

PROJECT ASTRAL

Aquatic Safety Through Research, Analysis and Linking of Data

CDC Grant: U01 CE003504-01

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Ned Levine & Associates, Houston

H-GAC Geographic Data Workgroup
June 3, 2026

Specific Aim 1

Develop analysis database by linking data from:

EMS, hospital, fatality, maritime, storm, media reports

Enrich with contextual information on protective and risk factors of drowning

Census and land-use data

Measures of health equity

Swimming pool inspection

Swimming lesson availability and attendance

Specific Aims 2a and 2b

Examine gender, race, ethnic differences in drowning rates

Identify risk and protective factors that account for these differences

Explore neighborhood characteristics, health equity, proximity to swimming pools

Spatial and temporal analysis of drownings

Diurnal and seasonal variation

Swimming pools vs. natural water

Private pools vs. public pools

Beaches vs. lakes

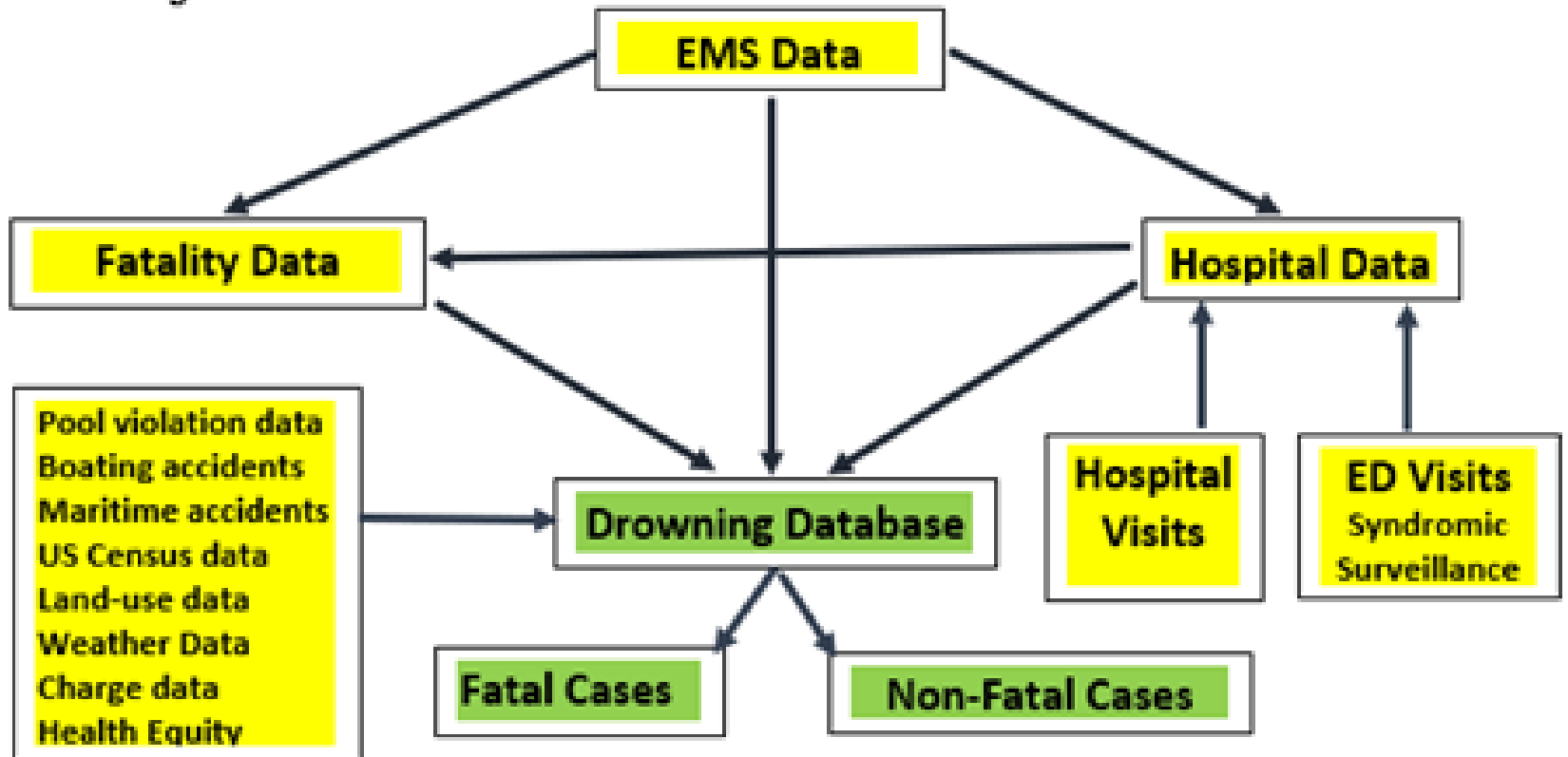
Specific Aim 3

Estimate costs associated with unintentional drownings among patients treated at Texas hospitals

By age, sex, race/ethnicity, discharge status, and aquatic body

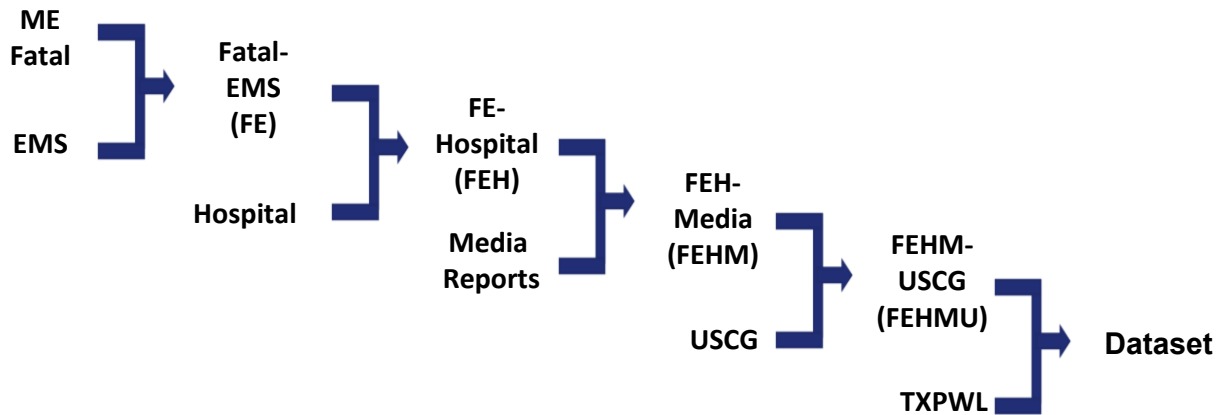
Data Linkage

Linking of Data



Texas Health Care Information Collection (THCIC) Database
For Data Verification for inpatient and outpatient cases and economic analysis

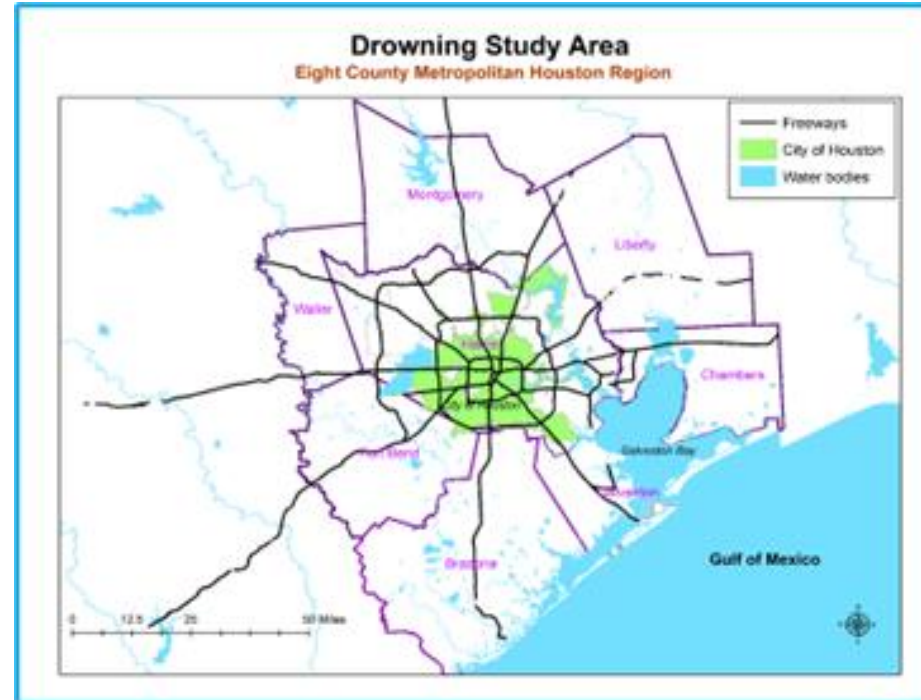
Data Linkage Order



EMS: Emergency Medical Services
ME: Medical Examiner
USCG: US Coast Guard
TXPWL: Texas Parks and Wildlife

8-County Metropolitan Houston

- Texas Gulf coast and Galveston Bay
- 3 river systems, Galveston Bay, 4 large lakes, smaller bays
- Population (2022): 7,092,073
- Children: 26% of the population
- Demographics:
 - Non-Hispanic White (34%)
 - African-American (19%)
 - Asian (8%)
 - American Indian/Alaskan Native (1%)
 - Hispanic (39%)



Classification of Bodies of Water in Metropolitan Houston

- **Constructed Bodies**

Swimming pools, hot tubs, bathtubs

- **Natural/Open Water**

The Gulf, bays, lakes, rivers

- **Flood Control structures**

Bayous, ponds, creeks, canals, ditches, concrete waterways, retention ponds, reservoirs

- **Flooding events (2016-2022)**

Hurricanes and rain events

- **Other**

Data were Geocoded

Drowning death locations

Pool drownings

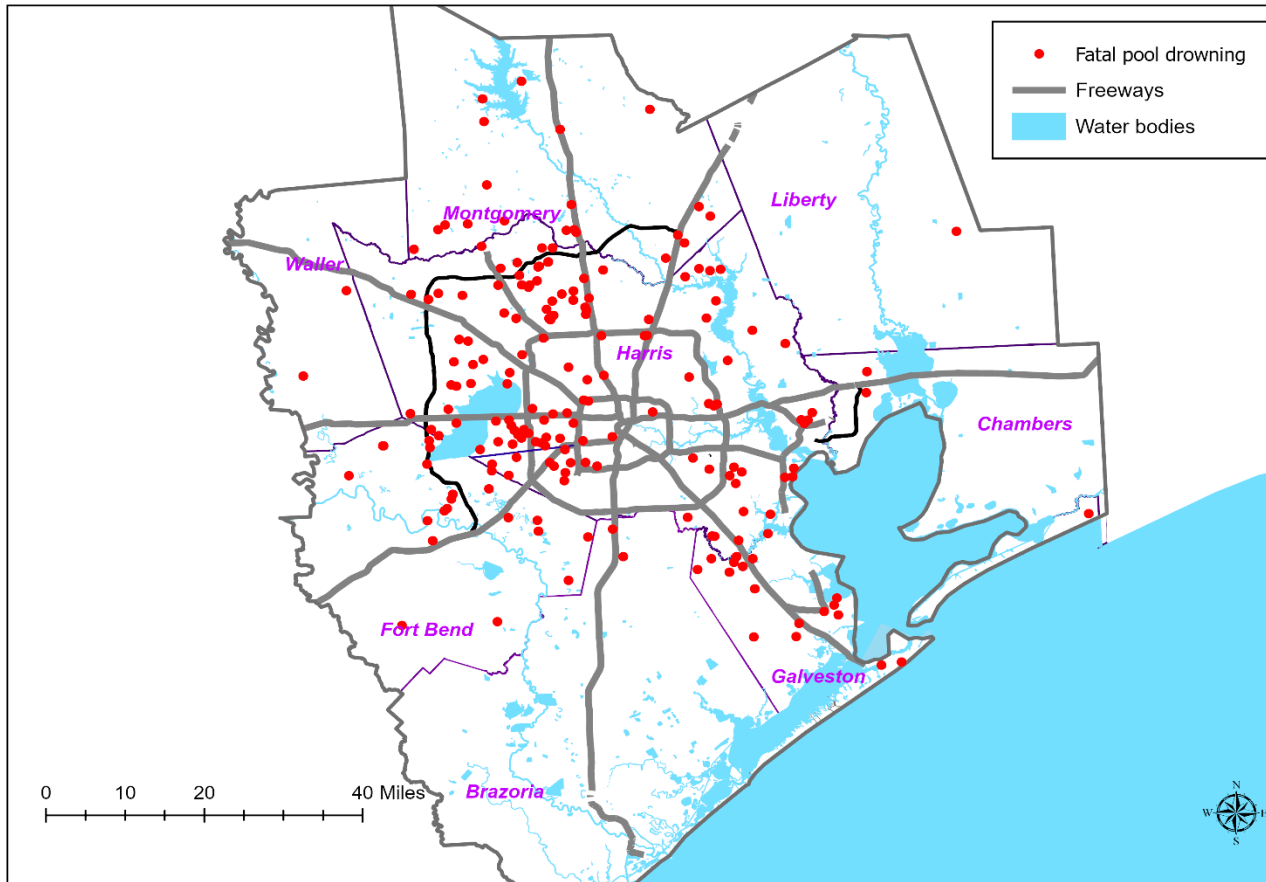
Drownings in other confined spaces

Drownings in natural/open water locations

Pool locations

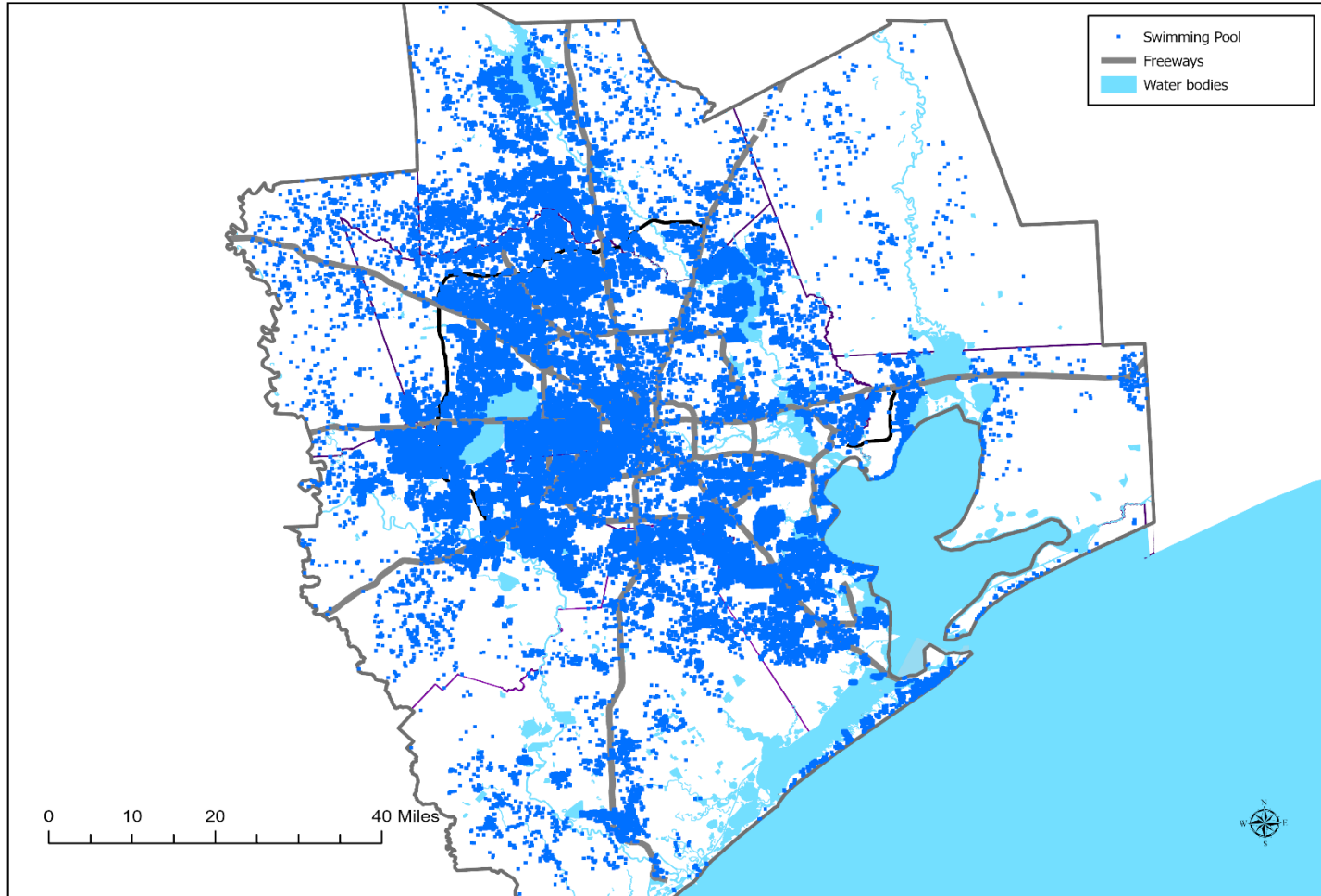
Fatal Swimming Pool Drownings: 2016-2022

