Forecasting In the Shadow of the Cloud

What are possible futures in the footprints of Loudoun County's data centers?

In the world we live in, the life of an industrial building is tied directly to its economic profitability. As the consituent parts of a data center age or reach storage capacity, requiring maintenance, upkeep, and replacement, data centers lose cost efficiency. Accelerating this economic obsolescence is increased data demands and so-called equipment upgrades to server speed and capacity, all of which generally demands more power, burning out the material components within servers and the equipment that keeps them cool enough to function. Within the industry, the economically productive lifespan of a data center is estimated to be somewhere between 10-15 years. The construction of data center buildings reflects that estimation, created to be easy to put up and perhaps just as easy to take down. As we consider the sunset of a data center, we must also consider what rises in its place. What comes next?

Adaptive Reuse or Abandonment?

MALHA - São Cristóvão, Brazil
Adaptive reuse project of a warehouse hangar into a collaborative space for fashion.
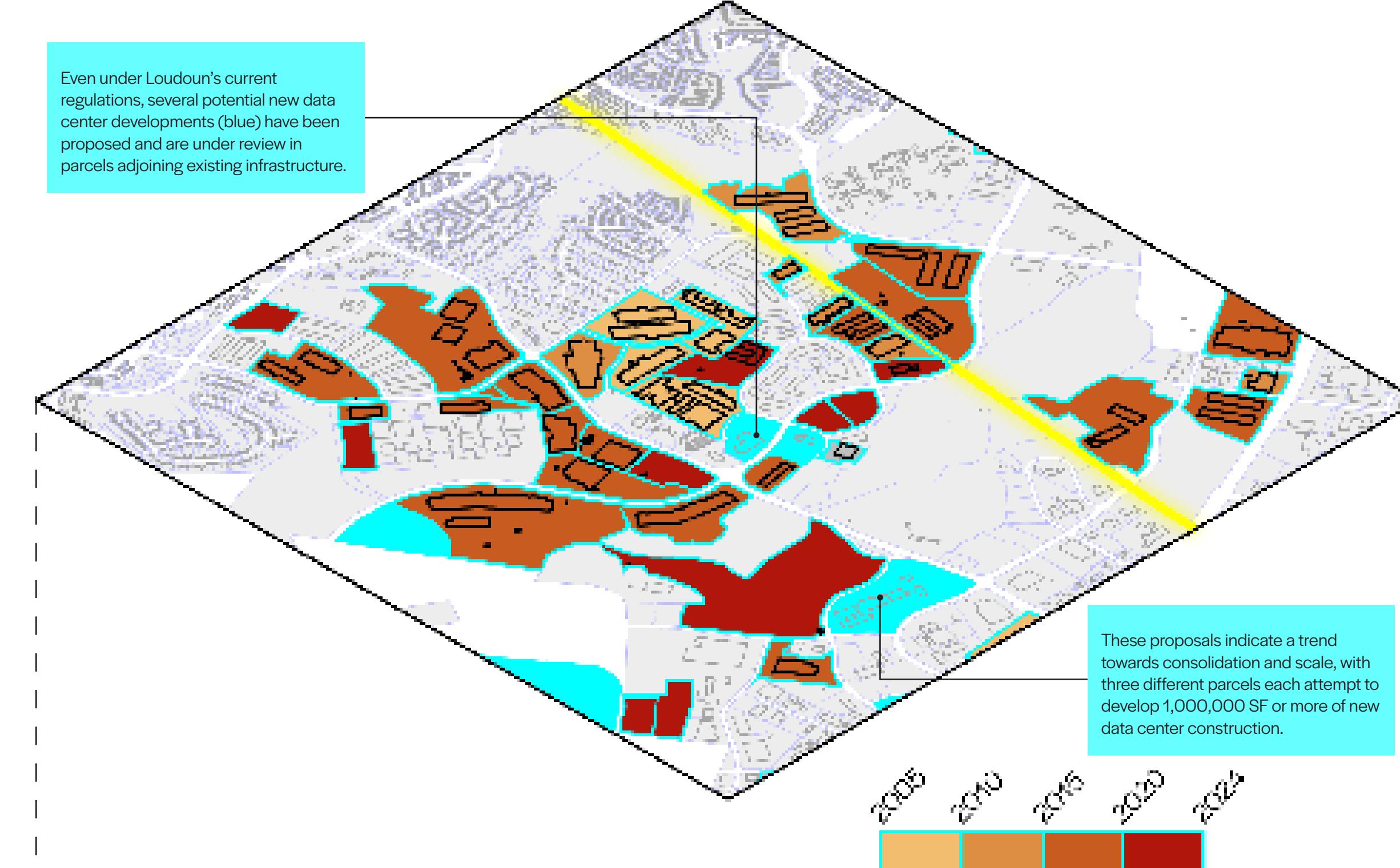
Hicks Lodge - Leichestershire, Great Britain
Adaptive reuse project rehabilitating sites of heavy industry (abandoned mining and open quarry sites) as a national forest

