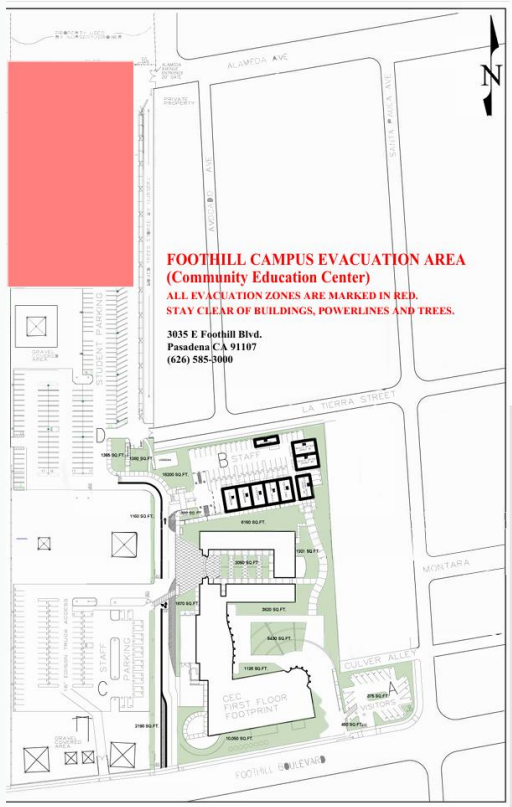
Making Digital Geographic Maps ADA Compliant and Inclusive

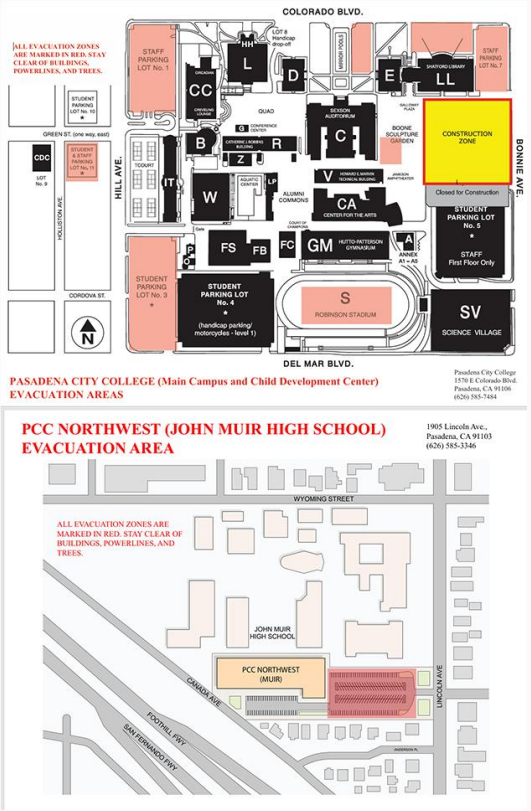
Presenter Contact: brandon.biggs@xrnavigation.io

In partnership with:

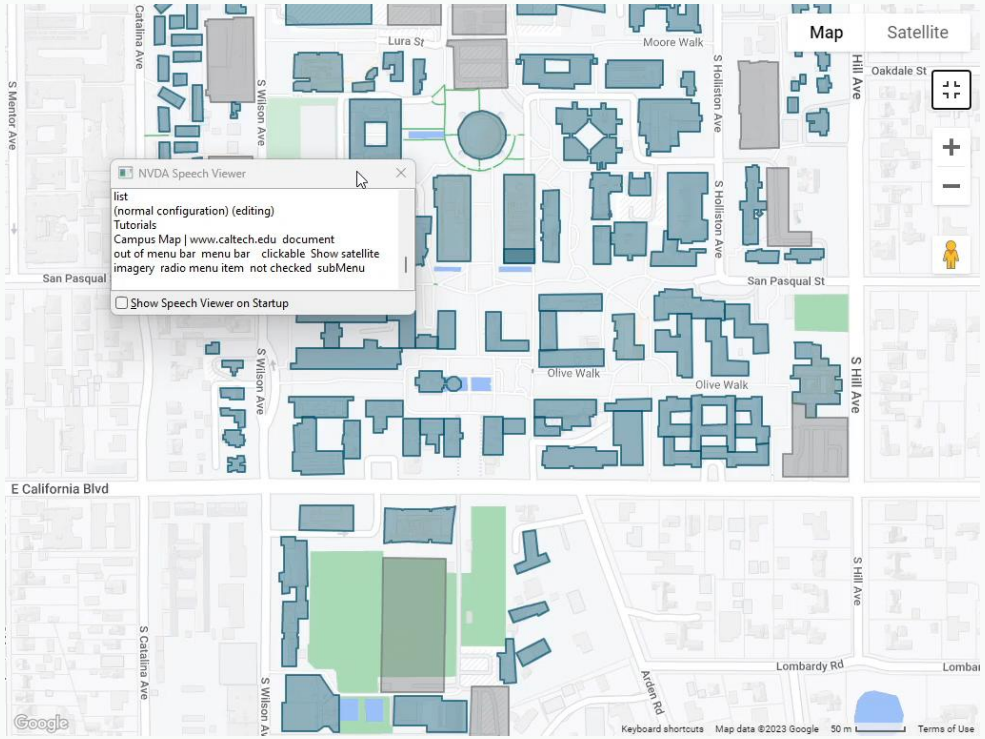
What a sighted person can *see*

Maps Are Inaccessible





What a screen reader will *say*



Maps


WORLD TRAVEL MAP
ARCTIC OCEAN
Arctic Circle
Tropic of Cancer
Tropic of Capricorn
Equator
Antarctic Circle
NORTH ATLANTIC OCEAN
SOUTH ATLANTIC OCEAN
PACIFIC OCEAN
INDIAN OCEAN
Ross Sea
Weddell Sea
Banff National Park
Yellowstone National Park
Golden Gate
Las Vegas
Grand Canyon
Hoover Dam
Niagara Falls
CN Tower
Empire State Building
Brooklyn Bridge
Statue of Liberty
Great Smoky Mountains NP
Aztecs Temple
Chichen Itza Pyramid
Belize Barrier Reef
Lake Atitlan
Panama Canal
Angel Falls
Amazon River
Machu Picchu
Lake Titicaca
Salar de Uyuni
Ulla Ulla National Reserve
Iguazu Falls
Christ the Redeemer
Buenos Aires
Falkland Islands
South Georgia and the South Sandwich Islands
Cape Town
Timbuktu
Alta Museum World Center for Rock
Reynisfjara
Loch Ness
Tower of London
City of Bath
Stonehenge
Eiffel Tower
English Channel Tunnel
Leaning Tower of Pisa
The Colosseum
Pompeii
Salamanca
Alhambra
Ibiza Island
Blue Grotto
Lighthouse of Alexandria
Pyramids of Giza
Suez Canal
The Kremlin and Red Square
Pamukkale
Dead Sea
Old City of Jerusalem
Petra
Dubai
Almaty
Flaming Cliffs
One Hundred Trees Oasis
Zhangye Danxia Landform
Great Wall of China
Golden Temple
Red Fort
Taj Mahal
Khajuraho Temple
Shanghai (World Financial Center)
Ajanta
Ellora Caves
Hampi
Phong Nha-Ke Bang
Angkor Wat
Phang Nga Bay
Ko Phi Phi Island
Kuala Lumpur
Maldives Archipelago
Golden Temple of Dambulla
Serengeti National Park
Mount Kilimanjaro
Lake Malawi
Victoria Falls
Kalahari Desert
Cocos Island
Uluru/Ayers Rock
Great Barrier Reef
Sydney Opera House
The Twelve Apostles
Milford Sound
Places to See
The Great Wall of China
0 1,000 2,000 Miles
0 2,000 Kilometers
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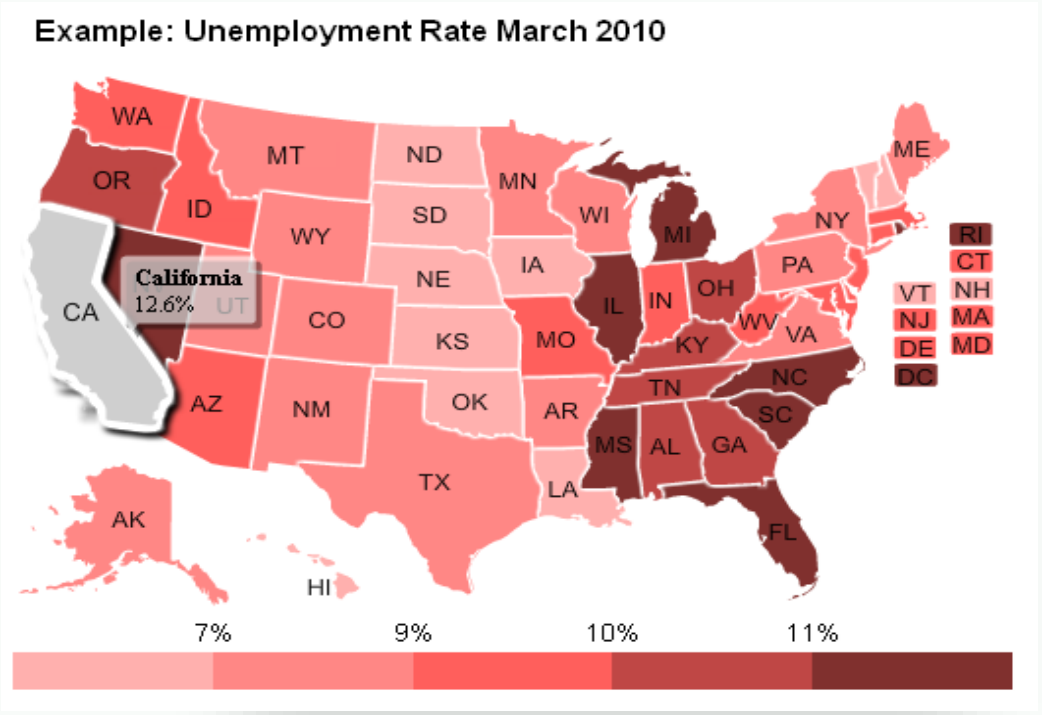
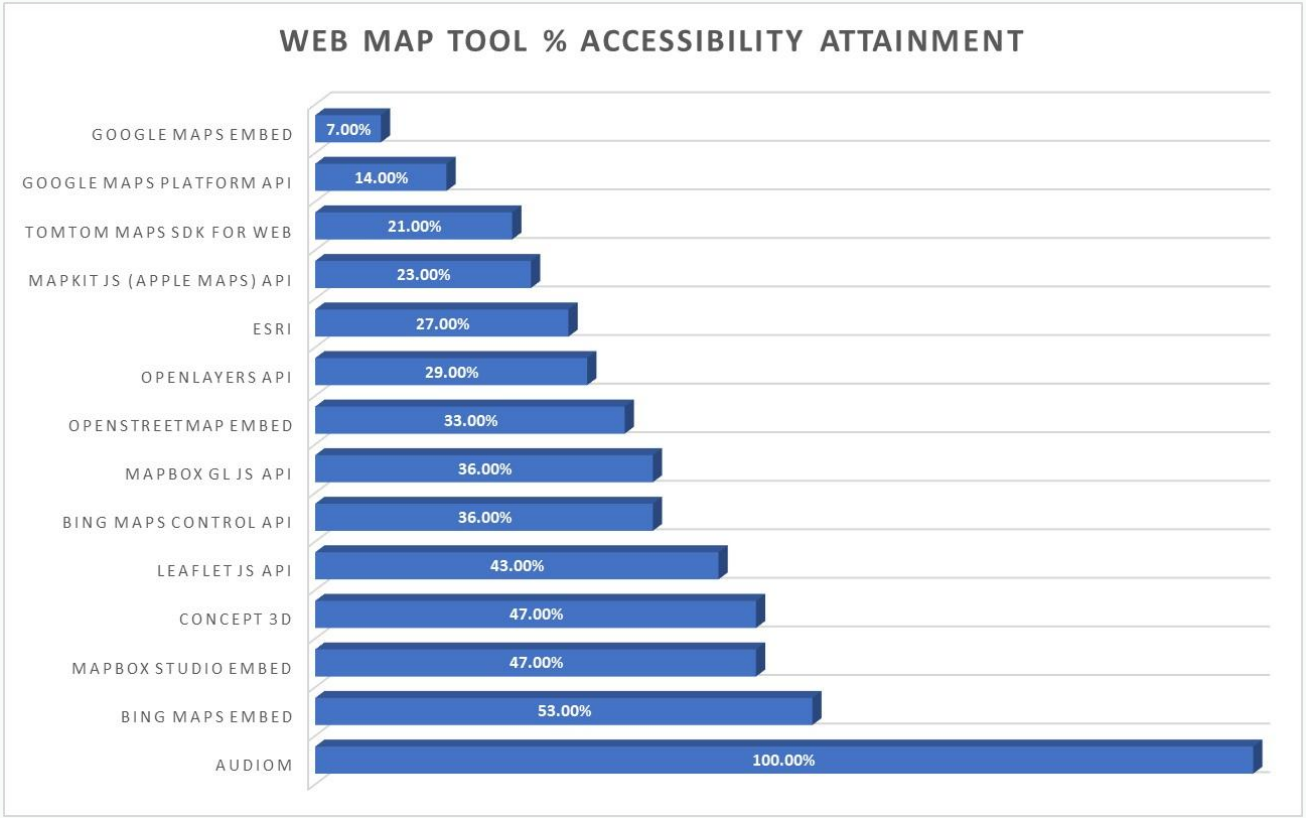