N=201 Known Fatal Drowning Locations



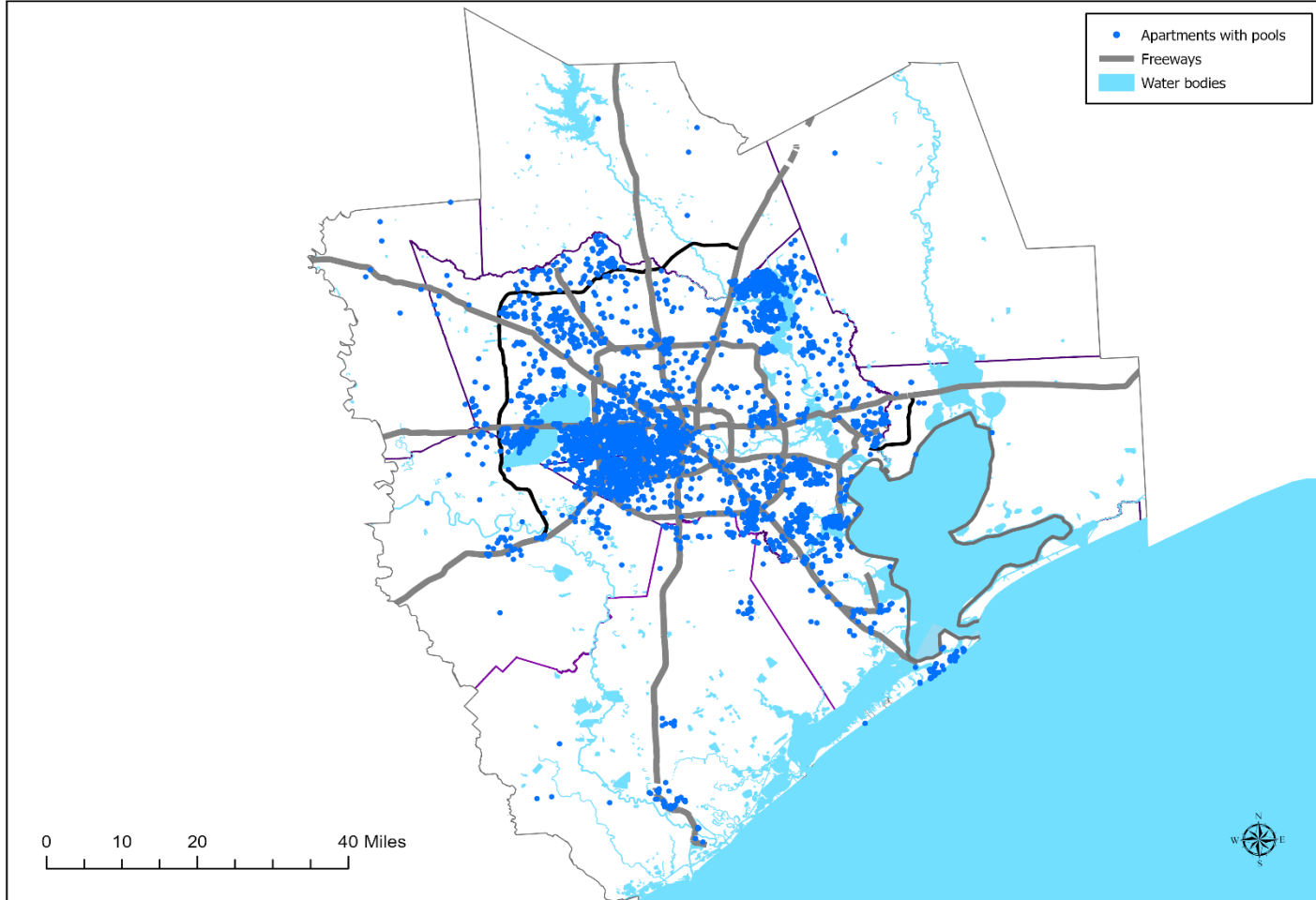
Swimming Pools in the Houston Metropolitan Region: 2022