Fisher Body Plant 21- Detroit, MI
A 3.7 million square-foot car plant that has been abandoned since 1993, up to the present day.

One option for the next-life of data center industrial sites is adaptive reuse: planned reconnection of isolated production sites to the communities and environments that surround it. Another option is abandonment, leaving structures to occupy the space without additional intervention. Abandoned structures might be reclaimed illicitly by people and environment, rather than in a planned fashion.

Land Use Past, Future...
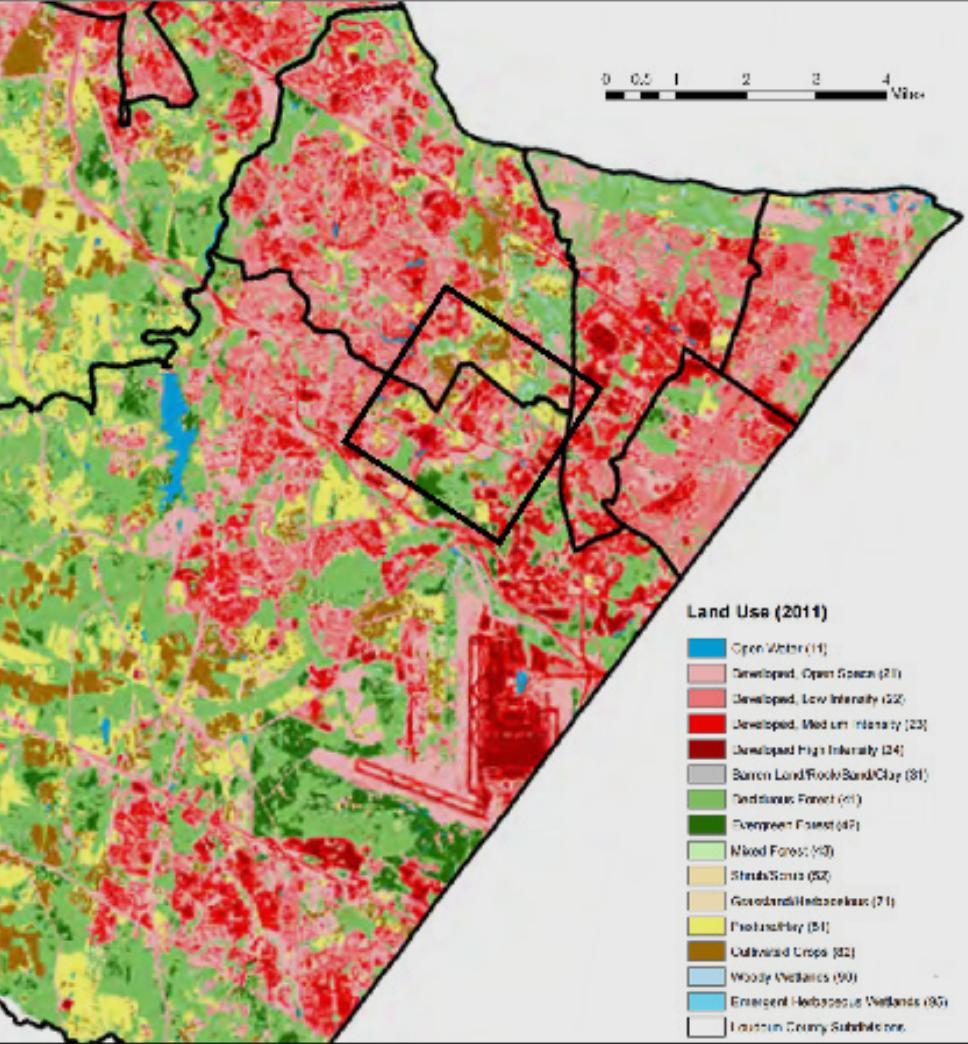
The Land Before Data Centers
In **1992**, the site data centers would eventually occupy contained evergreen forest, mixed forest and pasture. Rural activities consisted of 53.08% of the land use in Loudoun County, while urban land use consisted of only 5.52%.

