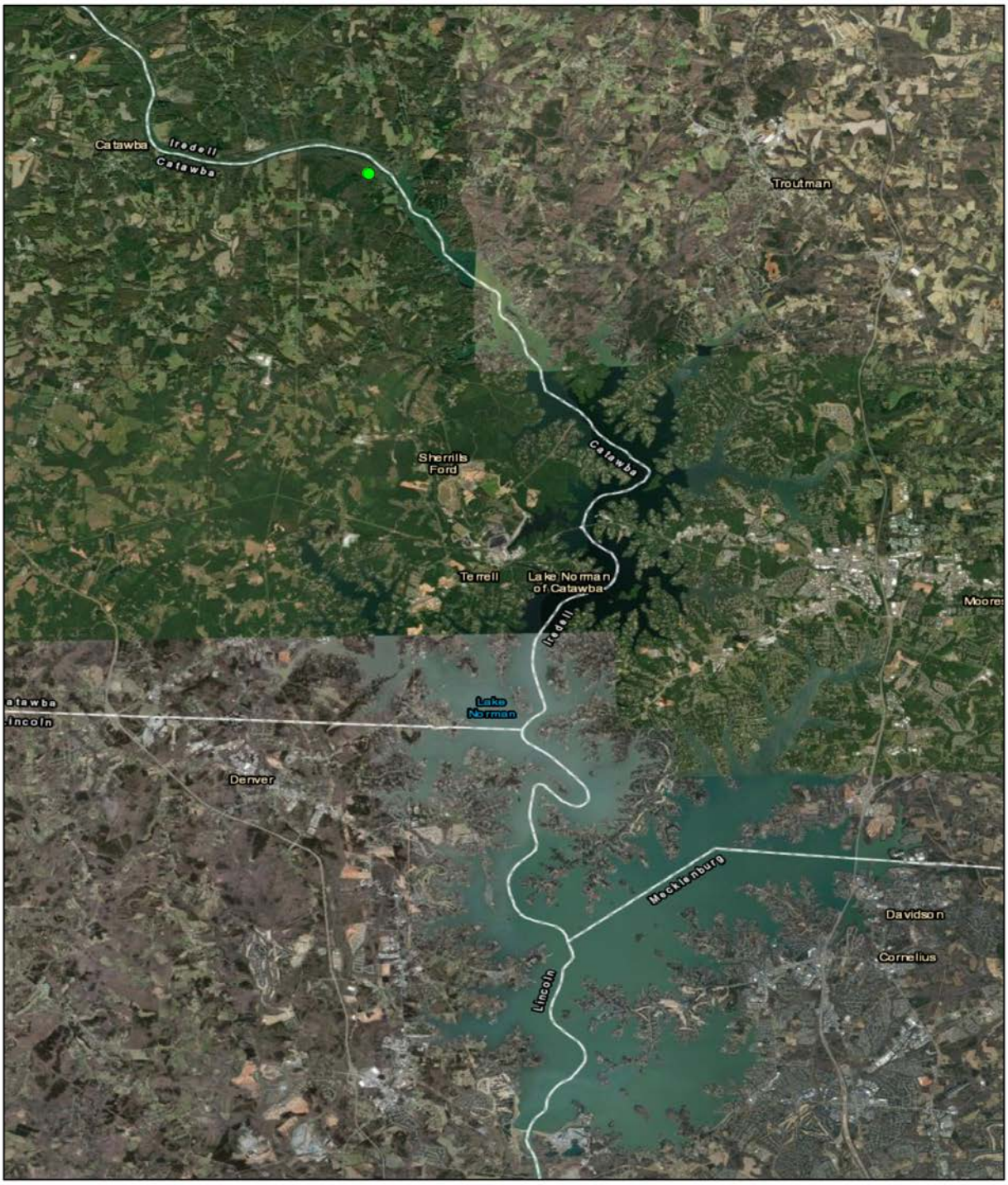