N=191,576



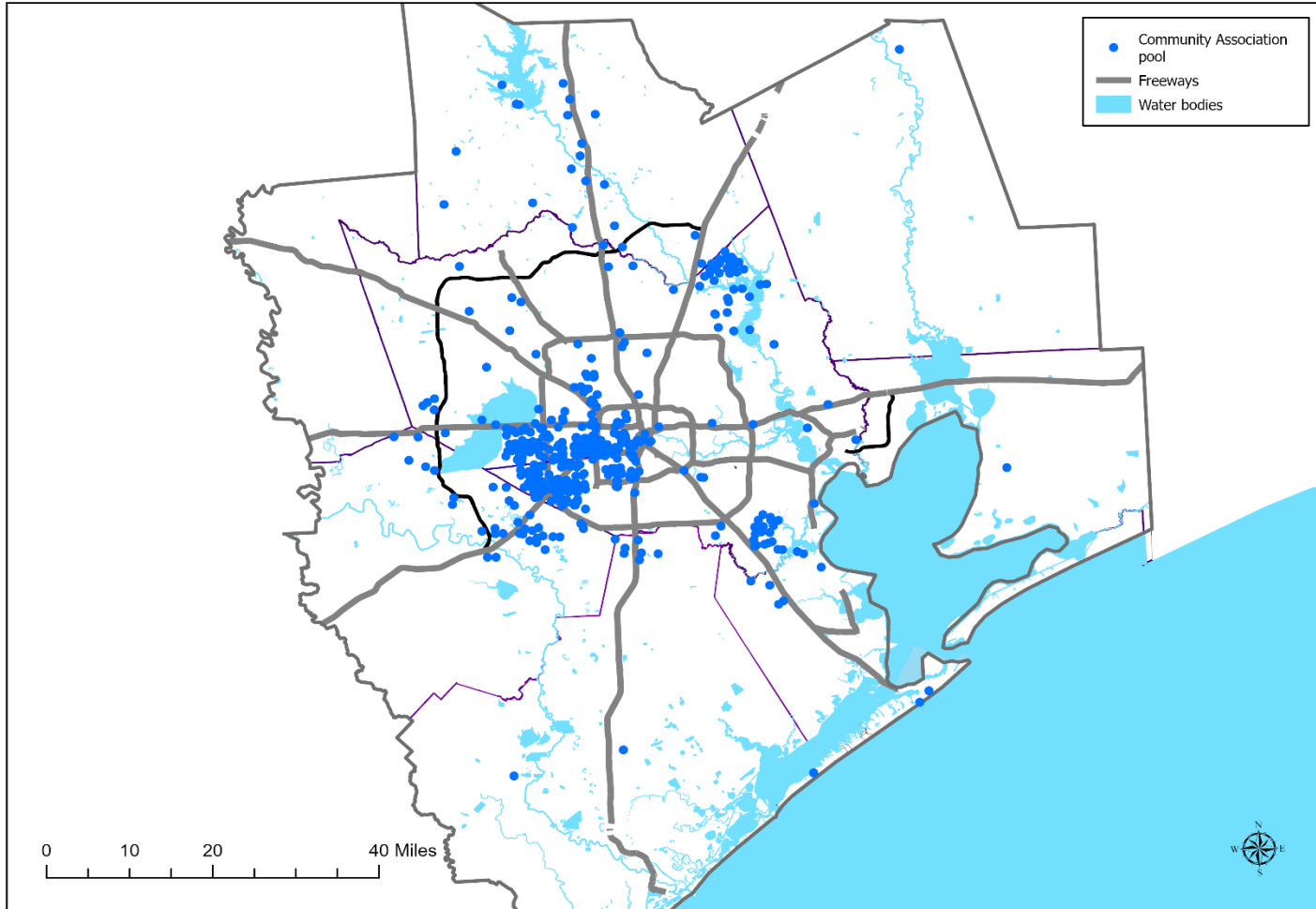
Apartments with Swimming Pools

N=4,984



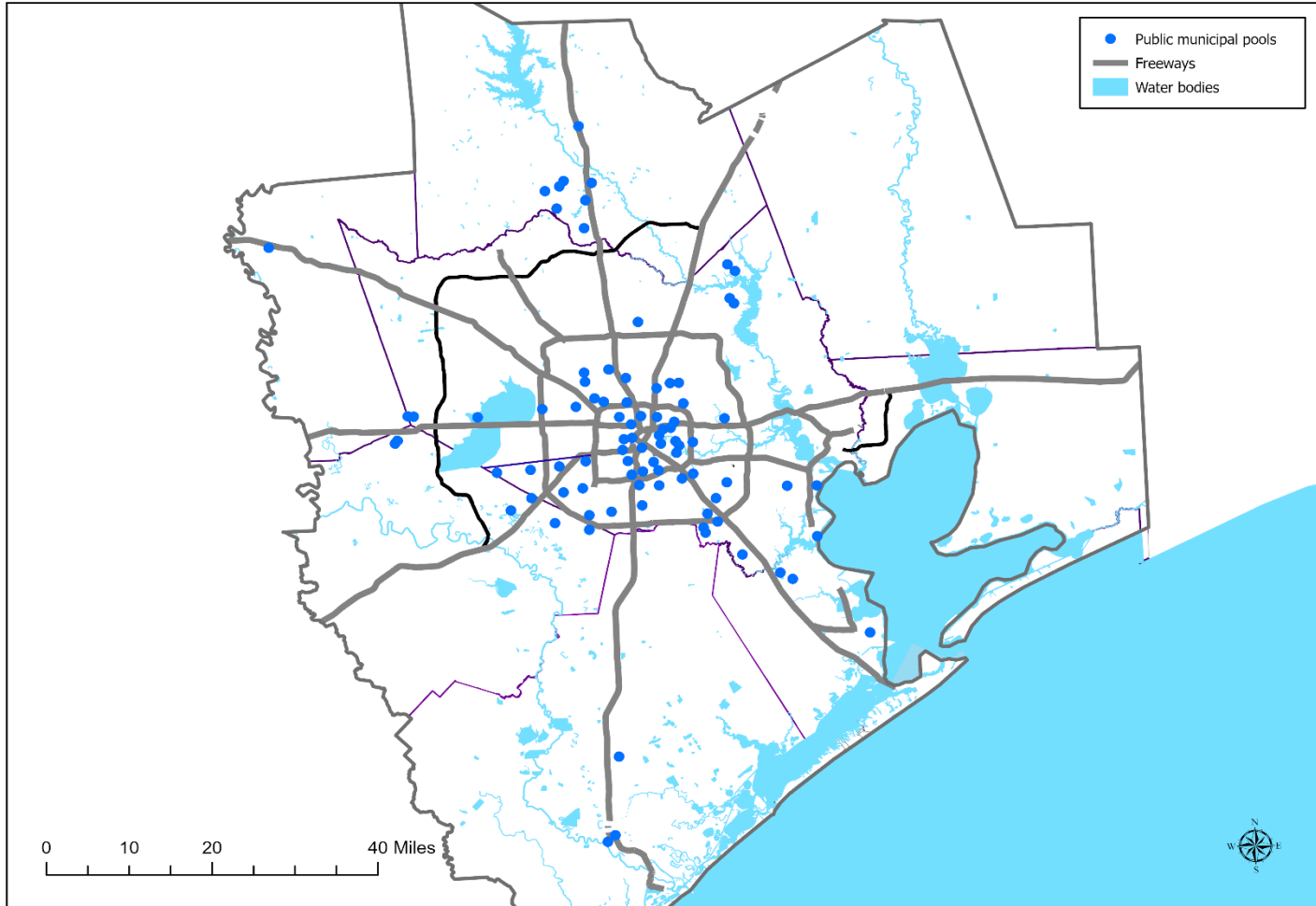
Community Association Communal Pools

N=507



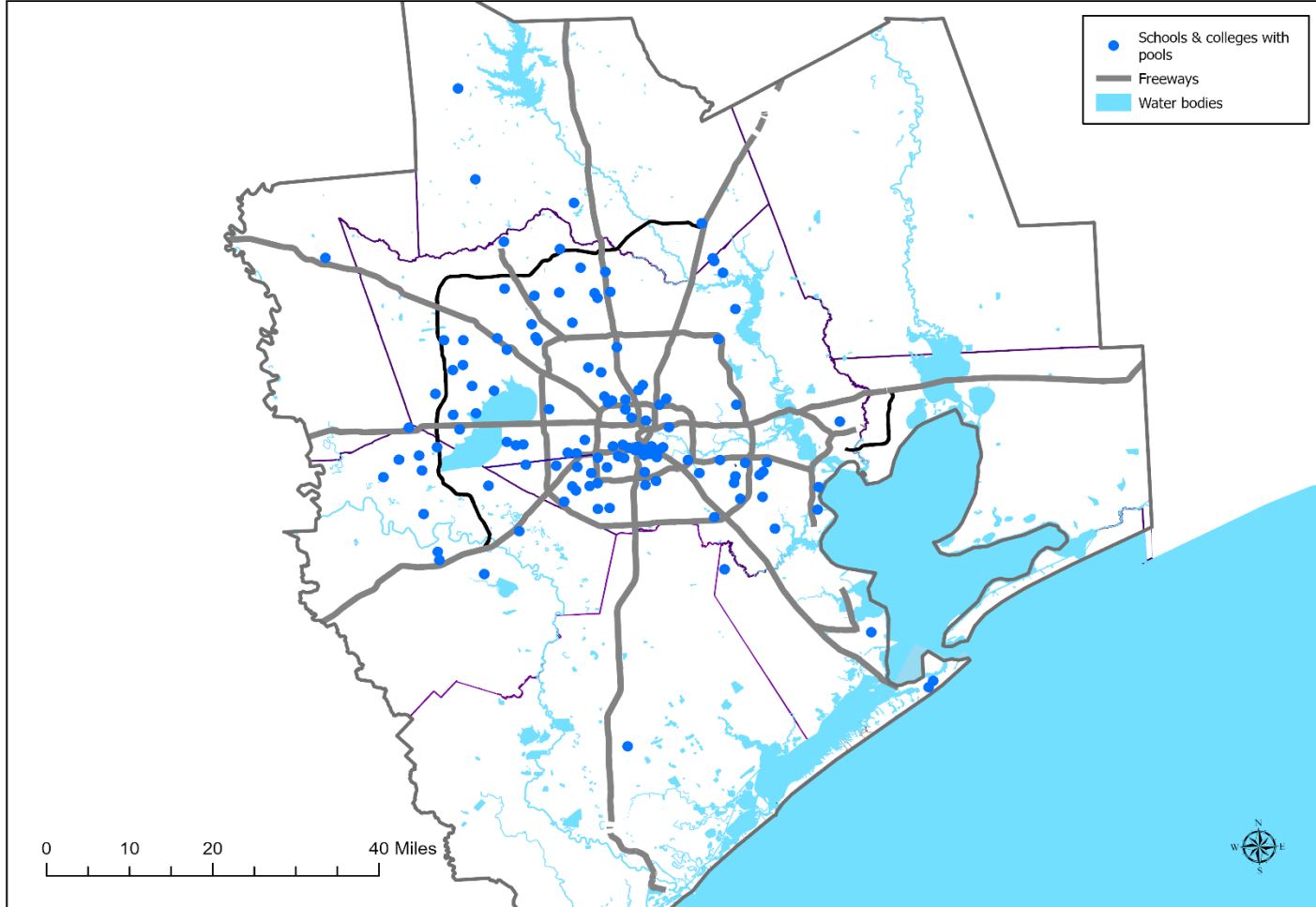
Public Municipal Pools

N=95



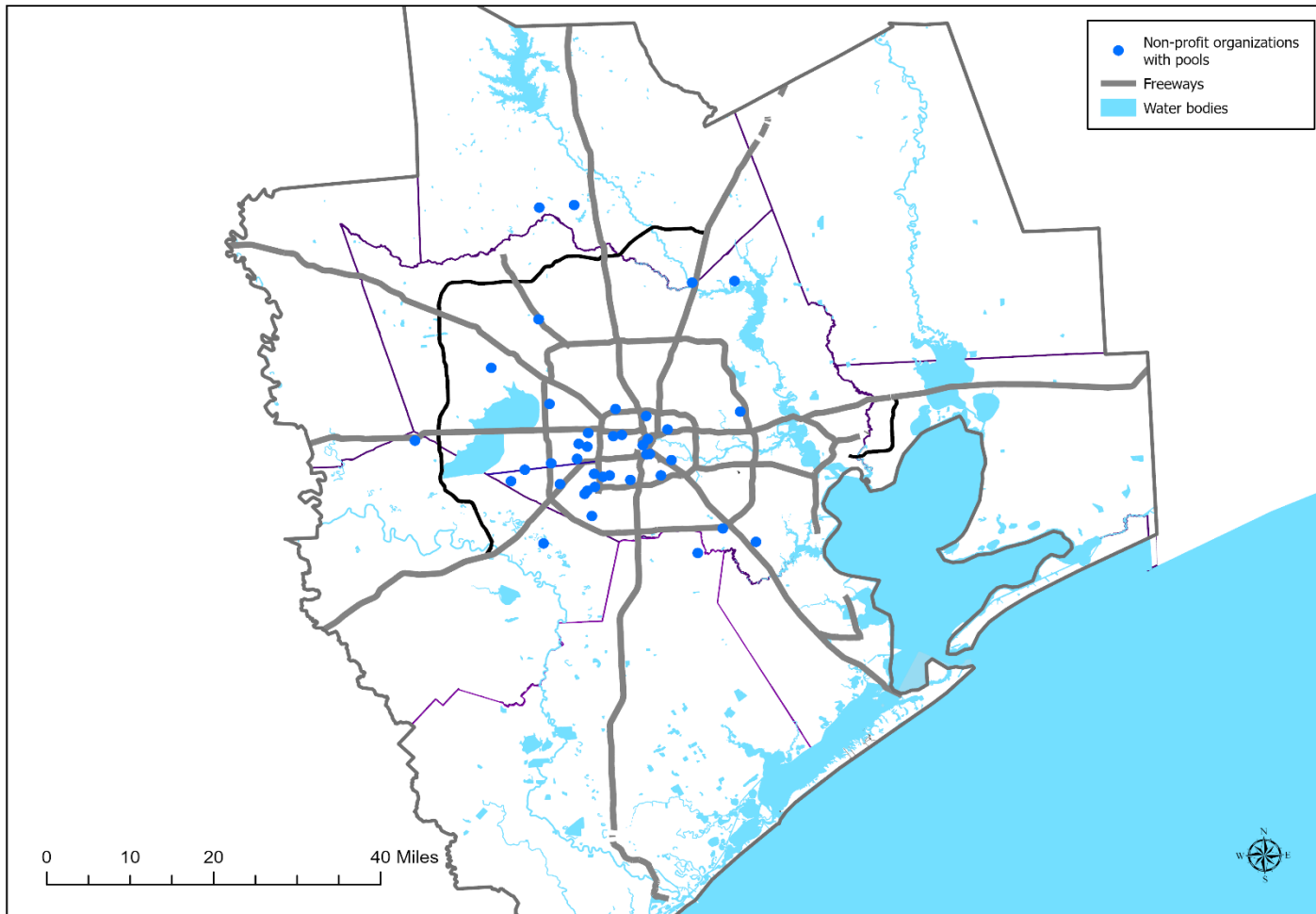
Schools and Colleges with Pools

N=123



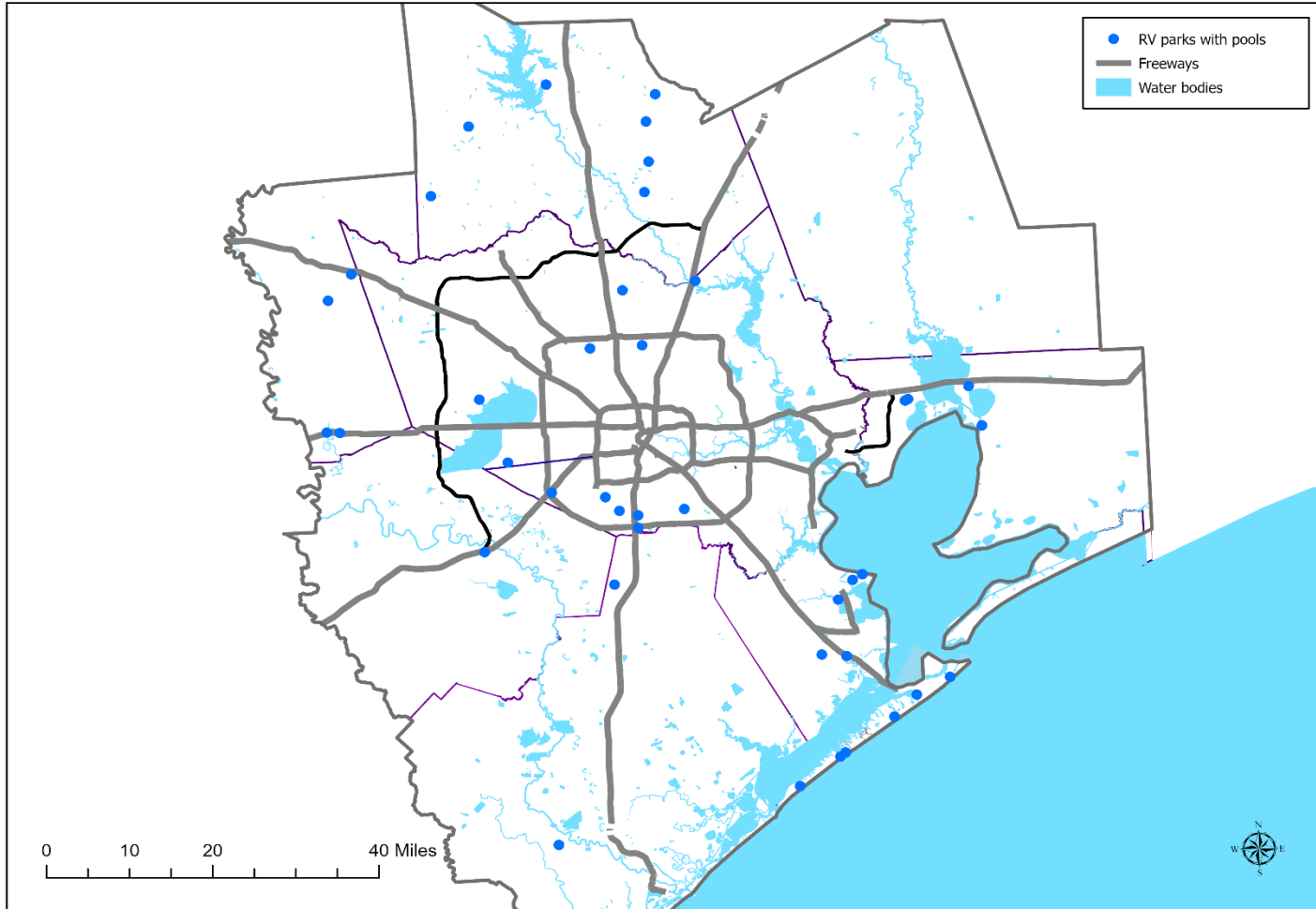
Non-profit Organizations with Pools

N=40



Recreational Vehicle Parks with Swimming Pools

N=41



Fatal Drowning Risk by Pool Type

	Total			Annual Fatal	Risk Relative
	Drowning	Pool		Drowning Risk	to Single
<u>Type of pool facility</u>	<u>Deaths</u>	<u>Count</u>	<u>%</u>	<u>(per 10,000 pools)</u>	<u>Family pools</u>
Single Family	137	184,933	96.5%	1.1	1.0
Apartment	39	4,984	2.6%	11.2	10.6
Condominium/CA/HOA	15	507	0.3%	41.4	39.1
Commercial	8	732	0.4%	15.0	14.2
Non-profit	1	40	0.0%	25.0	23.6
Municipal	0	95	0.0%	0.0	0.0
Schools/Colleges	0	123	0.1%	0.0	0.0
RV parks	0	41	0.0%	0.0	0.0
Other/Unknown	5	24	0.0%	297.6	280.8
REGION TOTAL	<u>205</u>	<u>191,578</u>	<u>100.0%</u>	<u>1.5</u>	<u>1.4</u>
	$\chi^2= 1252.6; p<0.001$				

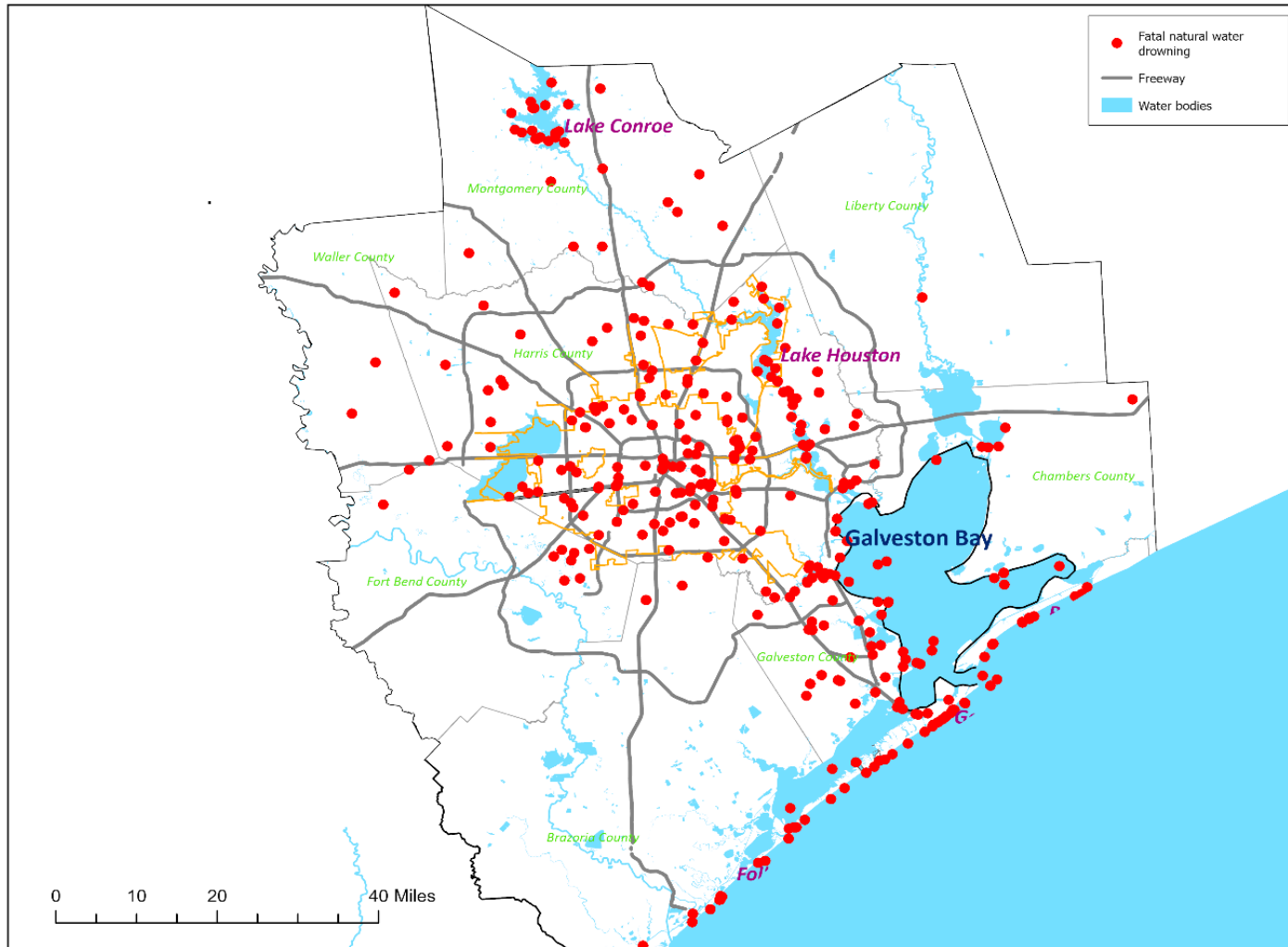
Geocoded Drowning Deaths Natural/Open Water Locations

Case narratives used to approximate location

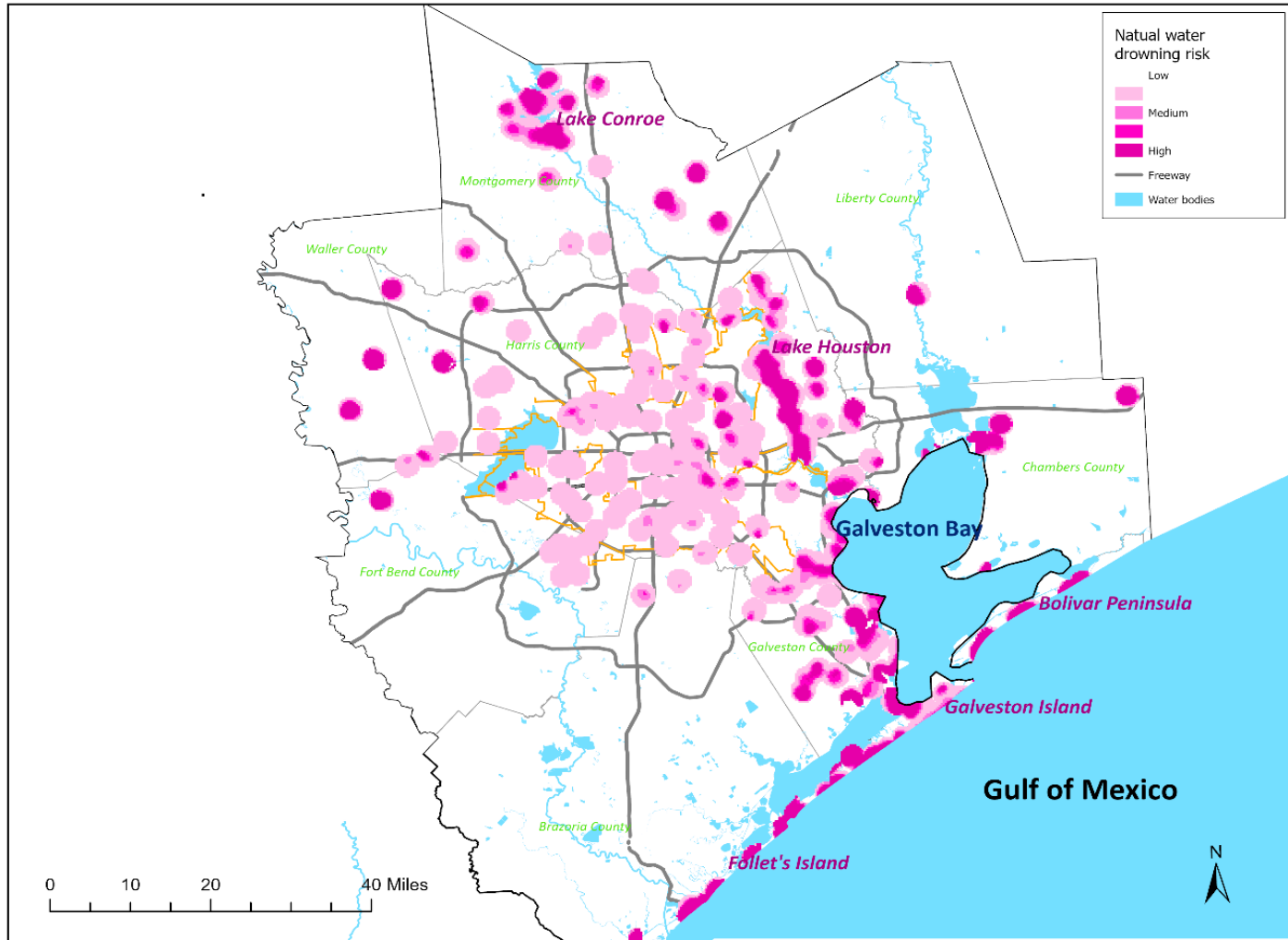
Fatal Drownings in Natural Water Bodies

	<u>Body of water</u>	<u>Count</u>
		<u>%</u>
Gulf of Mexico/Beaches	<u>72</u>	17.4%
Bays	<u>53</u>	12.8%
	Galveston Bay	51
	Other bays	2
Lakes	<u>56</u>	13.5%
	Clear Lake	13
	Lake Houston	8
	Lake Conroe	25
	Lake Anahuac	4
	Other lake	6
Rivers	<u>28</u>	6.8%
	San Jacinto River	27
	Trinity River	1
Flood Control Structures	<u>149</u>	36.0%
	Bayous	56
	Canals	2
	Creeks	11
	Ditches	28
	Ponds	48
	Reservoirs	2
	Other flood control	2
Flood Waters	<u>52</u>	12.6%
Unknown	<u>4</u>	1.0%
<u>TOTAL</u>	<u>414</u>	<u>100.00%</u>

Natural Water Drowning Deaths: 2016 to 2022



Natural Water Fatal Drowning Risk Relative to Population



Risk Factors Involved

For pool drownings:

Inadequate fencing (*3-sided v. 4-sided; too short*)

Poor supervision of children

No lifejackets for those with limited swimming skills

Alcohol/drug use

For natural water drownings:

Rip tides

Strong currents, tides, & waves

Sandbars, troughs & holes

Major storms/flood waters

Flood control structures

Behaviors that increase drowning risk

Poor supervision of those with limited swimming skills, autism

Not wearing lifejackets for children or while boating & fishing

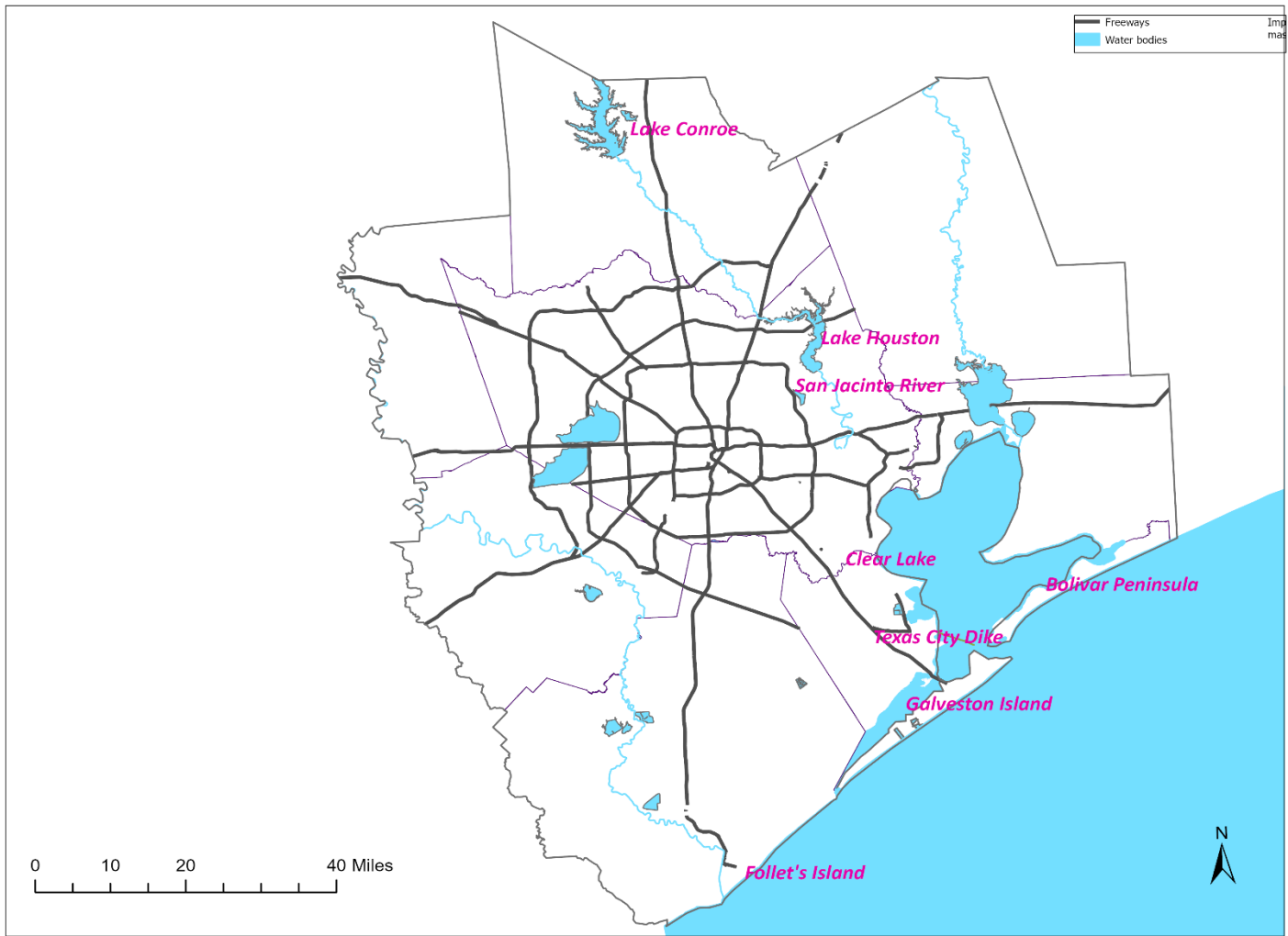
No lifeguards

Alcohol or drugs

Swimming in non-designated areas

Driving in flooded waters

Eight High-risk Locations for Natural Water Drowning Deaths



Galveston Island

Major Locations for Open Water Drownings

Places Where Many Fatal Drownings Occurred

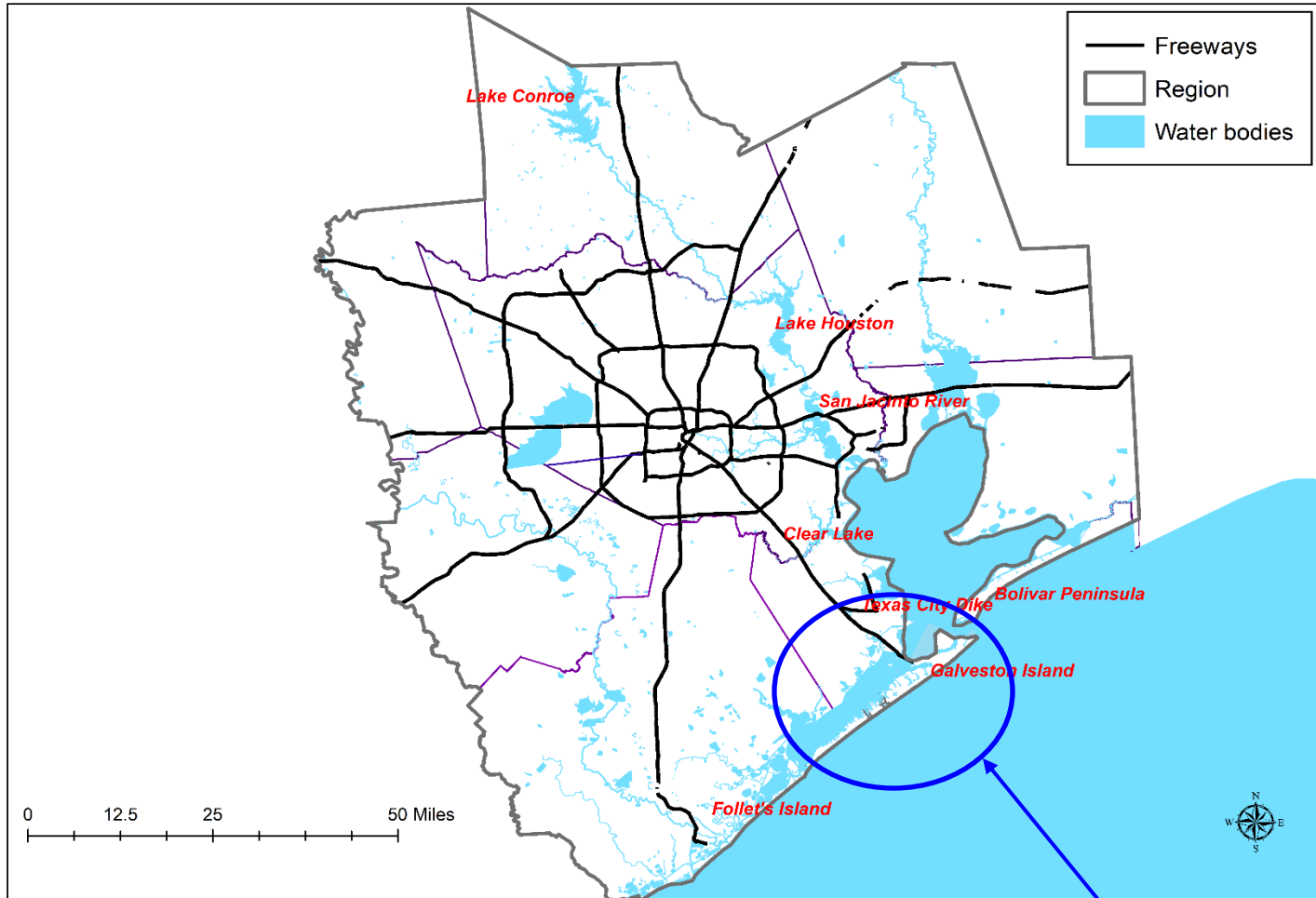
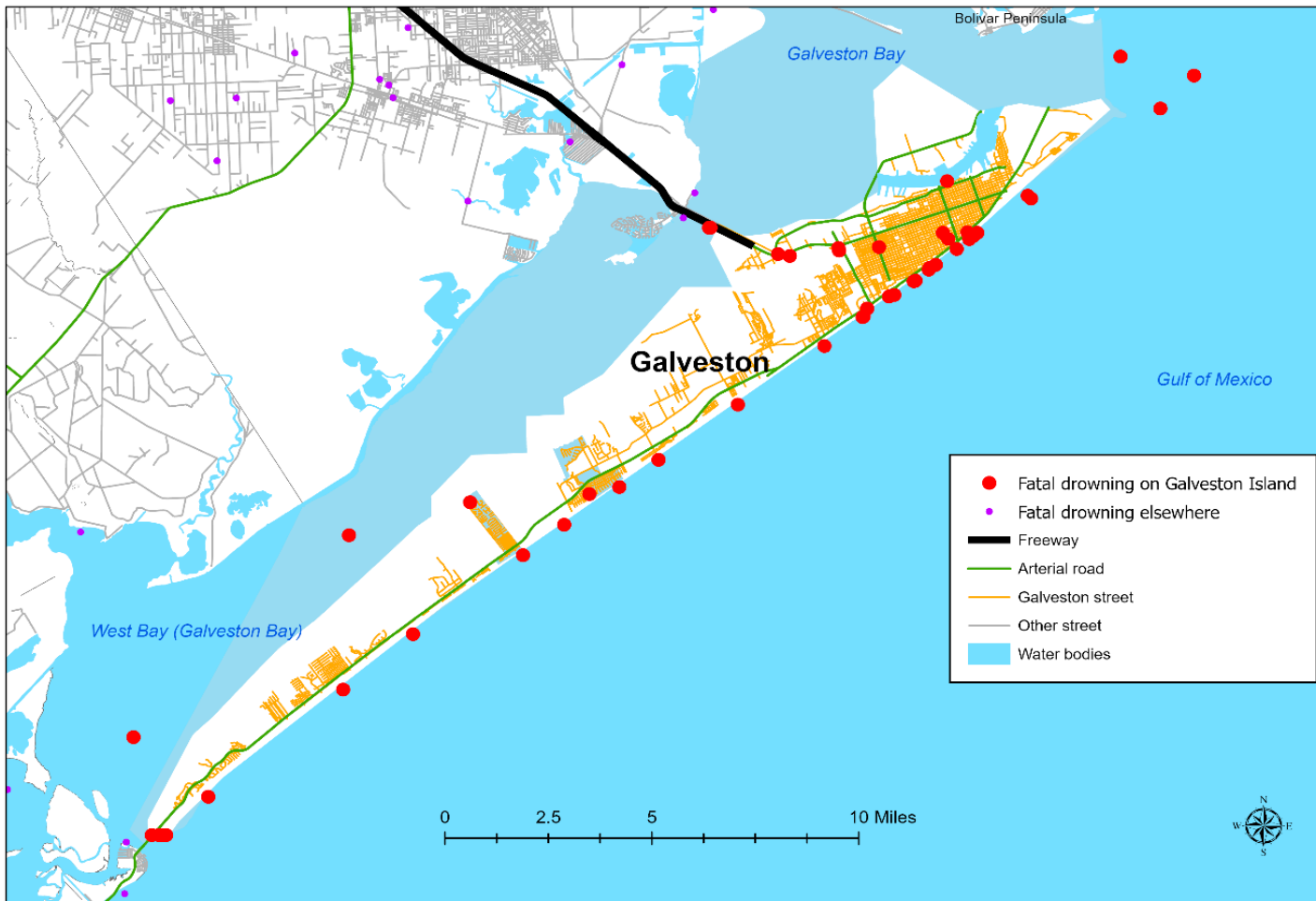