Dawn of the Data Center Boom
In **2011**, rural activitiesin this area had largely been replaced by low and medium intensity development. Most of this development took the form of light industry-- facilities like data centers.

The Plan Today for Tomorrow
2040 plans for the area introduce "place-type" to envision growth and development. Suburban employment and neighborhoods are envisioned in our site of interest, indicating a shift away from industrial sites, instead towards community character and environmental protection.

...and Present
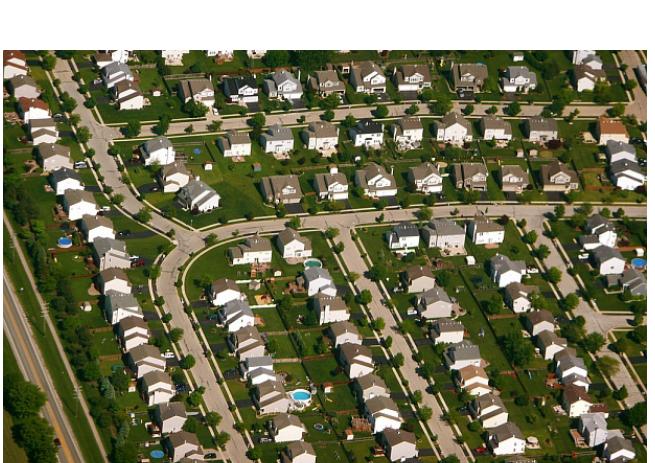
Agricultural
The western portion of Loudoun County is still mostly agricultural land. According to the 2022 USDA Census of Agriculture, there are 53,000 acres of cropland (hay, soybeans, corn for grain), 30,000 acres of pastureland, and 17,000 acres of woodland.

Residential
Brambleton Master-Planned Community
Loudoun County is home to many suburban master-planned communities. As of February 2024, the median home sale price in Loudoun County is $689K.