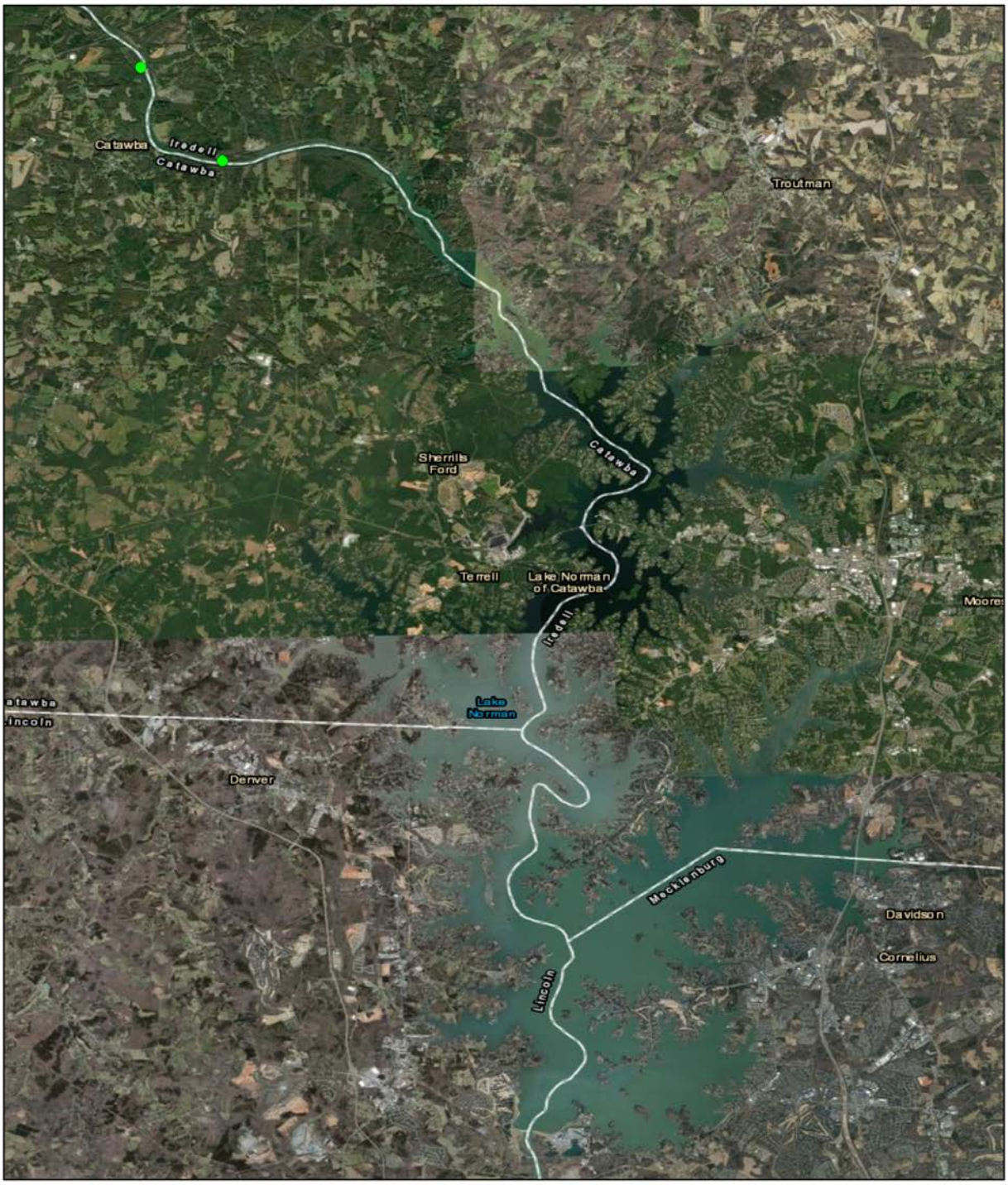