Photo by Ned Levine

Fatal Drownings On Galveston Island: 2016-2022

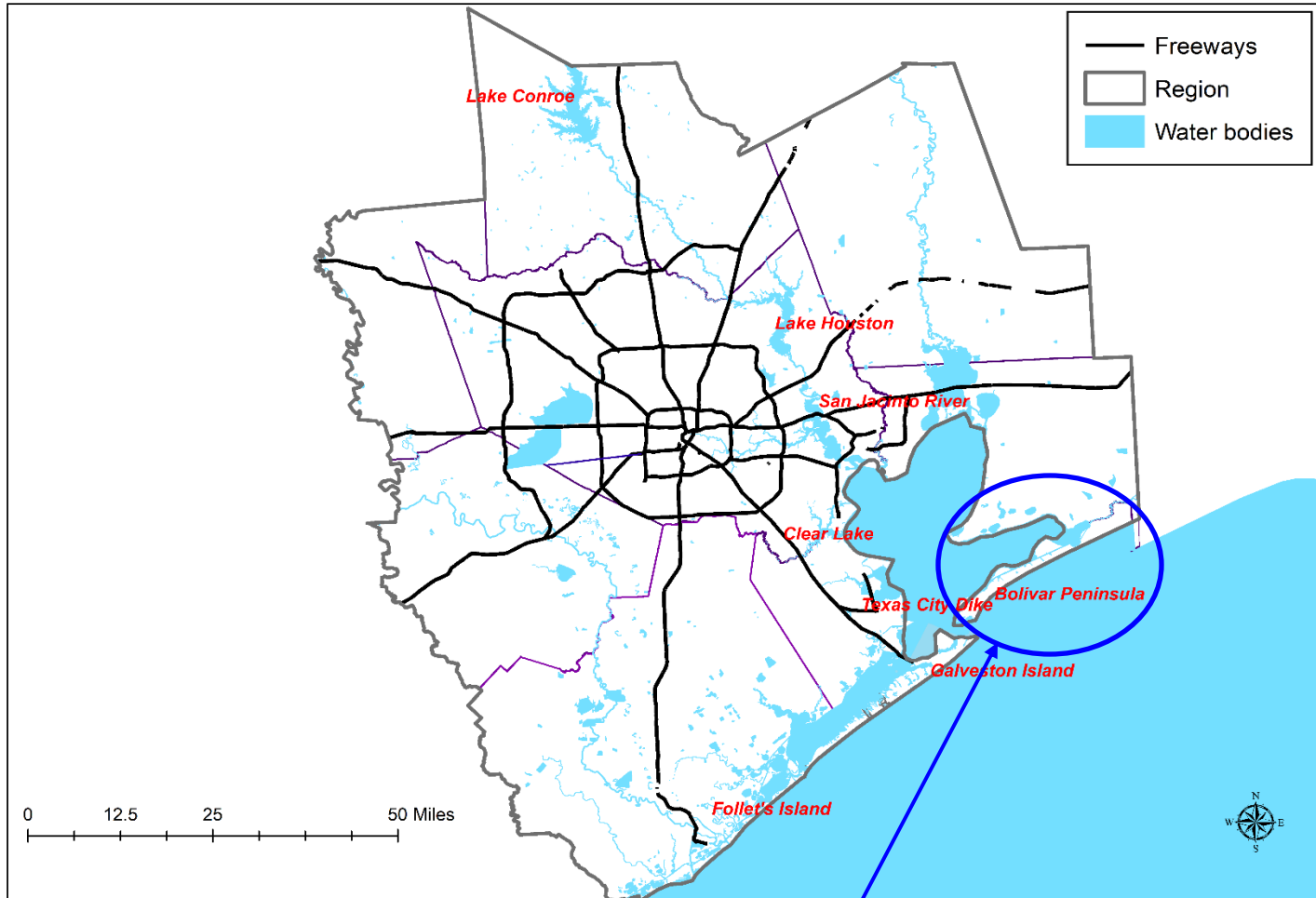
N=52 Known Fatal Drowning Locations

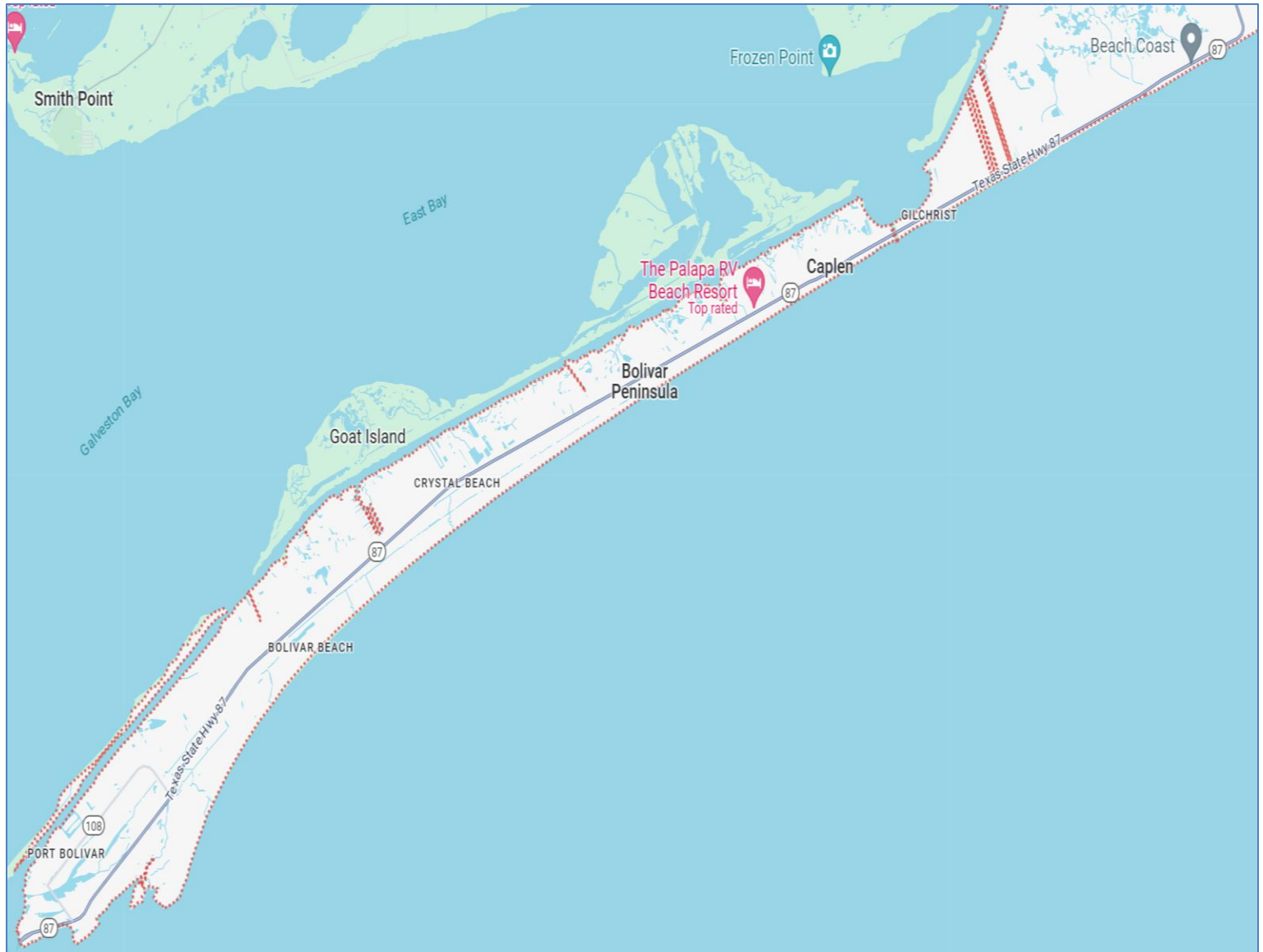


Bolivar Peninsula

Major Locations for Open Water Drownings

Places Where Many Fatal Drownings Occurred





From: Google Maps



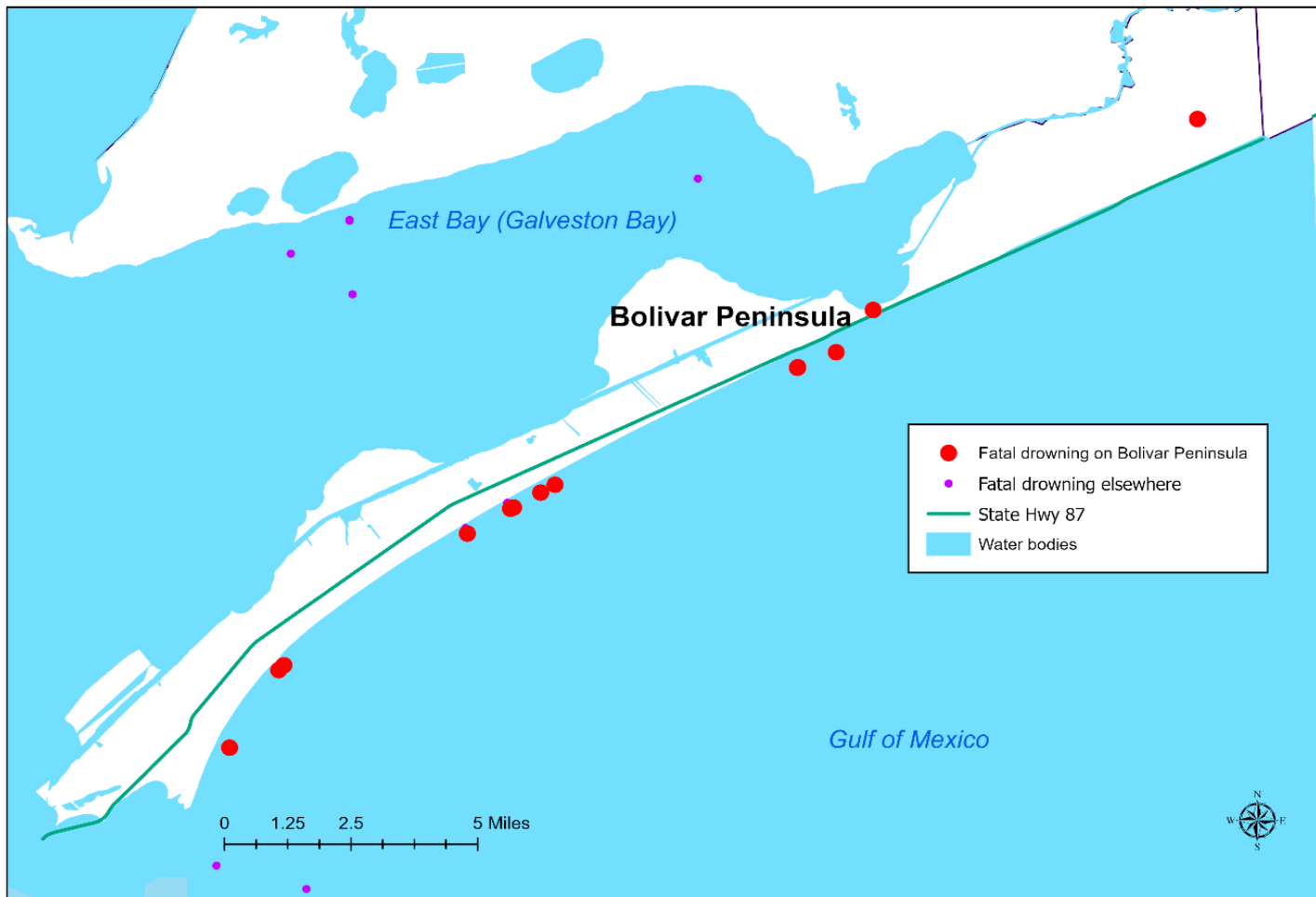
From: Beaumont Convention & Visitors Bureau <https://www.beaumontcvb.com/things-to-do/beach/>



Photo by Ned Levine

Fatal Drownings In Bolivar Peninsula: 2016-2022

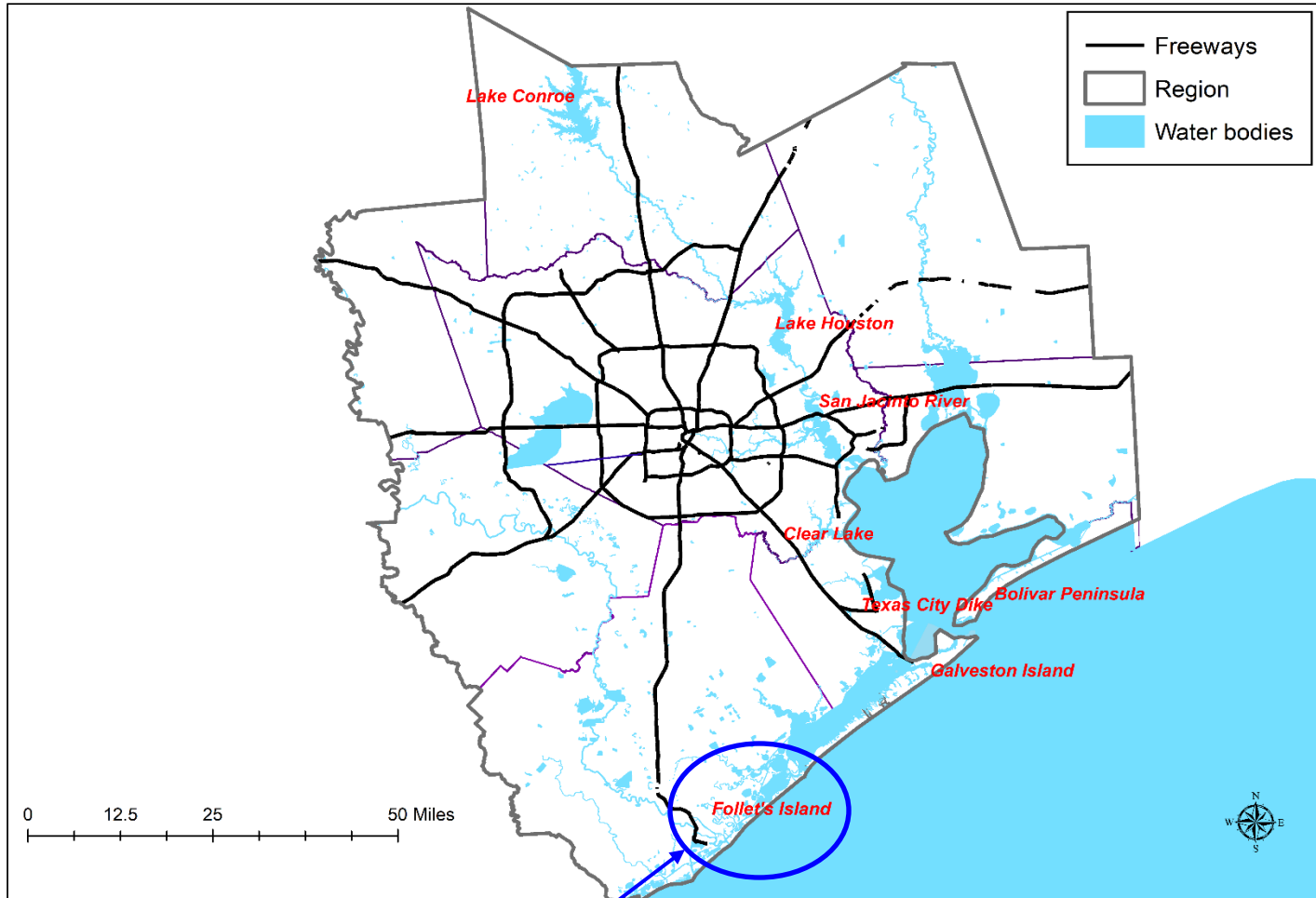
N=13 Known Fatal Open Water Drowning Locations

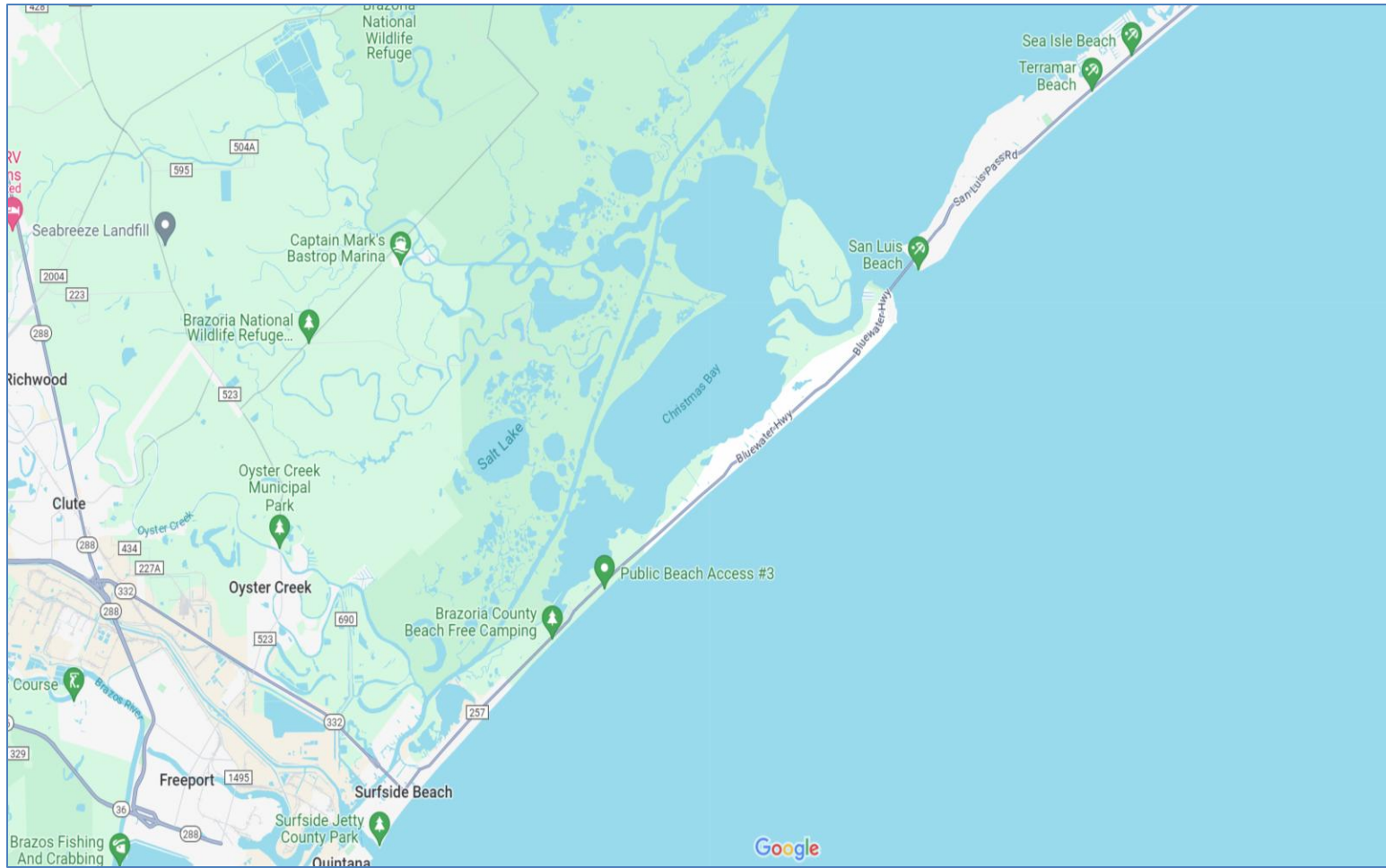


Follet's Island and Surfside Beach

Major Locations for Open Water Drownings

Places Where Many Fatal Drownings Occurred







https://www.click2houston.com/topic/Surfside_Beach/



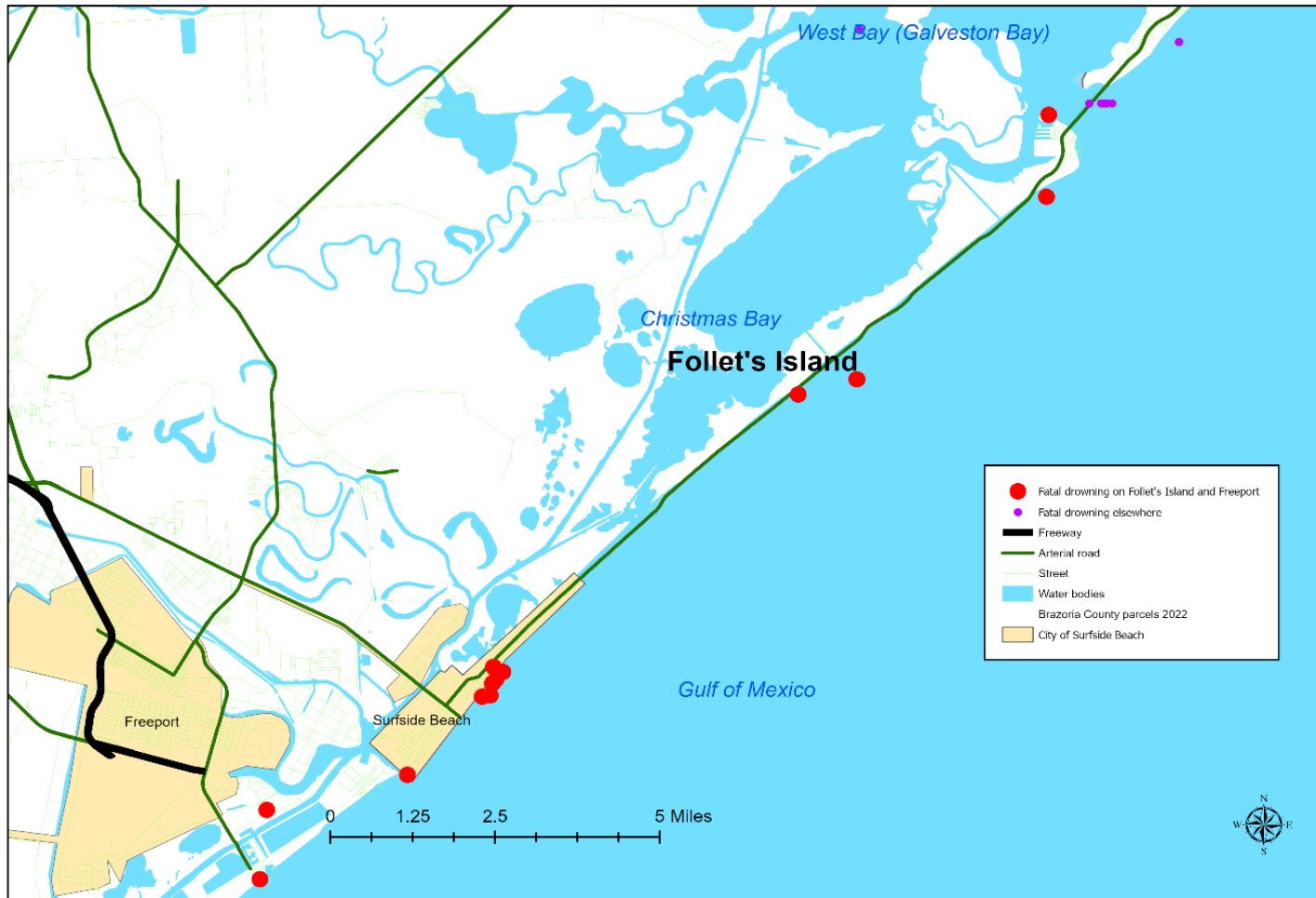
https://www.click2houston.com/topic/Surfside_Beach/