Planned Development
Most of the planned development in the current Loudoun County Zoning map is residential. A small percentage of planned development parcels are marked for data centers, office parks, and commercial centers.
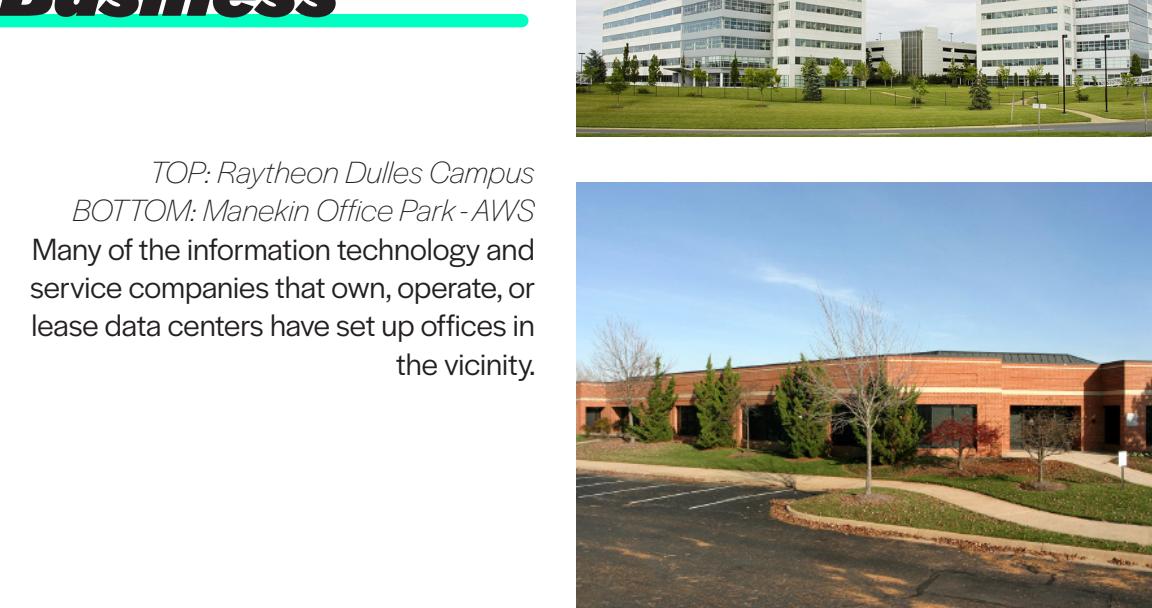
Commercial
TOP: Ashburn Junction Plaza
BOTTOM: One Loudoun
Commercial shopping centers in Loudoun County often take on the strip-mall style common to suburban areas. Other developments like One Loudoun include some mixed-use apartment housing, in addition to massive parking lots and garages to serve suburban visitors.
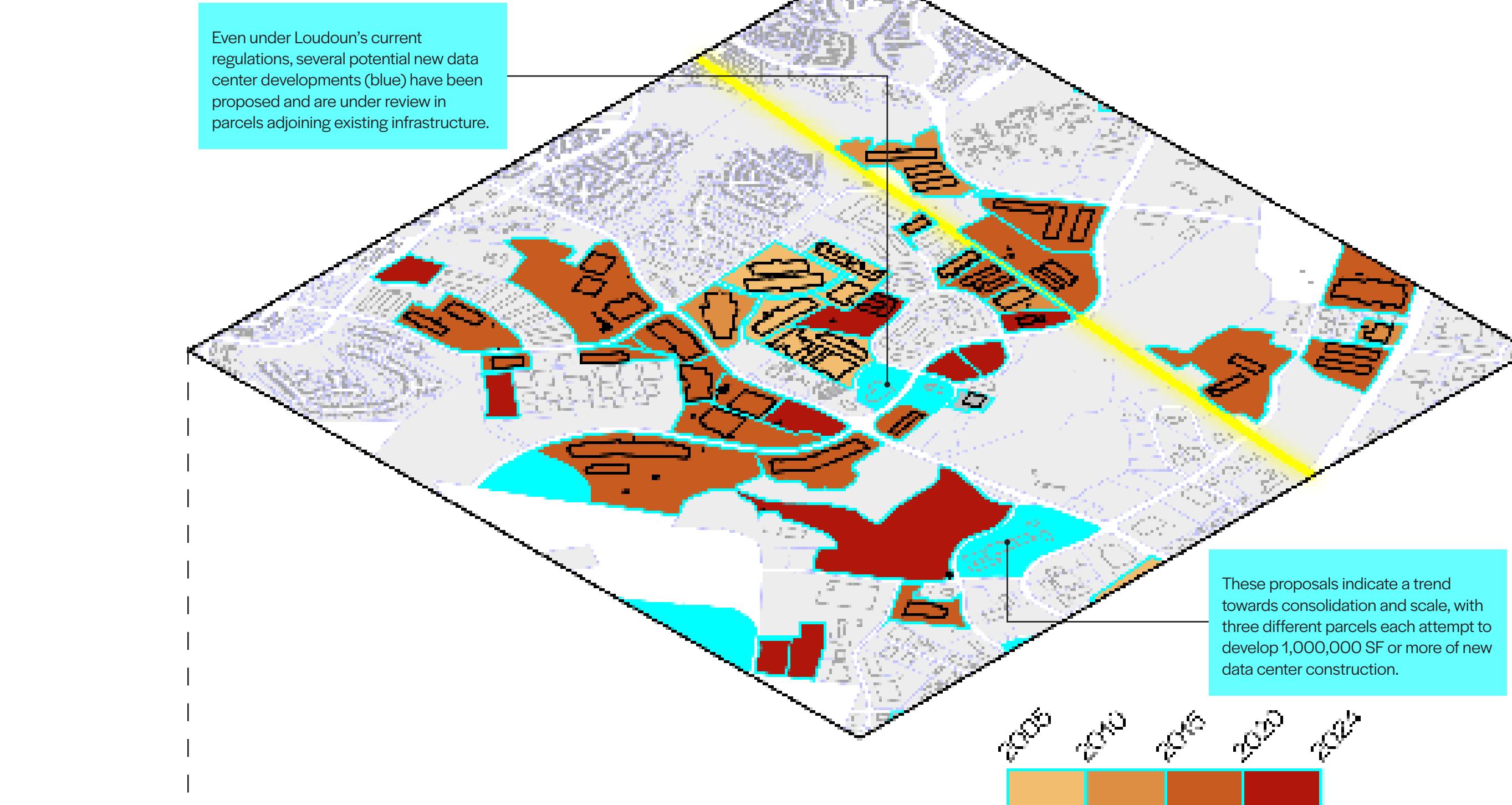
Industrial
Luck Stone Quarries- Leesburg and Goose Creek
Diabase (traprock), used in the construction of Northern Virginia roads and building foundations, is mined here.