Example: Unemployment Rate March 2010
California
12.6%
WA
OR
CA
ID
NV
MT
WY
UT
AZ
CO
NM
ND
SD
NE
KS
OK
TX
MN
IA
MO
AR
LA
WI
IL
MS
MI
IN
KY
TN
AL
OH
WV
GA
FL
SC
NC
VA
PA
NY
ME
AK
HI
RI
CT
NH
MA
MD
VT
NJ
DE
DC
7%
9%
10%
11%

ADA and the WCAG

- Testable criteria that make sure web content is usable
- Used by the ADA, section 504, and other laws
- Are not perfect, but are the best

Most digital map tools are NOT accessible by default



Biggs, B., Coughlan, J., & Bruce, W. (2025). Systematically Evaluating Digital Map Tools Based on the WCAG. Journal on Technology and Persons with Disabilities, 13.

National Federation of the Blind Calls for Inclusive Digital Maps (Resolution 2024.11)

- All Federal Agencies and higher education institutions need to adopt inclusive digital maps in 3 years.
- Inclusive digital maps mean WCAG compliant
- We use their definition in this presentation

Paper tactile maps are not digital

- Not WCAG compliant
- Static
- No standard
- Simplified
- Need years of braille training
- Need years of tactile graphics training

Contact information is not accessible or compliant

- Not WCAG compliant
- Will not work for professional cartographers

Three Most Complex WCAG Criteria for Maps

- Text alternatives (SC 1.1.1)
- Non-text color contrast (SC 1.4.11)
- Keyboard accessibility (SC 2.1.1)

Non-Text Content (SC 1.1.1)

“All non-text content that is presented to the user has a text alternative that serves the equivalent purpose**”**

Purpose

- Generalized: Are all points, lines, and polygons on the visual map, described in detail?
- Spatial Information: Is the shape, size, and orientation described for each object?
- Spatial Relationships: Is there a way to understand the distance, direction, topological, and relative location between every object?

- Generalized spatial information and relationships

Landmark Knowledge (Includes all features)

- Sensory characteristics
- name
- type
- shape
- orientation
- size
- if applicable: numeric or categorical variables of features
- if applicable: Temporal information

Survey knowledge (Overall understanding of spatial relationships between all objects)

- distance
- Direction
- Absolute location
- Topological information

Route Knowledge (For Defined routes)

- Landmark information
- Survey information
- Prominence

Traditional alternate text loses most spatial knowledge

- Lack most spatial information
- Lack standard
- Long
- Can’t handle thousands of features
- Can’t allow map creation
- Not dynamic
- Turn-by-turn directions
- Nearby address search lists
- Tables
- Simple alternate text descriptions