<https://brazosport.org/brazosport-is/surfside-beach/>

Fatal Drownings on Follet's Island: 2016-2022

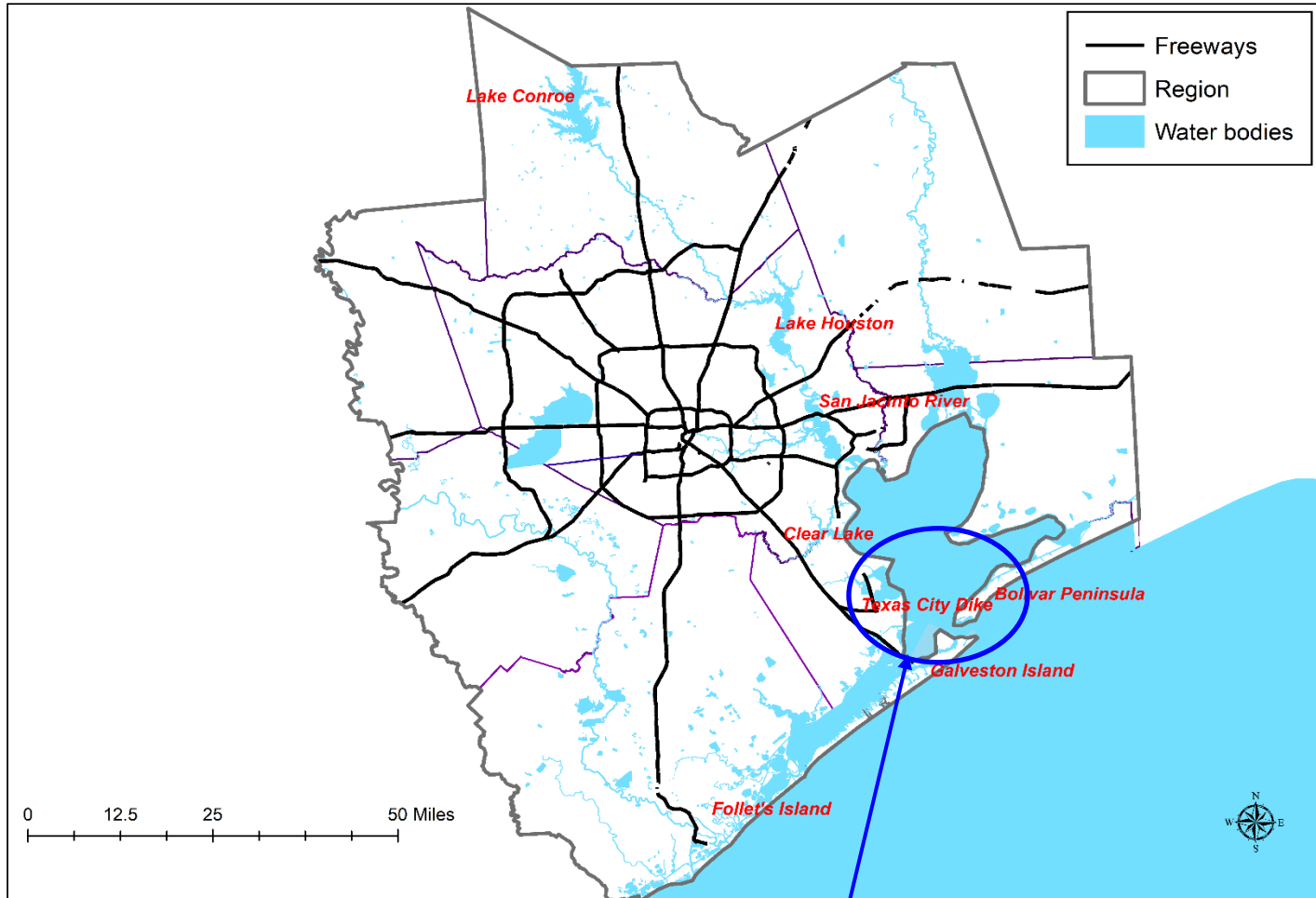
N=13 Known Fatal Drowning Locations

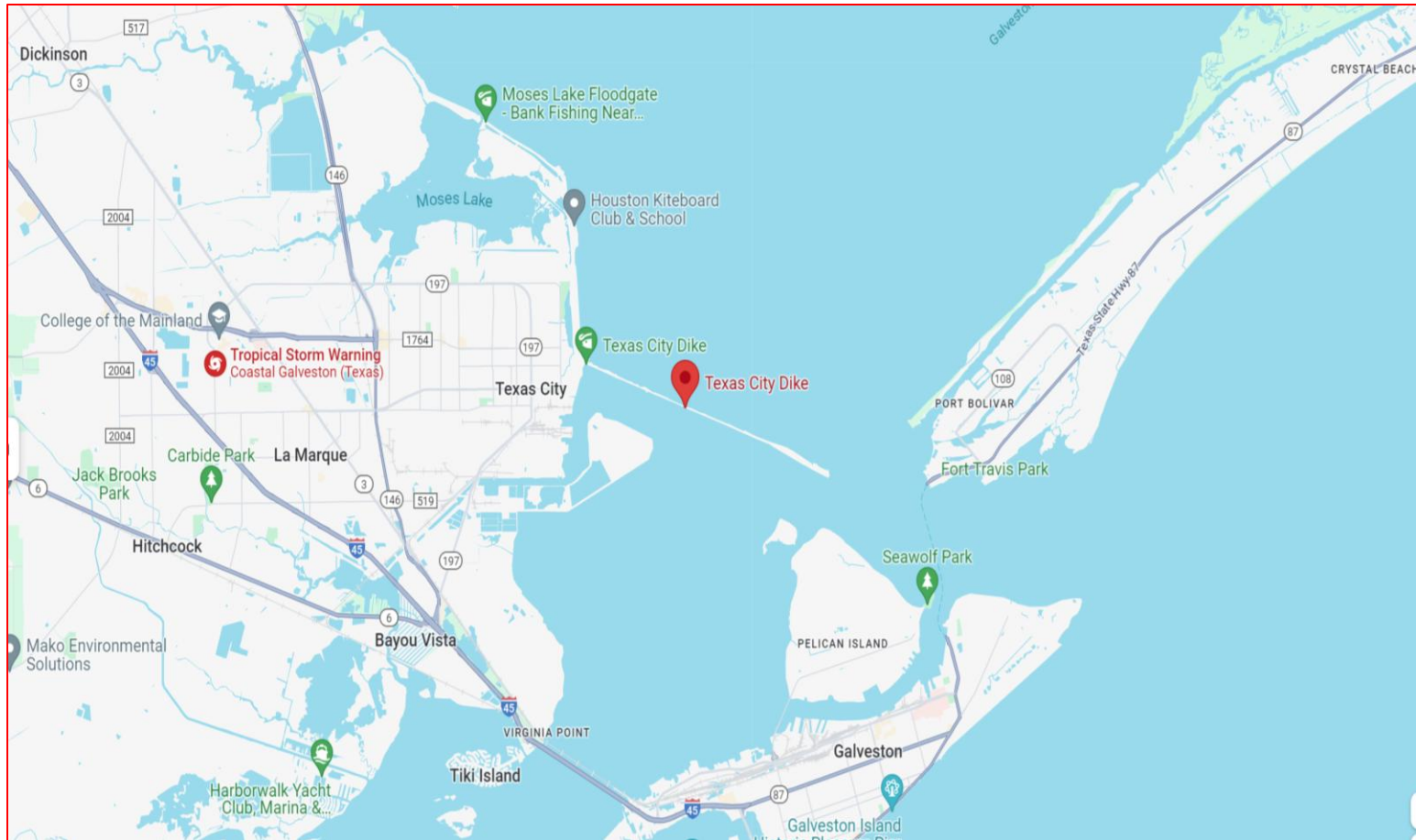


Texas City Dike

Major Locations for Open Water Drownings

Places Where Many Fatal Drownings Occurred







From: <https://www.texascitytx.gov/392/Texas-City-Dike>



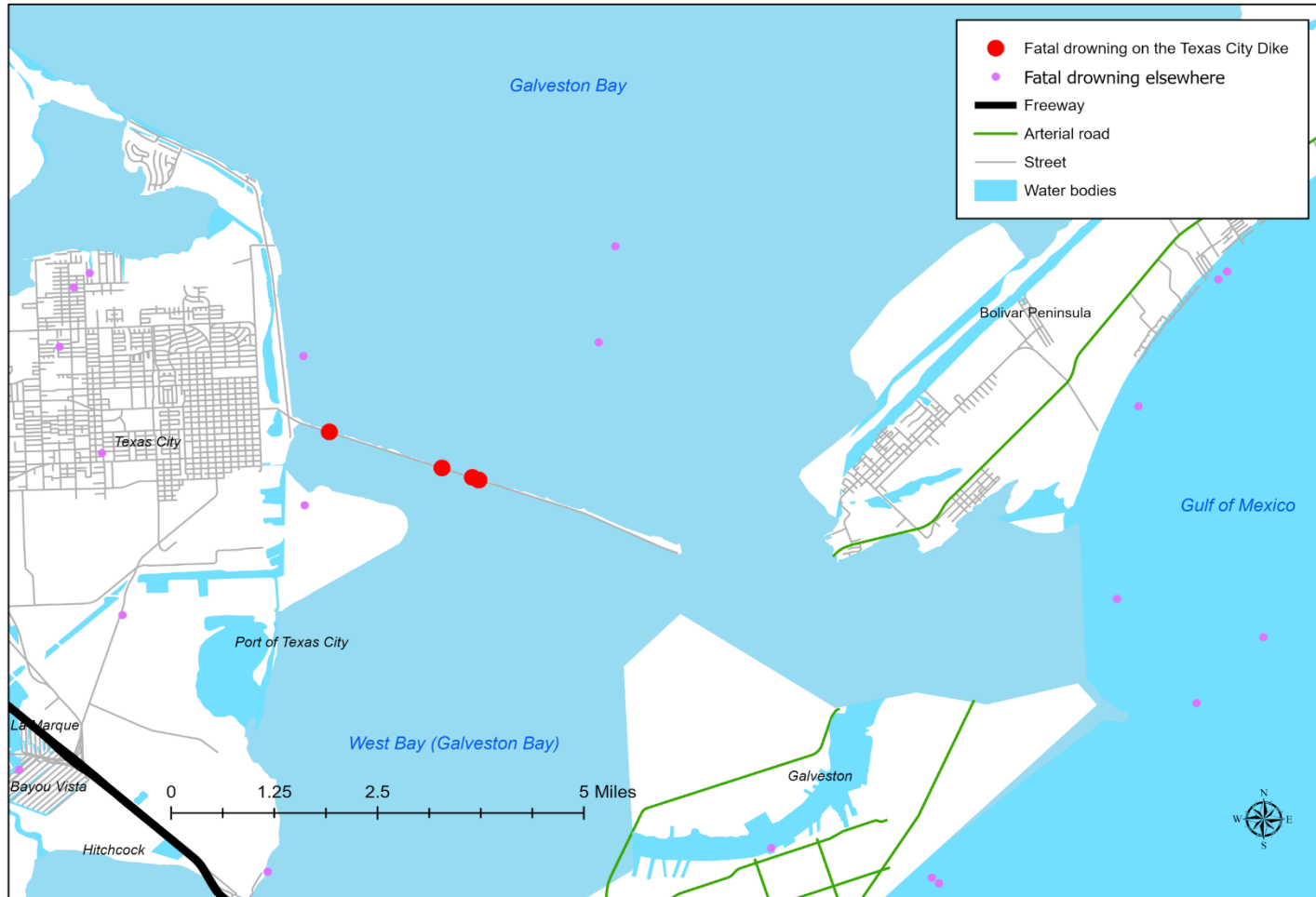
Photo by Rohit Shenoi



Photo by Rohit Shenoi

Fatal Drownings on the Texas City Dike: 2016-2022

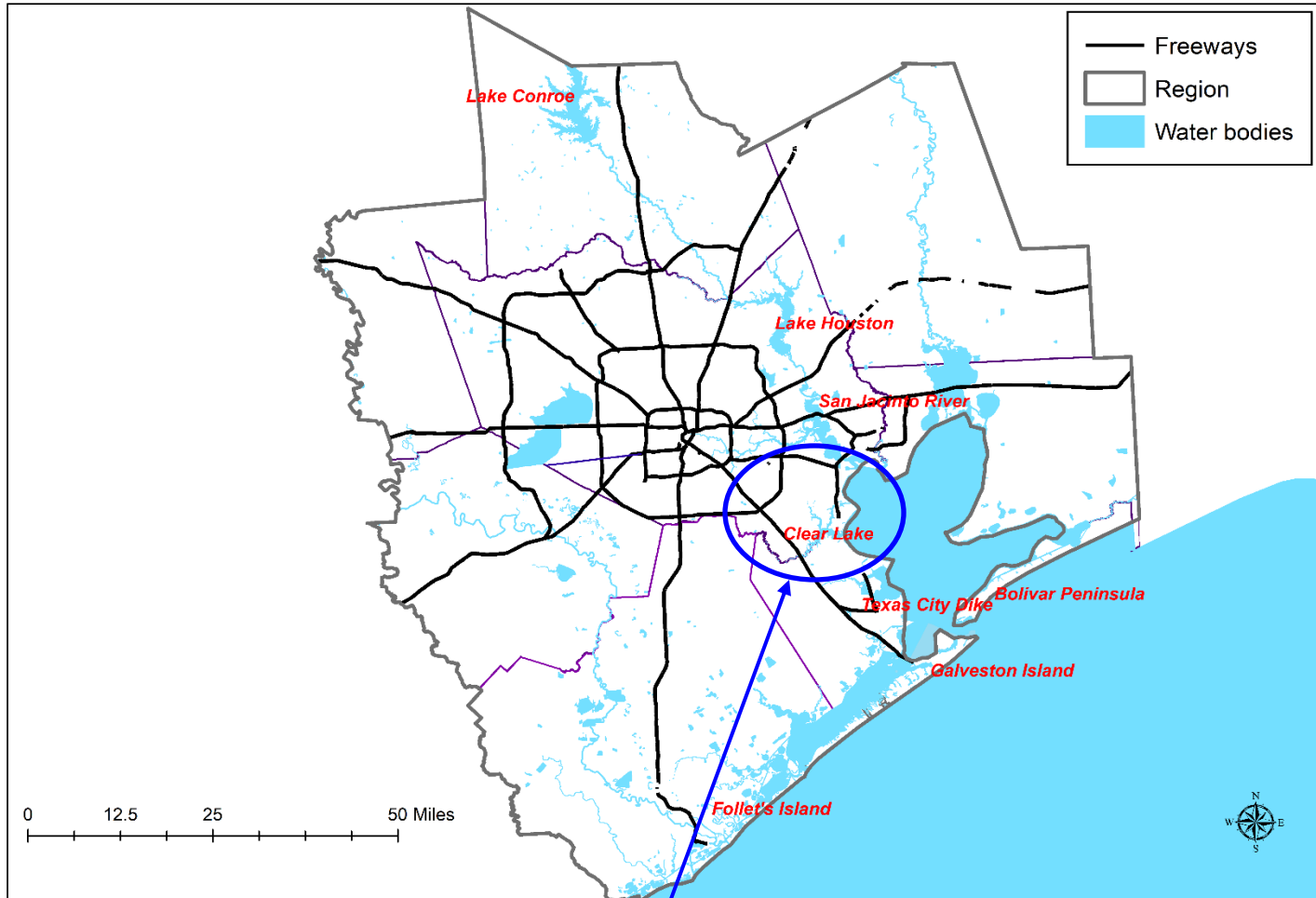
N=7 Known Fatal Drowning Locations

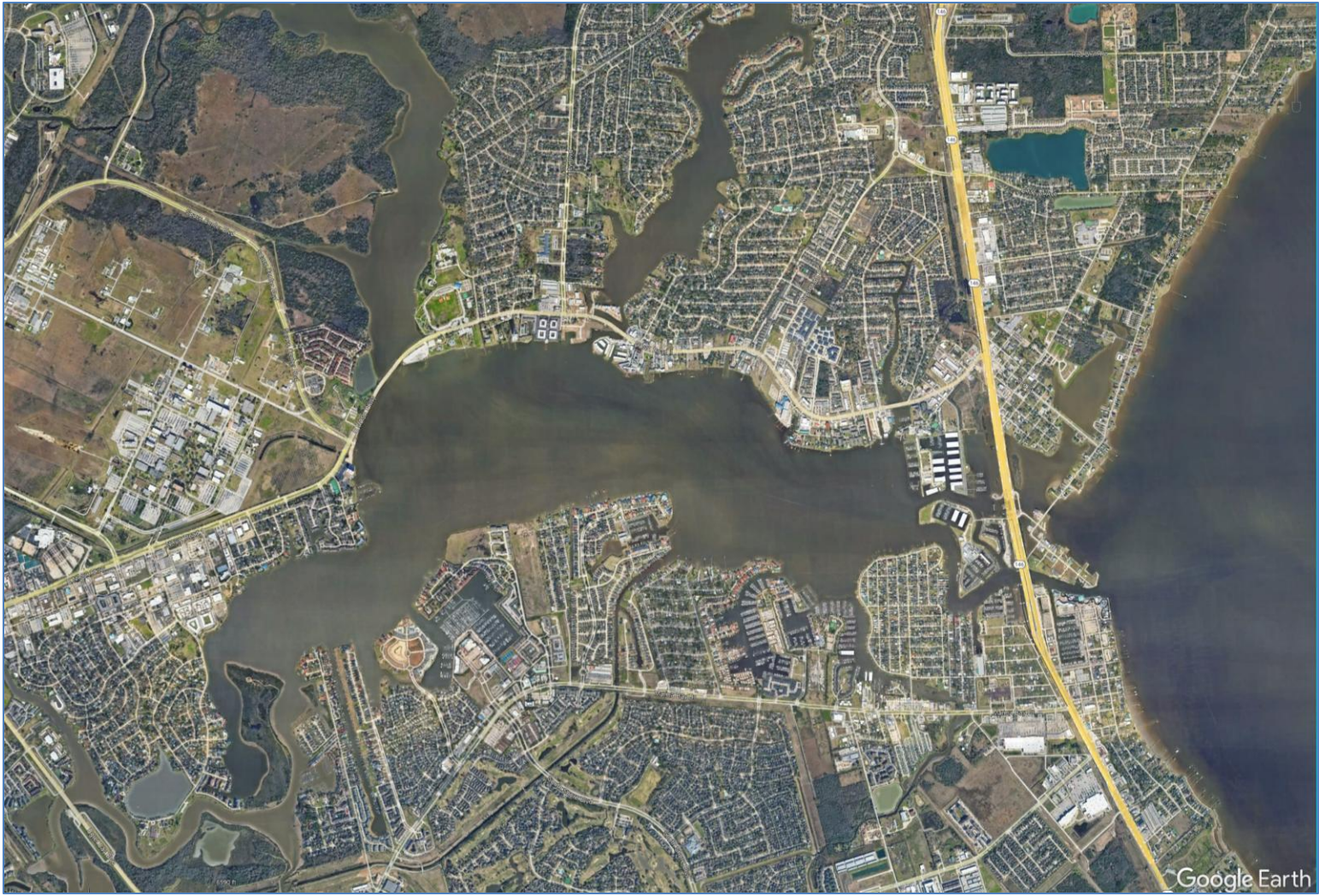


Clear Lake

Major Locations for Open Water Drownings

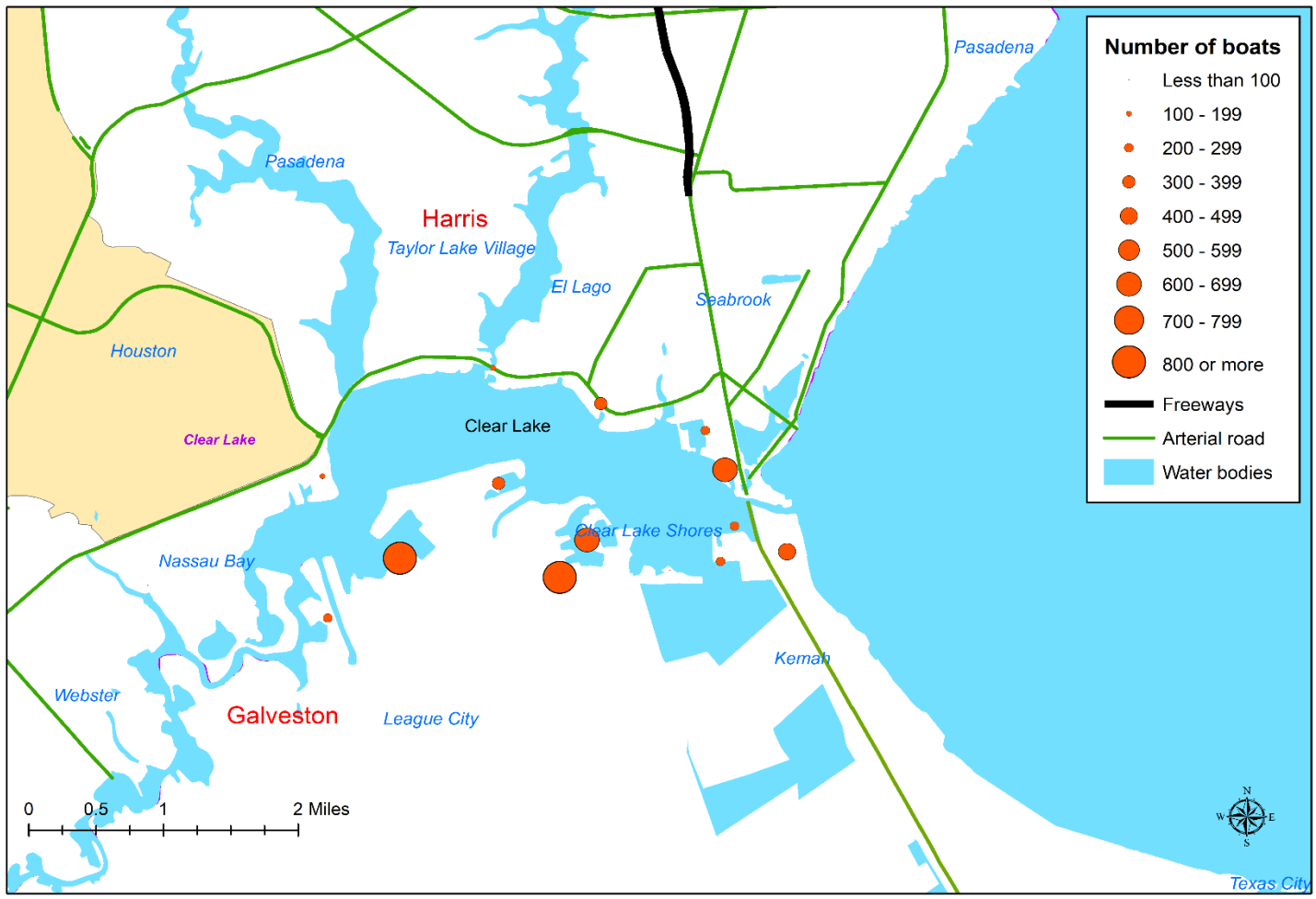
Places Where Many Fatal Drownings Occurred