Figure 13: Hydrilla locations and abundance ratings



Variable-leaf Pondweed (Potamogeton diversifolius)

Species Abundance 1 2 3 4

Figure 14: Variable-leaf pondweed locations and abundance ratings

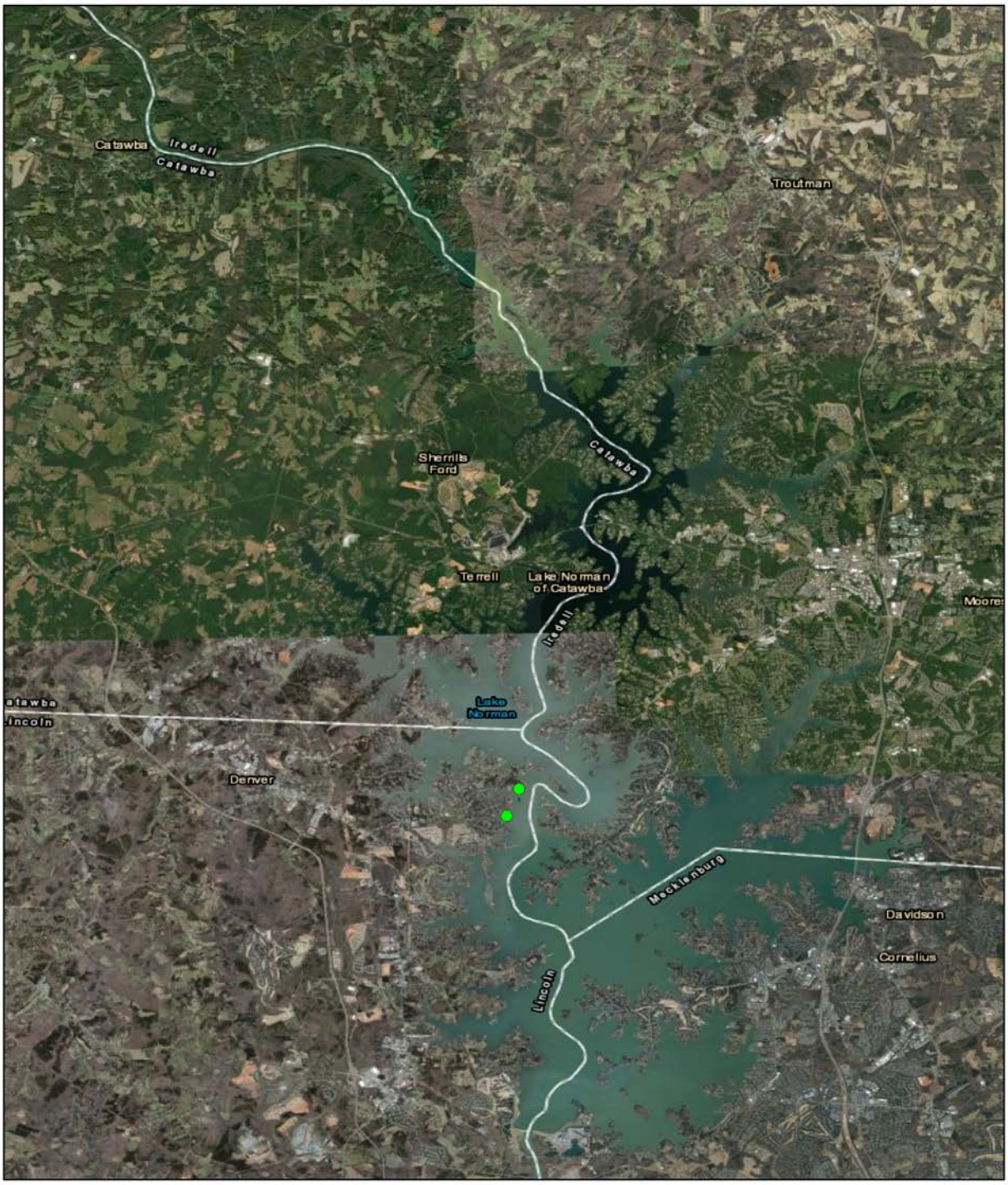


Figure 15: Tapegrass locations and abundance ratings