Data Center Alley - Ashburn, VA
A major cluster of data centers in Loudoun County. The W&OD trail runs right through it.

Dulles International Airport
One of the major air transportation hubs in the DMV - Northern Virginia area. Located adjacent to the old Loudoun Quarries.
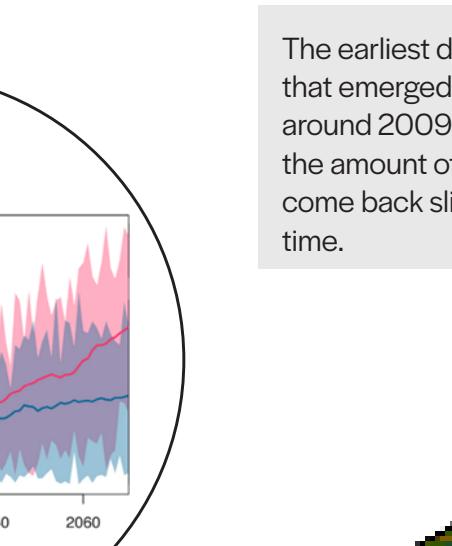
Business
TOP: Raytheon Dulles Campus
BOTTOM: Manekin Office Park - AWS
Many of the information technology and service companies that own, operate, or lease data centers have set up offices in the vicinity.

Build Year
The growth of data center infrastructure in the Ashburn/ Sterling corridor began in 2007 and continued exponentially through the 2020s, which saw Loudoun attempt to slow their development for the first time. The oldest data centers are over 15 years old and have typically changed ownership multiple times.
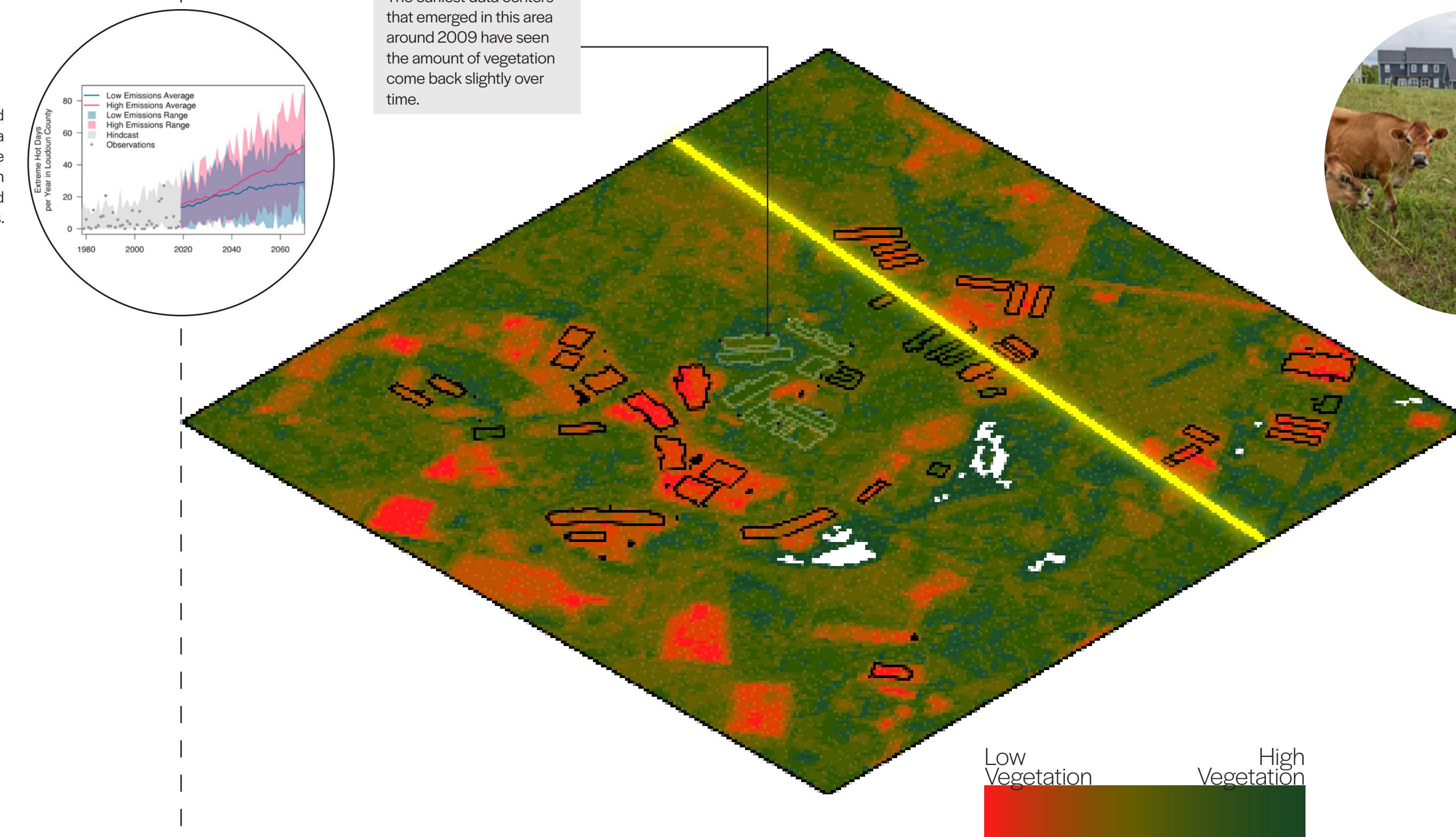
Even under Loudoun's current regulations, several potential new data center developments (blue) have been proposed and are under review in parcels adjoining existing infrastructure.