Boat Marinas in the Clear Lake Area

Estimated 5,355 Boats Housed in 16 Marinas for Access to Open Water





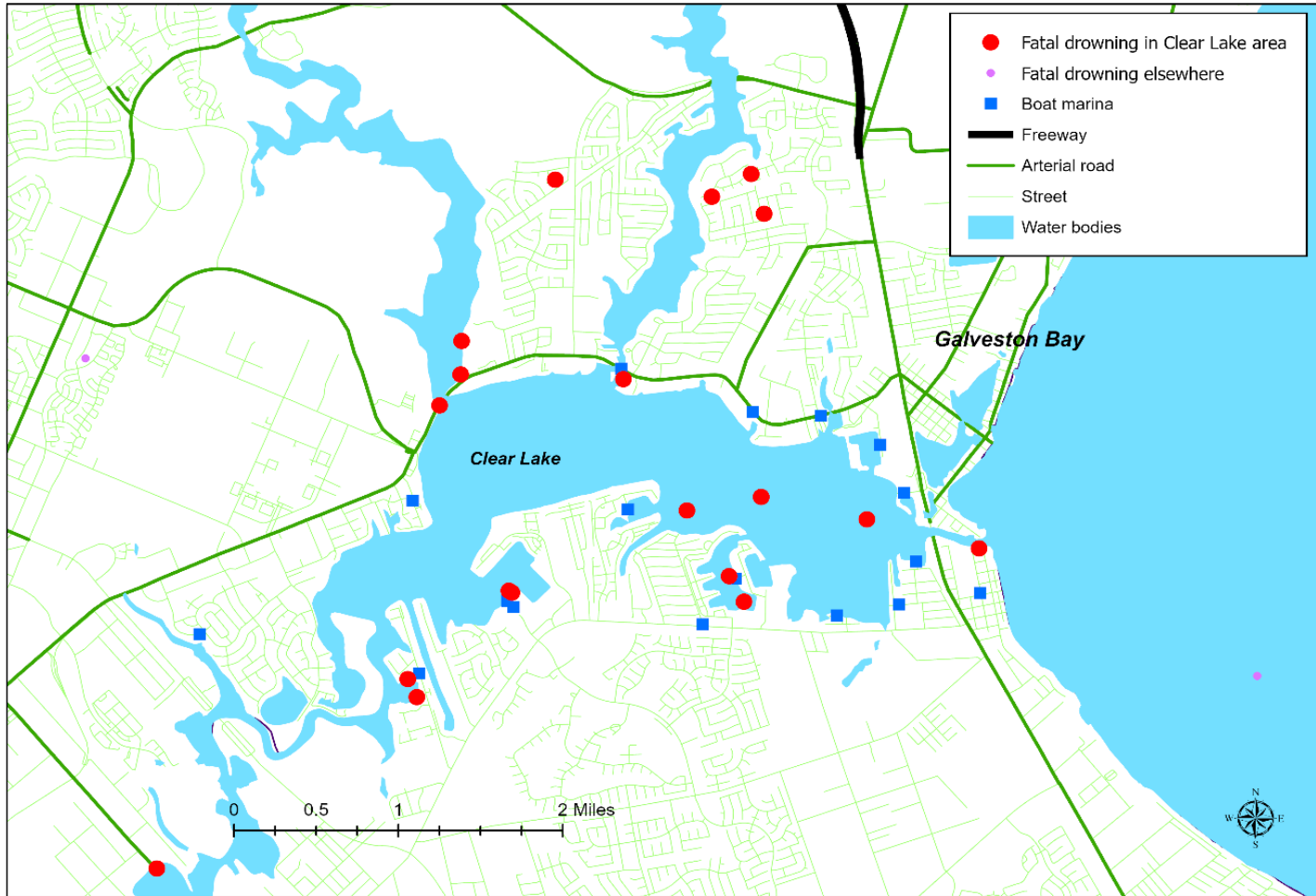
By Carol Highsmith, in the Library of Congress: <https://www.loc.gov/pictures/resource/highsm.12324/>



From: https://marinas.com/view/marina/4qc29z_Portofino_Harbour_Marina_and_Yacht_Club_Clear_Lake_Shores_TX_United_States

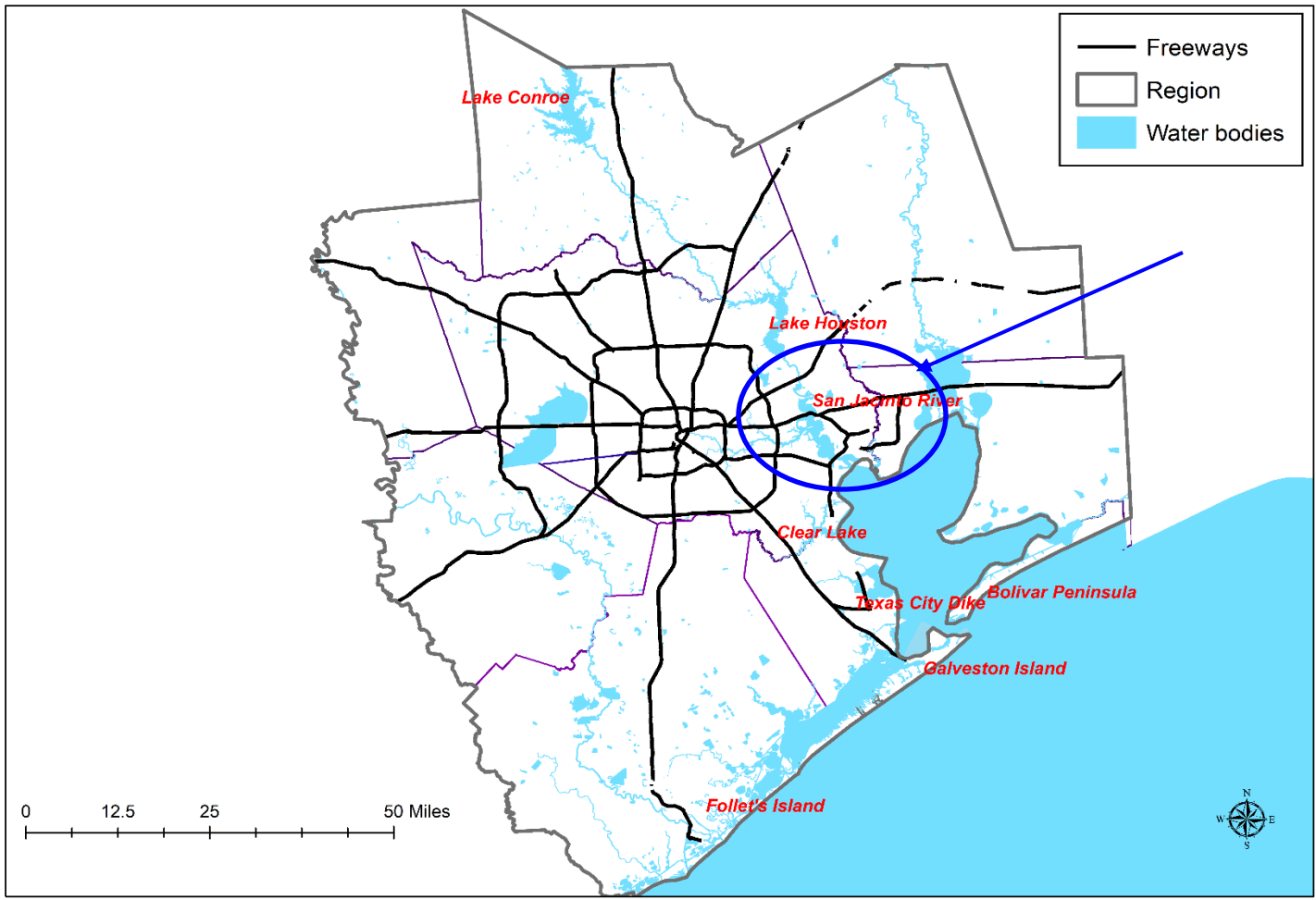
Fatal Open Water Drownings in Clear Lake: 2016-2022

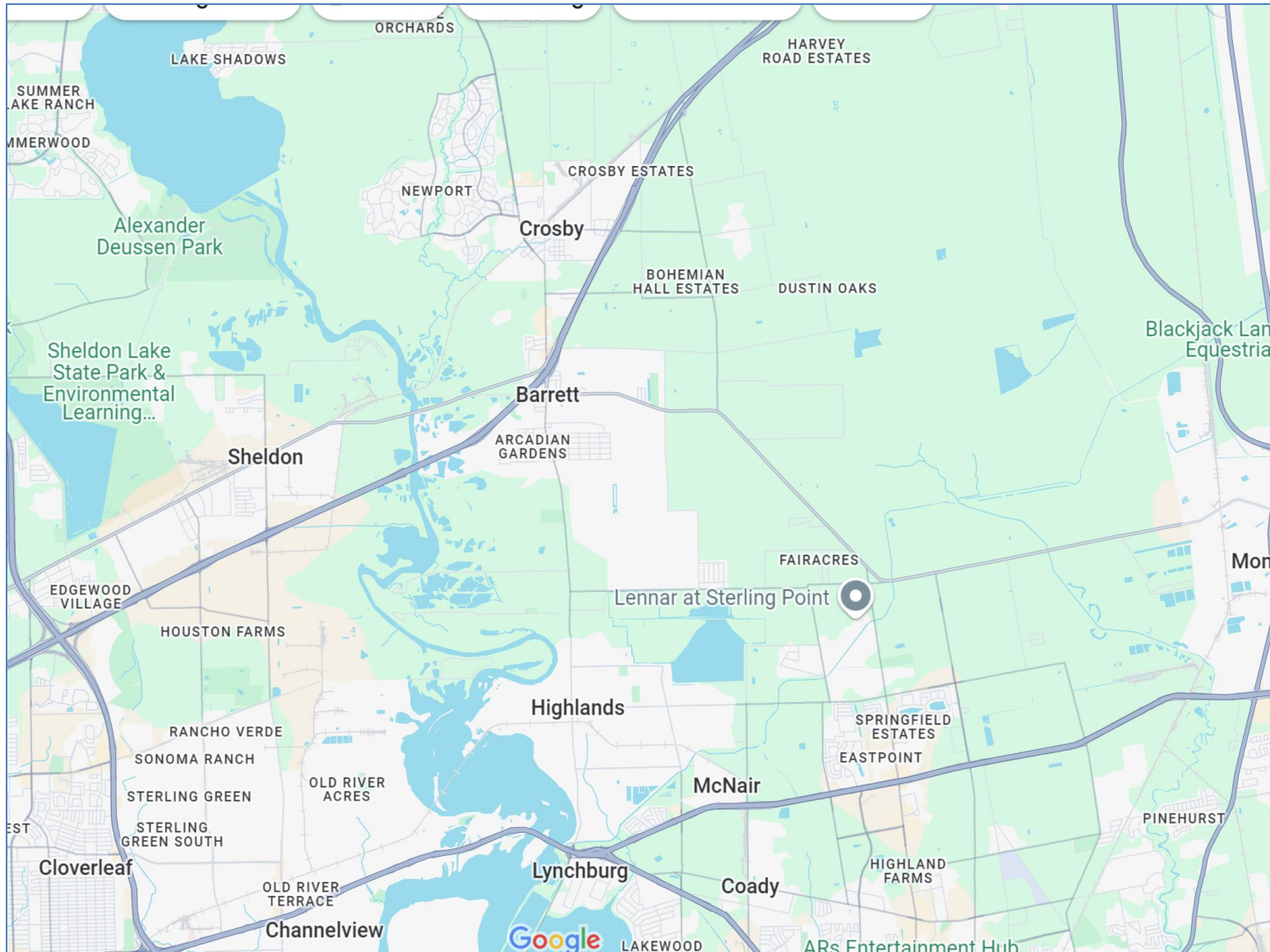
N=20 Known Fatal Drowning Locations



Major Locations for Open Water Drownings

Places Where Many Fatal Drownings Occurred





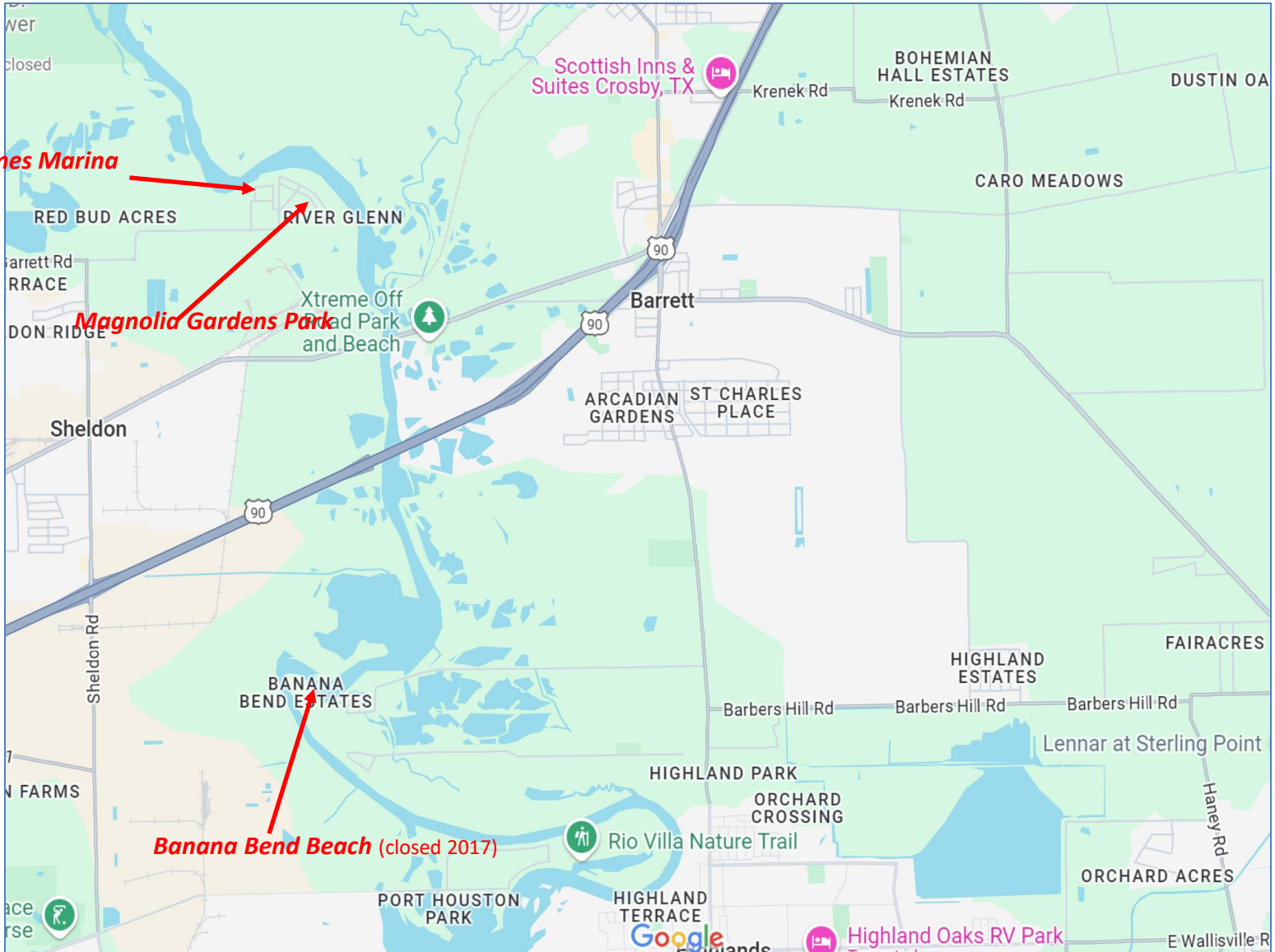
Good Times Marina



Magnolia Gardens Park



Banana Bend Beach (closed 2017)