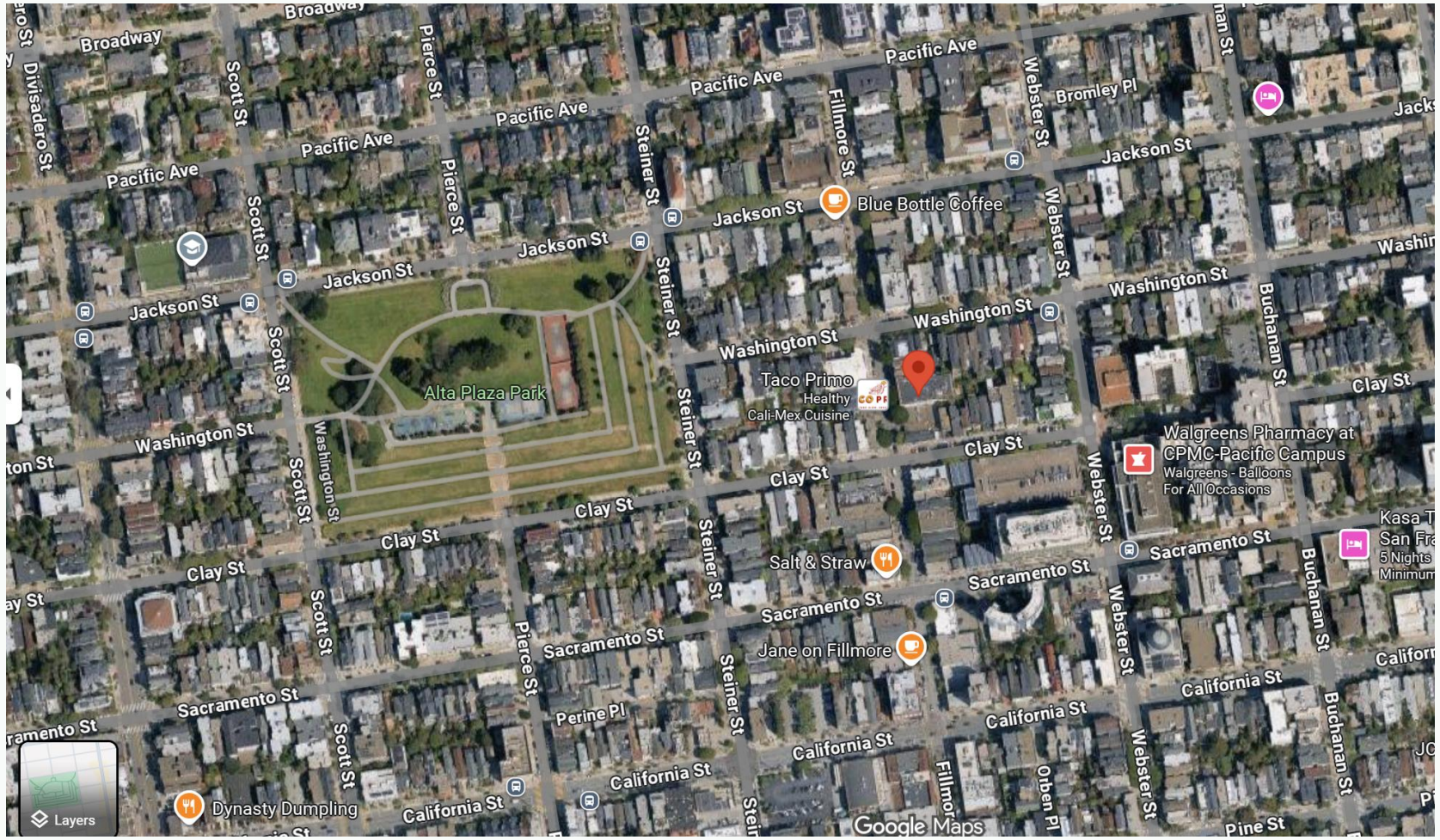
Example 1: map alt-text

Landmark, Route, and Survey Knowledge for all points, polygons, and lines:

- Distance
- Direction
- Orientation
- Shape
- Size
- General layout

A neighborhood in San Francisco centered at 2318 Fillmore St.

Example 1: Visual Map



Example 2: Turn-by-turn directions

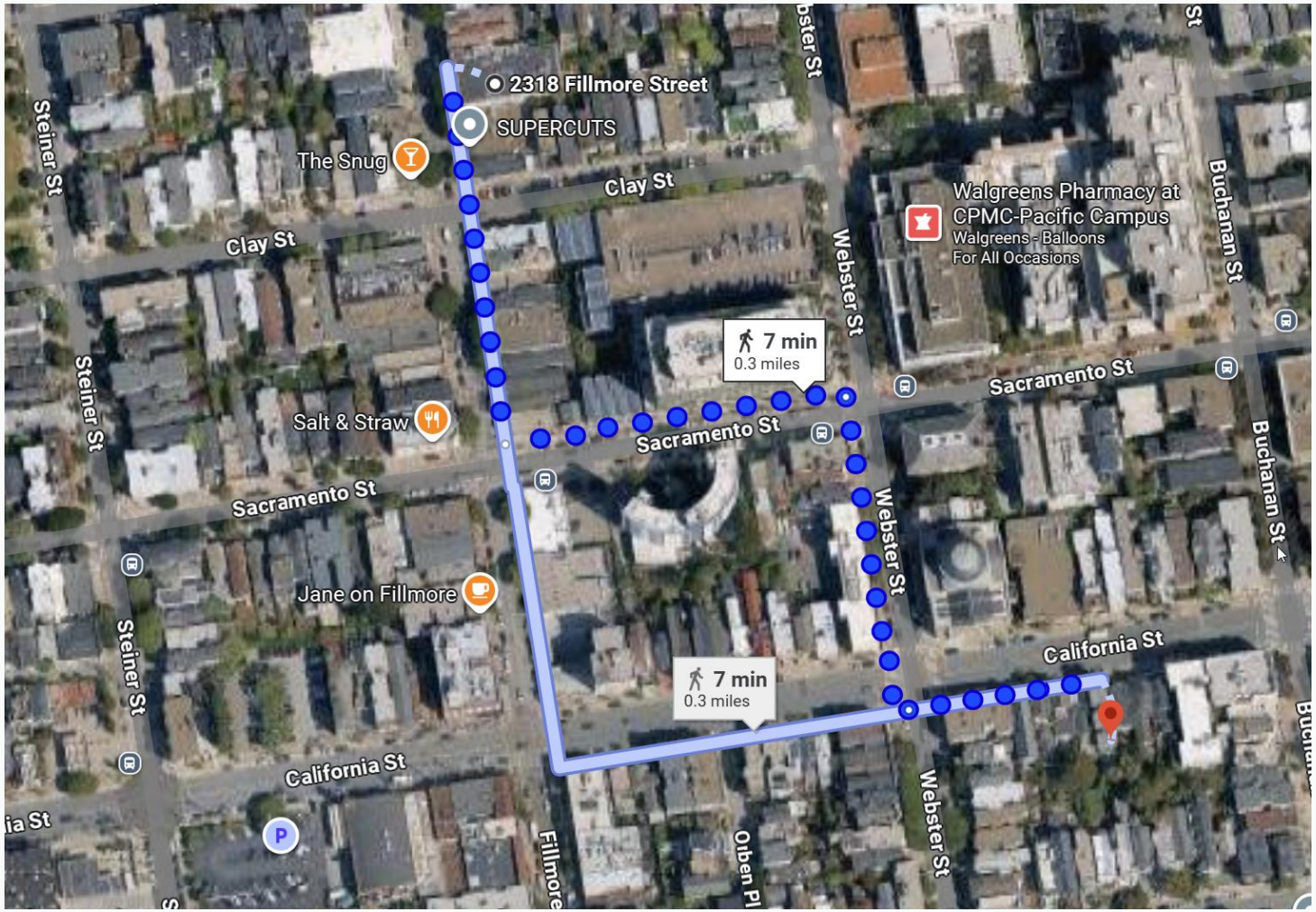
Landmark, Route, and Survey Knowledge for

all points, polygons, and lines:

- Distance
- Direction
- Orientation
- Shape
- Size
- General layout

- Head south on Fillmore St toward Clay St, 180 ft
- Turn left onto Clay St, 125 ft
- Turn right onto Goldberg Ln, take the stairs, 322 ft
- Turn left onto Sacramento St, 351 ft
- Turn right onto Webster St, 341 ft
- Turn left onto California St, Destination will be on the right, 233 ft

Example 2 Visual Map



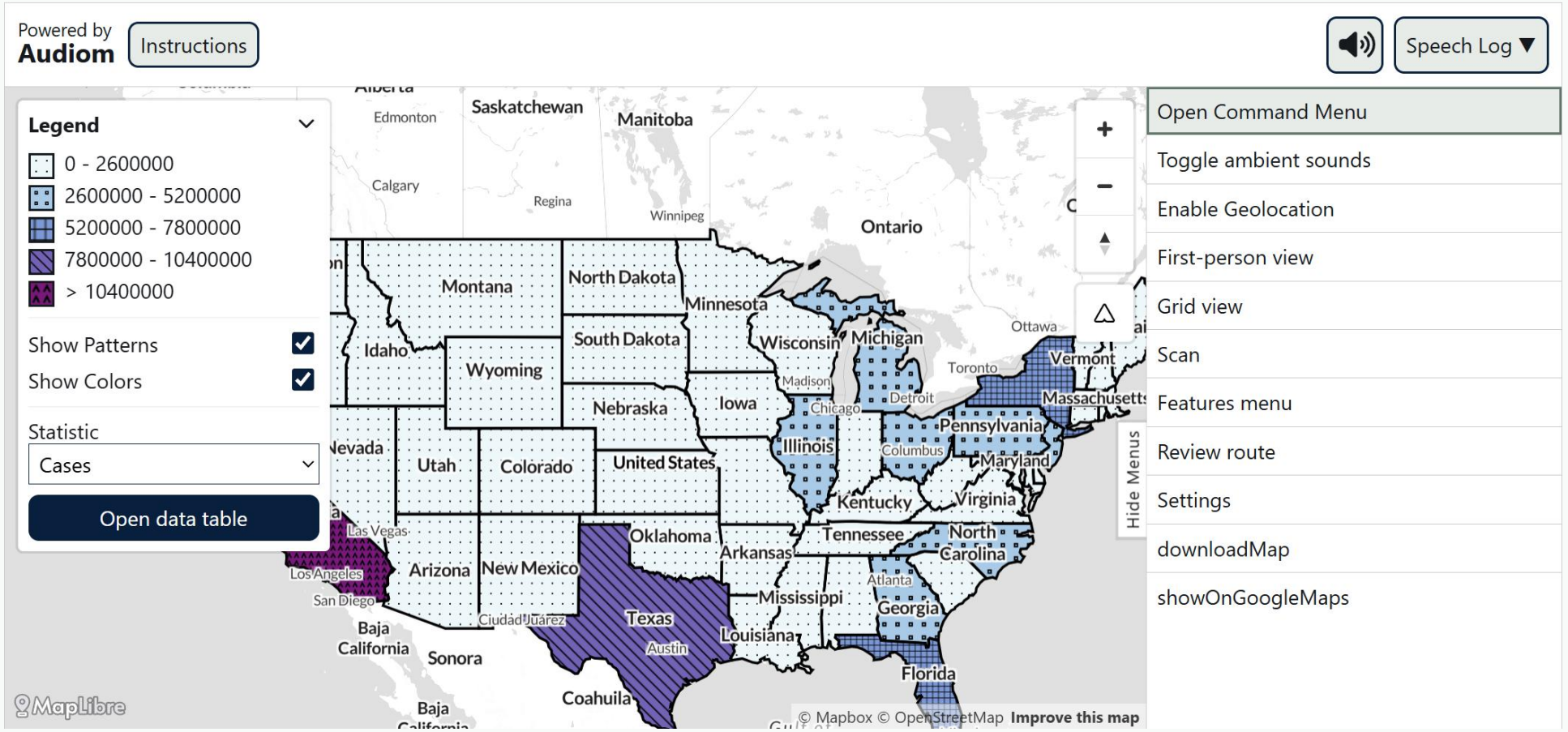
Example 3: Table

Landmark, Route, and Survey Knowledge for all points, polygons, and lines:

- Distance
- Direction
- Orientation
- Shape
- Size
- General layout

Name	Total Cases
Washington	1975382
Minnesota	1817565
Oregon	974924
Nevada	904558
Idaho	525825
Wyoming	187858
Virginia	2315784
Massachusetts	2257300
Utah	1101767

Example 3 visual map



Types of Equivalent Digital Maps

- Detailed text descriptions (Audio descriptions)
- Interactive alt-text

Detailed Text Descriptions

- Start with a map summary
- Have clear headings and table of contents
- Landmark section describes all map features independently
- Route section describes important routes
- Survey section describes overall layout in reference to a major landmark (e.g., entrance)

- Example and more detailed instructions at:

https://xrnavigation.io/how-to-make-detailed-map-text-descriptions/

Pros and Cons of Detailed Text Descriptions

Cons:

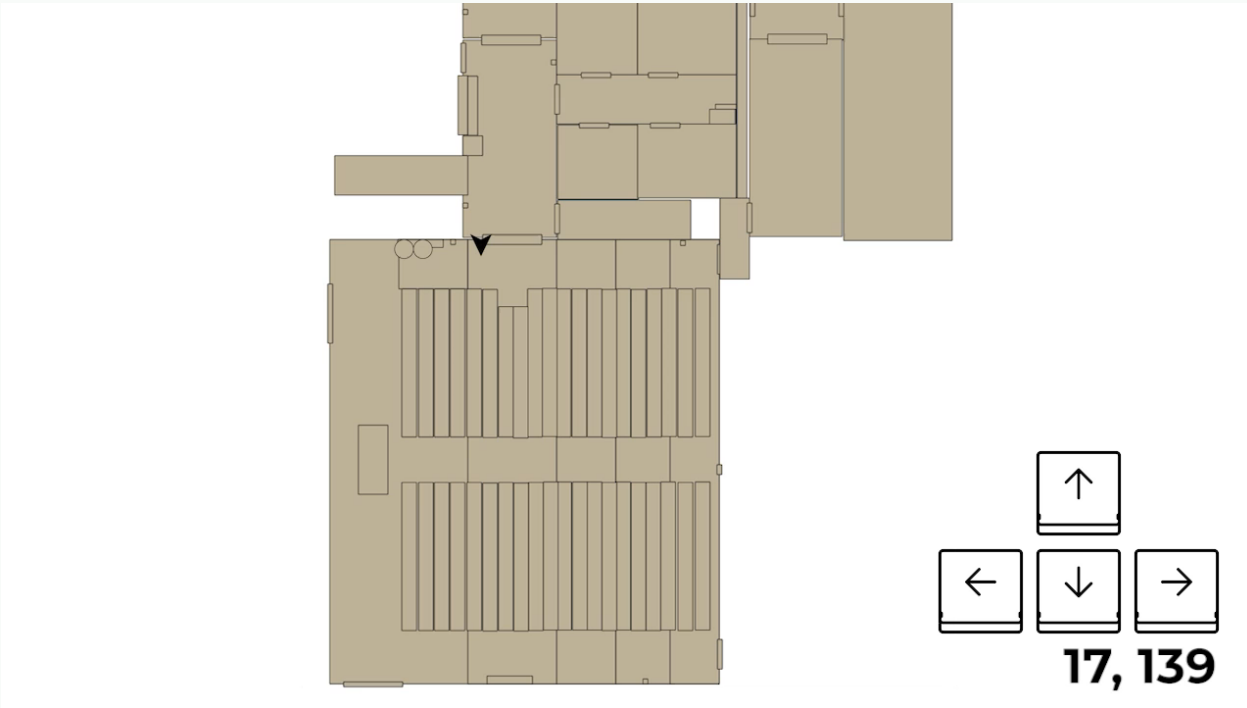
- Take significant time and money
- Are only static
- Difficult to index
- Are separate but equal
- Need to be easy to read
- Hard to provide the same resolution as a visual map
- Difficult and costly to maintain
- Not inclusive
- Difficult to find

Pros:

- Least technical option
- Viewable on any device
- Simple concept

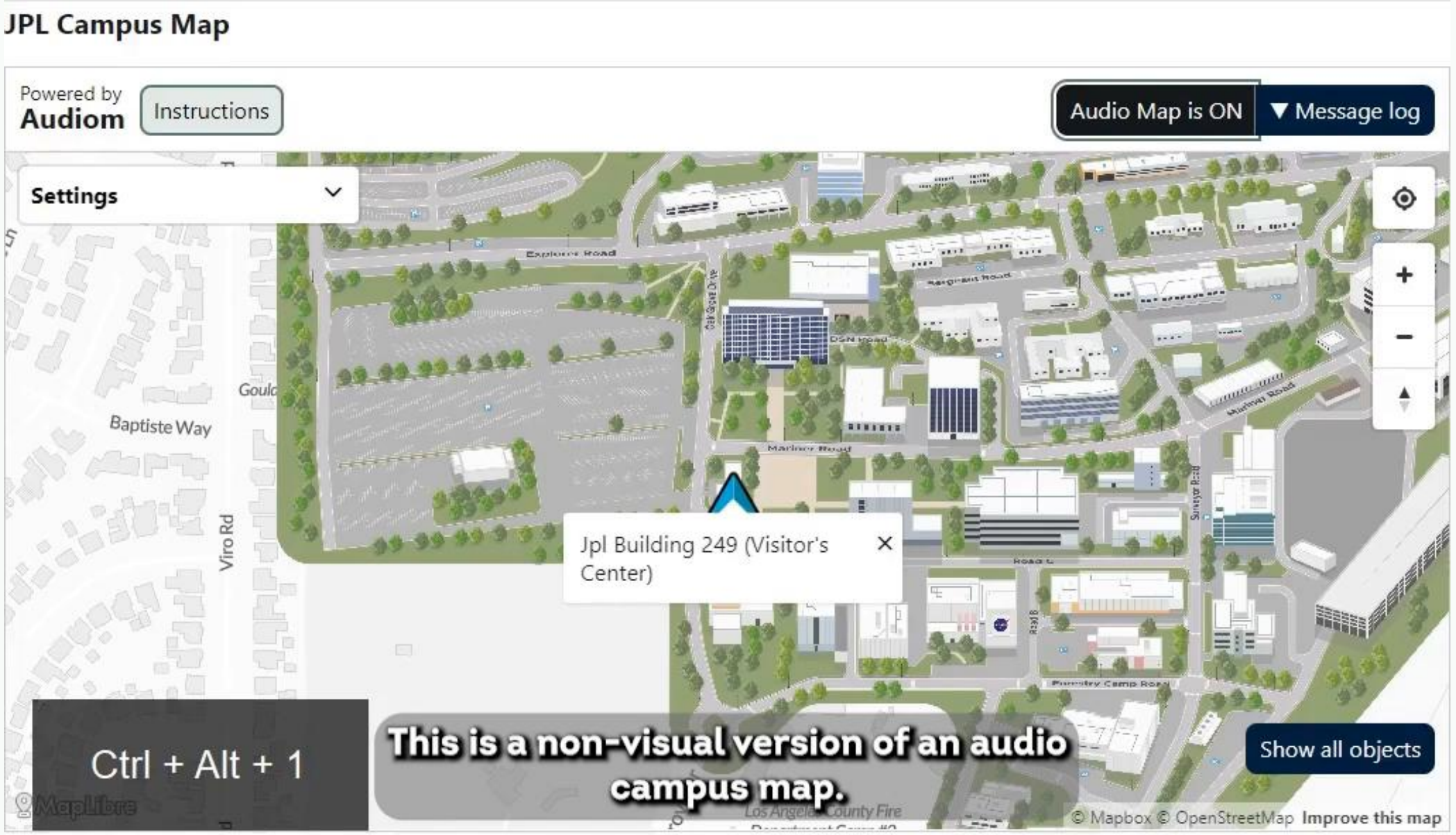
Interactive Alt-Text with Audiom

- Like a video game
- ArcGIS integration
- Scales across thousands of features and maps
- Move a character
- Hear names and sounds of features
- Change step size



XR NAVIGATION

Audiom Campus Map Example



Audiom Heatmap Demo

Pros and Cons of Interactive Alt-Text

Cons:

- Has a 5-10 minute learning curve
- Requires 3rd-party tools

Pros:

- WCAG compliant from LevelAccess
- Research-backed
- Combined visual/text solution
- Runs on same data as other maps (ESRI and GeoJSON)
- Supports thousands of features
- Easy to get data of interest
- Supports multiple layers

Non-text Contrast (SC 1.4.11)

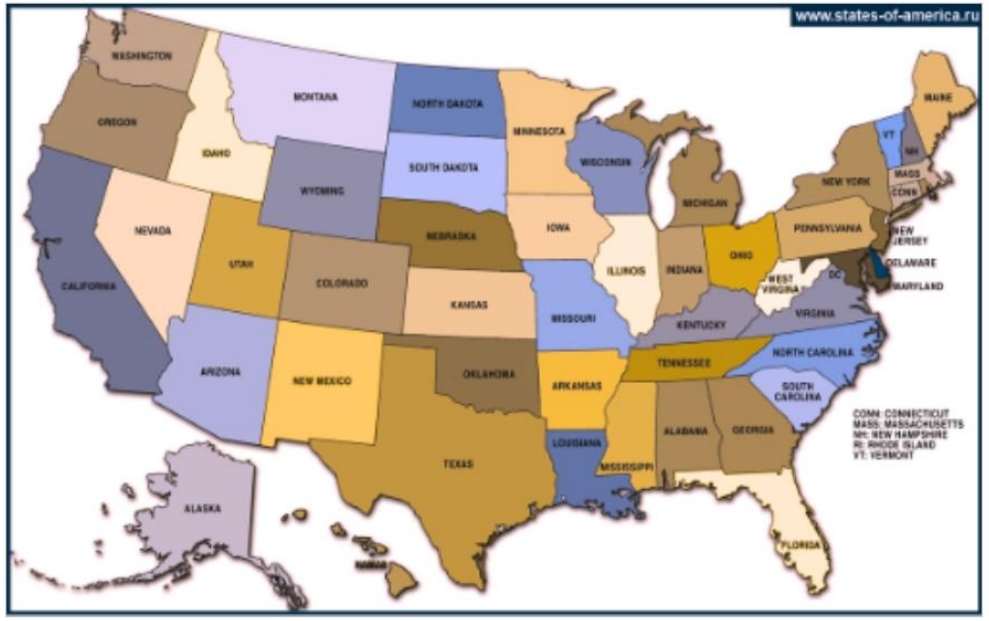
The visual presentation of the following have a contrast ratio of at least 3:1 against adjacent color(s):