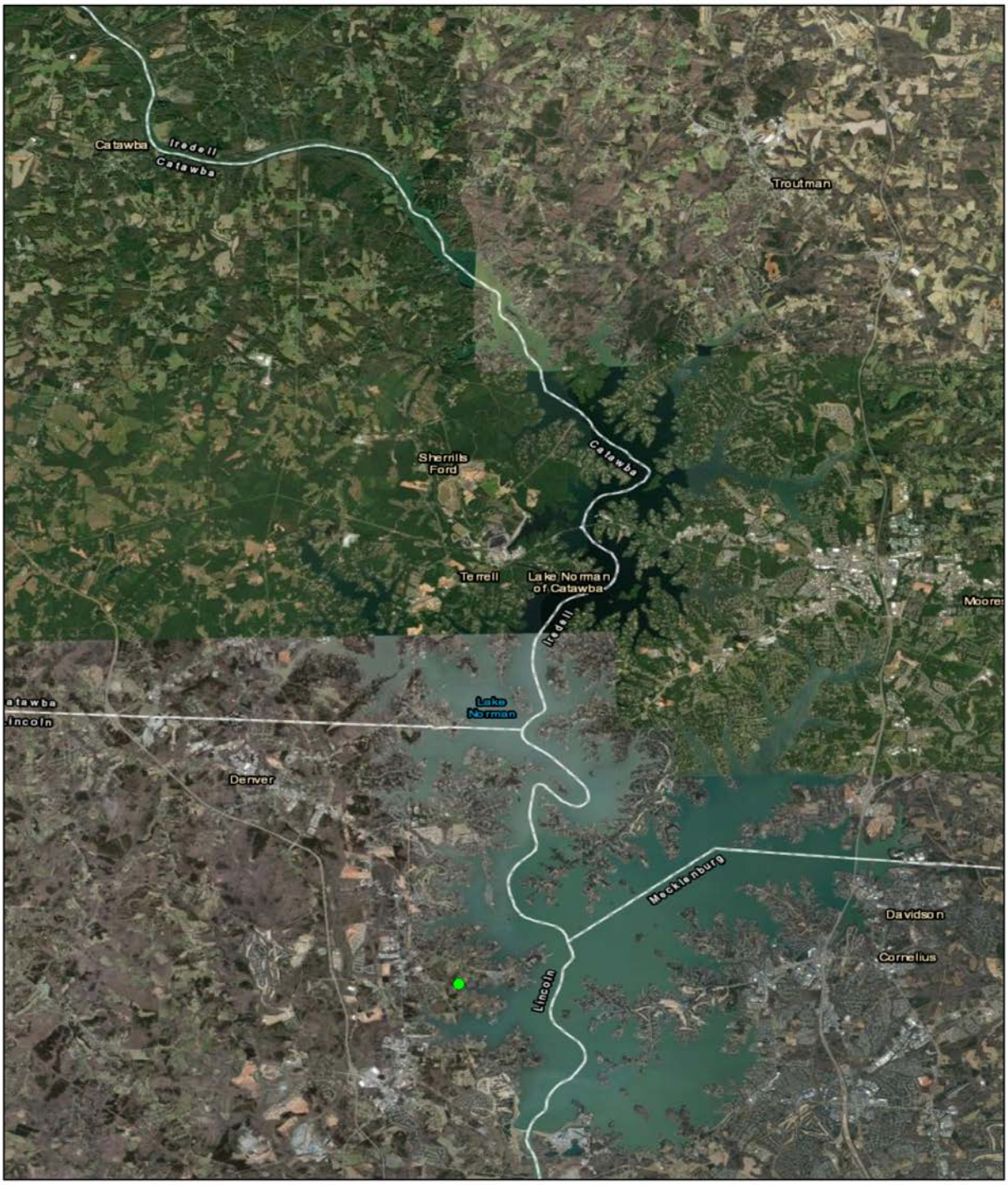


Figure 16: Southern naiad locations and abundance ratings

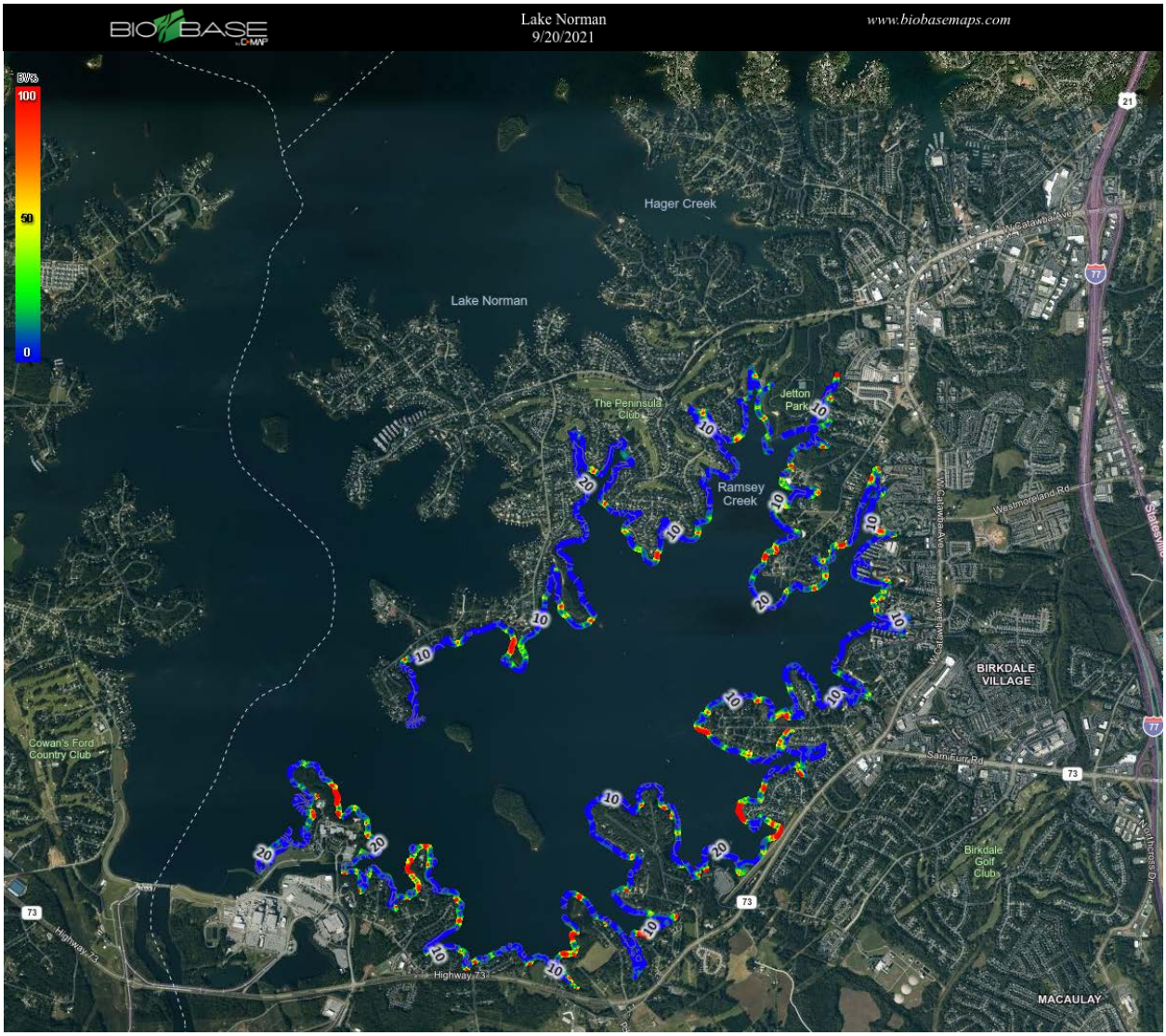


Figure 17: Biovolume data collected along the shoreline of the Ramsey Creek Arm of Lake Norman during the 2021 survey. Note that red (high biovolume) patches were mostly delineated in shallow regions of the shoreline and are likely an artifact of low water levels during the survey time. SAV documented in this region included macroalgae, benthic filamentous algae, and spikerush.