These proposals indicate a trend towards consolidation and scale, with three different parcels each attempt to develop 1,000,000 SF or more of new data center construction.

2005 2010 2015 2020 2024

NDVI
There is a strong positive correlation between vegetation degradation and the presence of data centers, especially newer ones. Energy demand in Loudoun County has doubled from 2010-2022 and is expected to double again by 2028. At the same time, there are over 4,000 diesel generators in Loudoun County, which also contribute to soil contamination and elevated temperatures.

Within the next 50 years (around 2070), Loudoun County can expect a yearly average of 30 to 52 days above 95°F, with associated increases in cooling costs, reduced air quality, and heat-related illnesses.

The earliest data centers that emerged in this area around 2009 have seen the amount of vegetation come back slightly over time.

Development accounts for the loss of at least 1,120 acres of what is considered prime agricultural soil in Loudoun County during the past two decades.

Low Vegetation — High Vegetation

Transportation Infrastructure
The area around the data centers is highly automobile-oriented, resulting in disconnection between nearby communities and recreation spaces.

The communities that are directly connected to W&OD trail have some pedestrian-friendly infrastructure (benches, wooden platforms). These encourage people using the trail to explore the nearby communities.

Neighborhoods disconnected from the W&OD

Trail crossings with pedestrian priority

Trail Crossings with automobile priority

Many communities are only connected by W&OD trail cuts through these communities as an isolated tunnel. This results in a disconnection between communities and nearby recreational spaces.

W&OD Trail
Low-Traffic Roads
Sidewalks
High-Traffic Roads

Possibilities
Loudoun's attempts to regulate and limit the growth of data centers have encouraged new visions for the area's land use during and after the centers' lifespans, represented here in an amended Future Land Use Map. How might this change the possibilites for adaptation?

Can these older data centers adjacent to the W&OD trail be envisioned as parks or areas to rehabilitate the flora and fauna in the region, as restorative places for local communities?

Many older data centers do not comply with the current land use vision. Sited next to residential nodes, they generate excess noise and cut off pedestrian mobility to nearby open spaces.

Data centers currently located in places zoned as 'suburban mixed-use' might some-day serve well as community centers or commercial mixed use structures, becoming sites of connection in these neighborhoods.

In Suburban Mixed Use areas, new data center developments are expressly prohibited. Developments are expected to provide compact housing and/or neighborhood-servicing commercial uses.

In Suburban Employment areas, manufacturing and commercial uses should provide sufficient open space for recreation and pedestrian mobility, and hide parking away from street.

Suburban Compact Neighborhood
Suburban Neighborhood
Industrial/Mineral Extraction
Suburban Employment
Suburban Mixed Use