- User Interface Components
- Graphical Objects

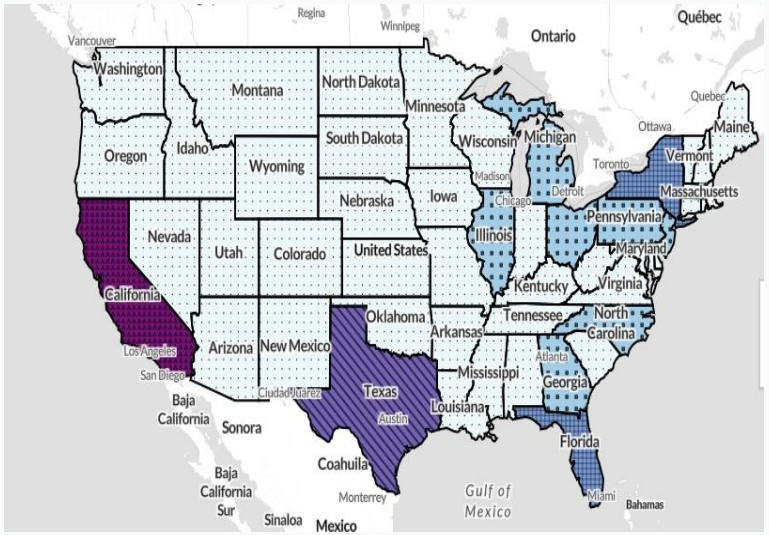
Colors are not always accessible

Original

Simulated



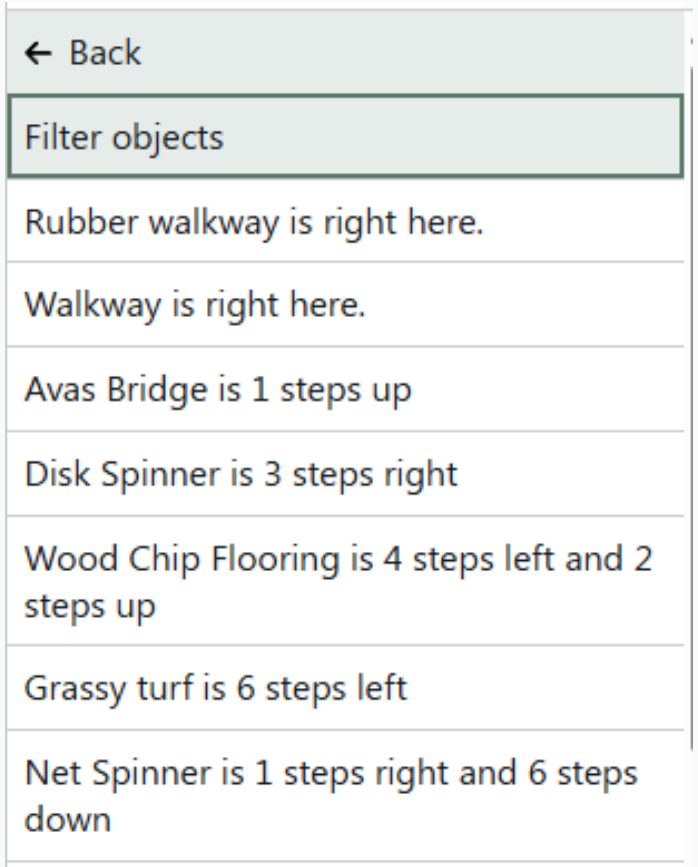
Use high contrast, patterns, and or Oreo (cased) borders



Keyboard Accessibility (SC 2.1.1)

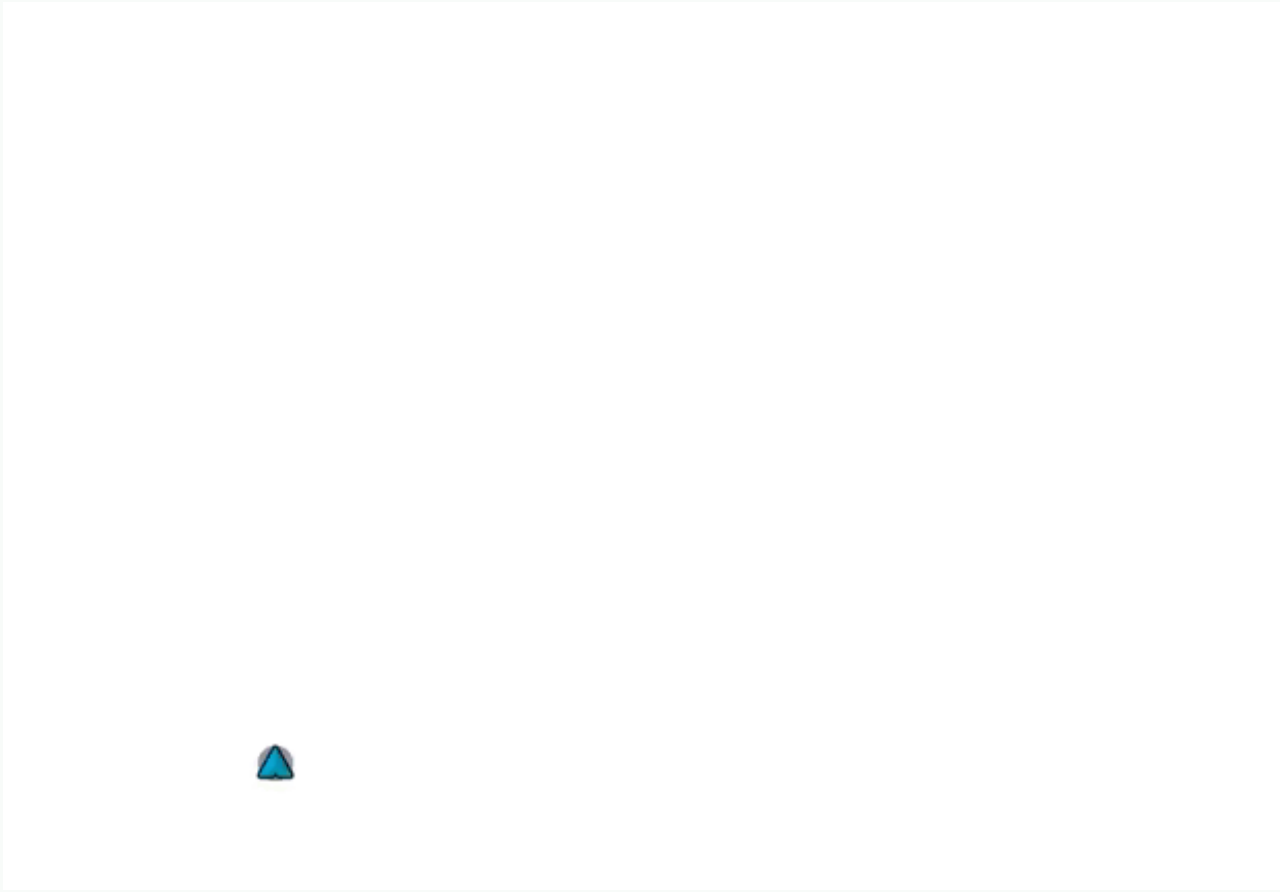
All functionality of the content is operable through a keyboard interface without requiring specific timings for individual keystrokes, except where the underlying function requires input that depends on the path of the user's movement and not just the endpoints. (This exception relates to the underlying function, not the input technique.)

Features can be presented through lists, tables, or menus



Use keyboard to draw

- Drop points at vertices



There’s a 99% chance these maps are unusable from your department

- Zoning
- Parcel
- Utility
- Land Use
- Transportation
- Demographic
- Park
- University
- Environmental
- Emergency
- Proposed maps

Usable Digital Maps Should Be Expected

- Systematically evaluate landmark, route, and survey knowledge for text alternatives.
- Full keyboard accessibility
- High contrast and patterns

Free Map Evaluation Tool Based on WCAG

- Guide for novices
- Includes 15 WCAG criteria
- Has links for color and screen reader testing

https://xrnavigation.io/map-evaluation-tool/

Our vision is that everyone can use spatial information.

What questions do you have?

Let’s talk to make your maps usable:

Brandon.biggs@xrnavigation.io