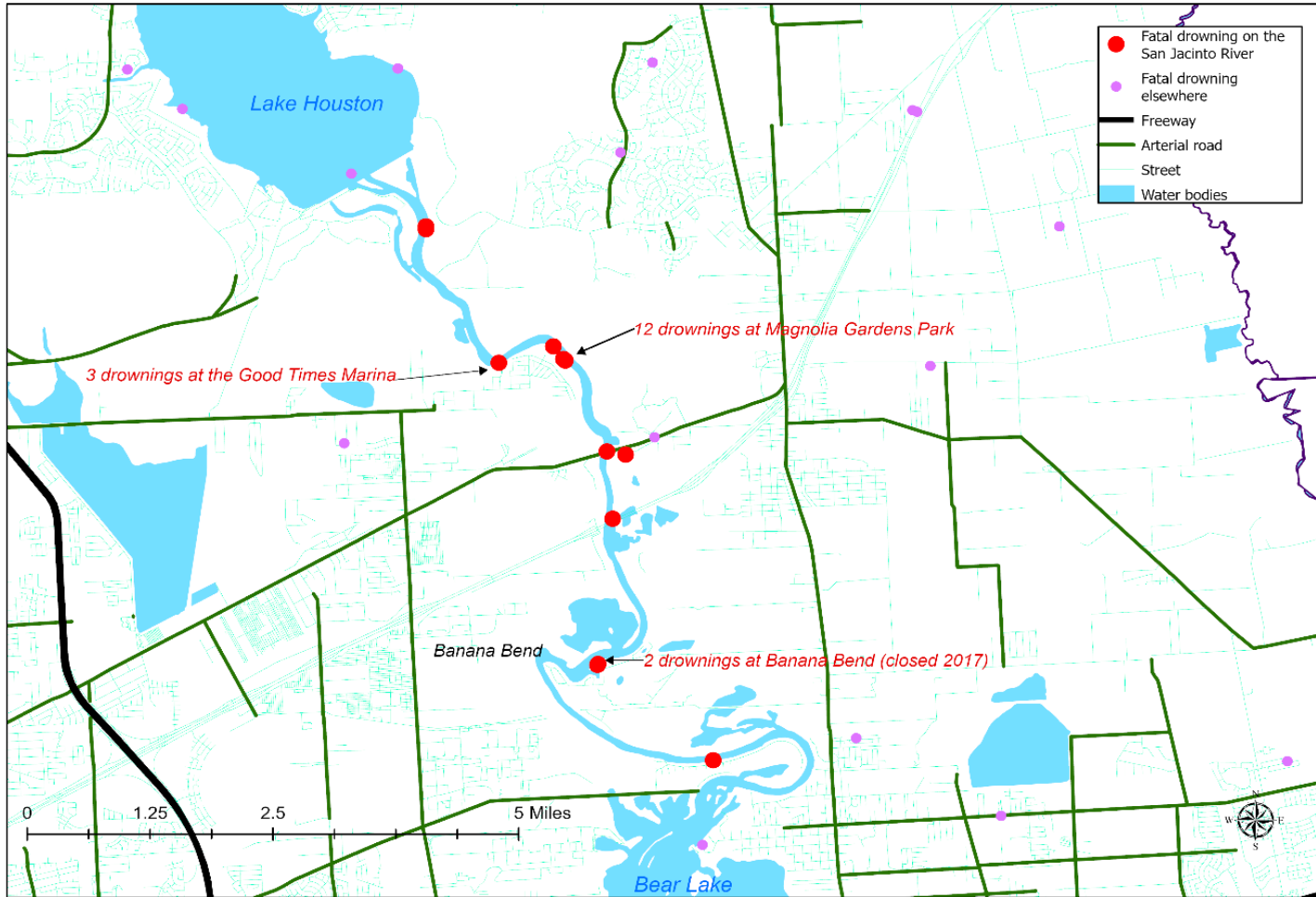
<https://youtu.be/3vTsWZuSebo>



https://s3-media0.fl.yelpcdn.com/bphoto/whgMxWfngsHjD8RSwo_9bg/348s.jpg

San Jacinto River Fatal Drownings: 2016-2022

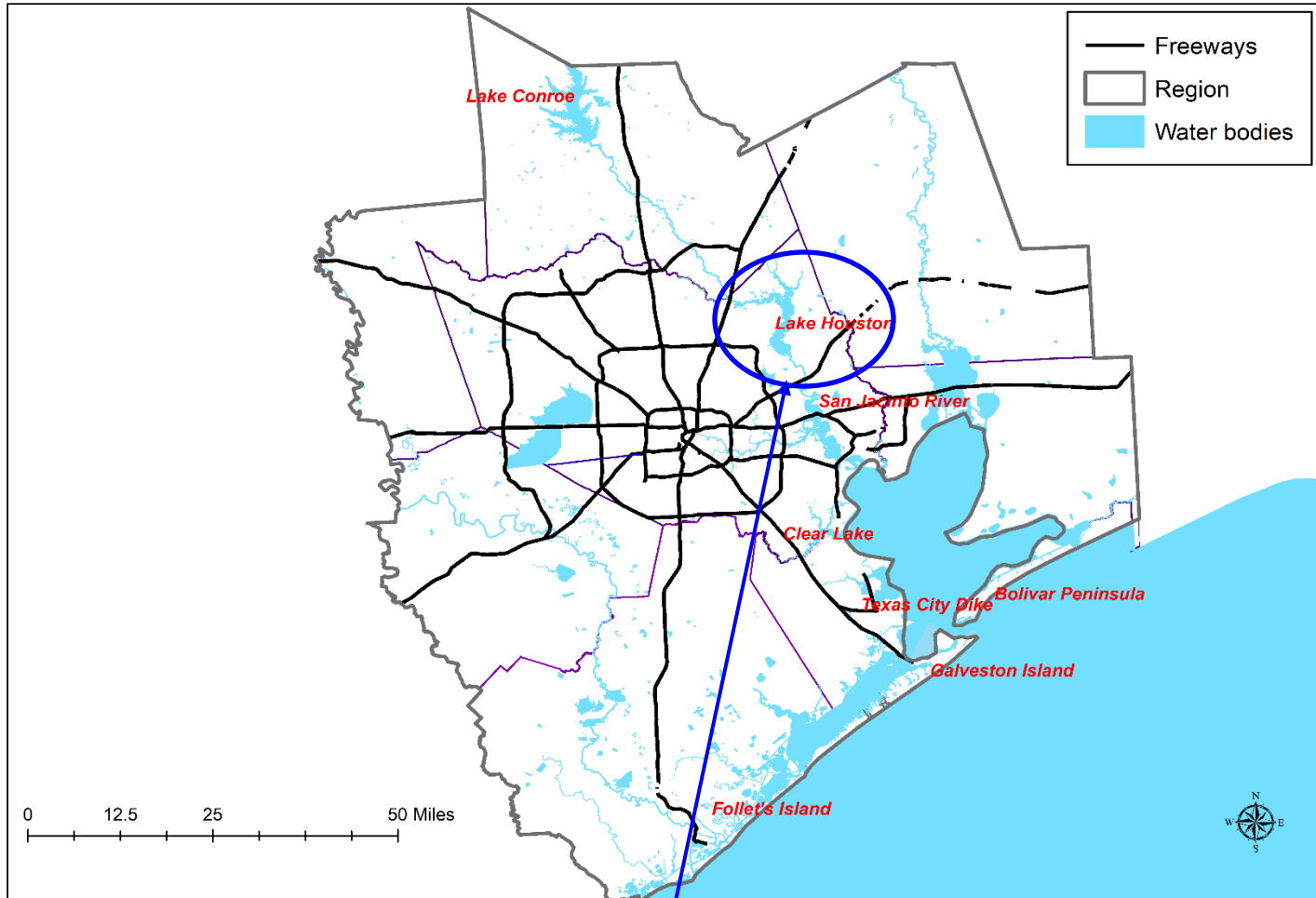
N=24 Known Fatal Drowning Locations

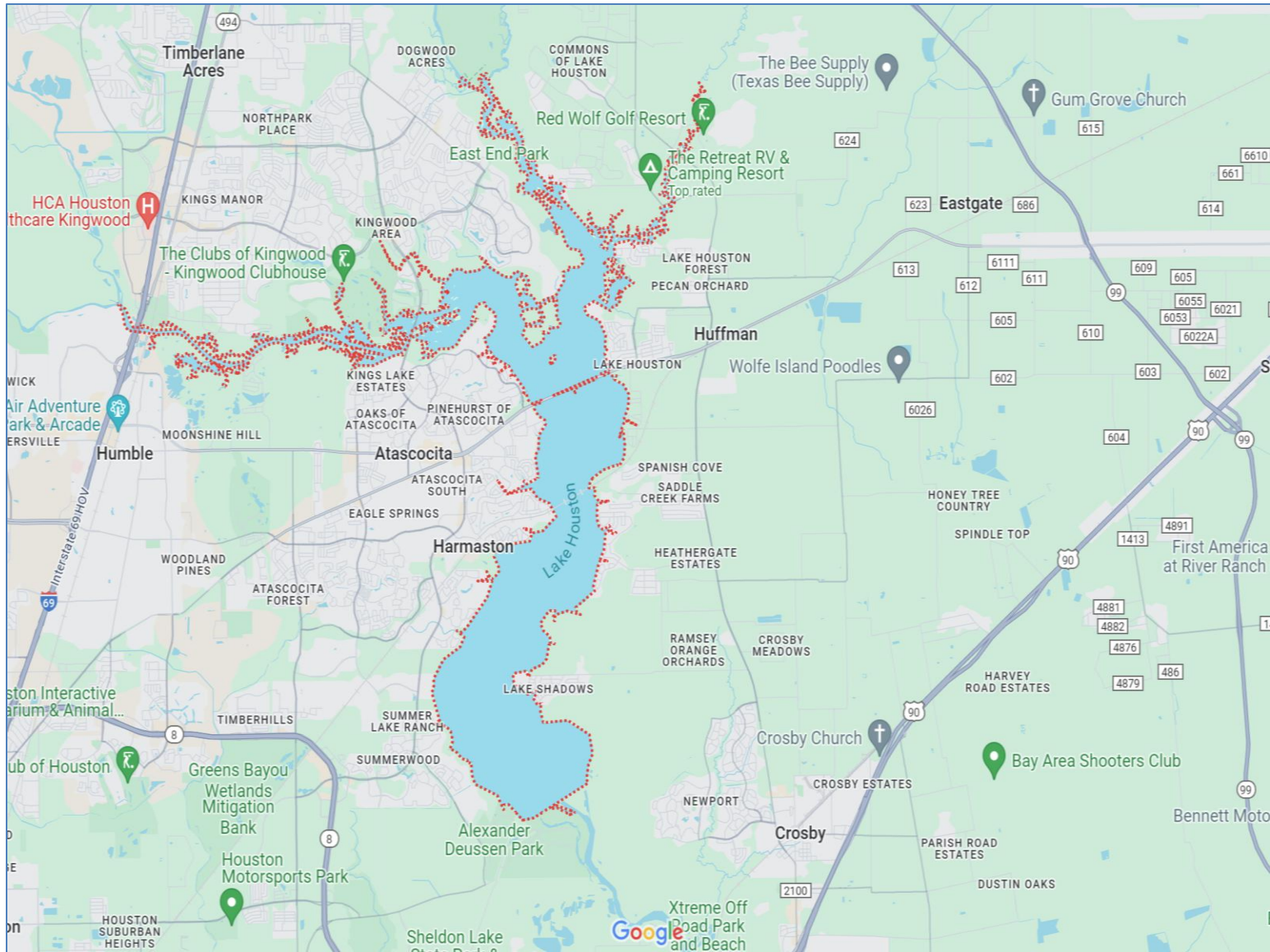


Lake Houston

Major Locations for Open Water Drownings

Places Where Many Fatal Drownings Occurred







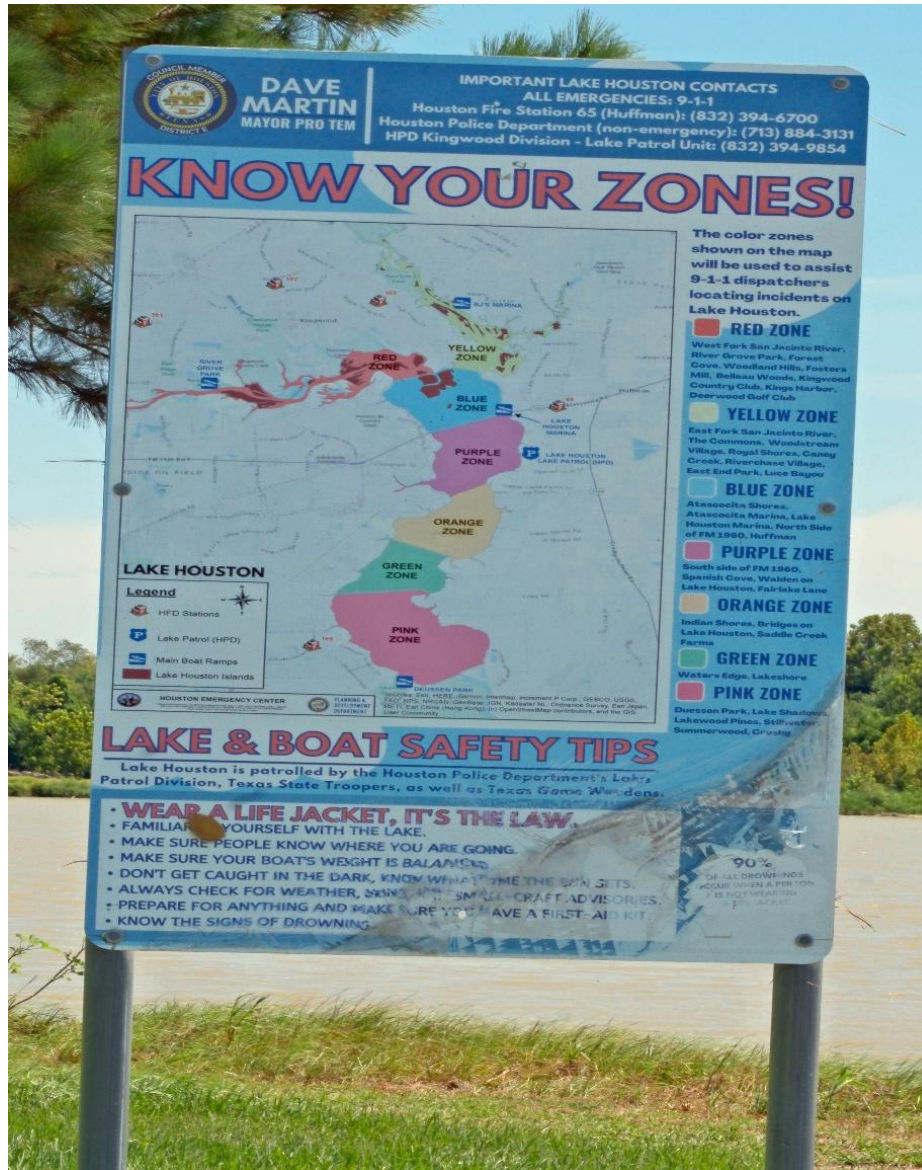
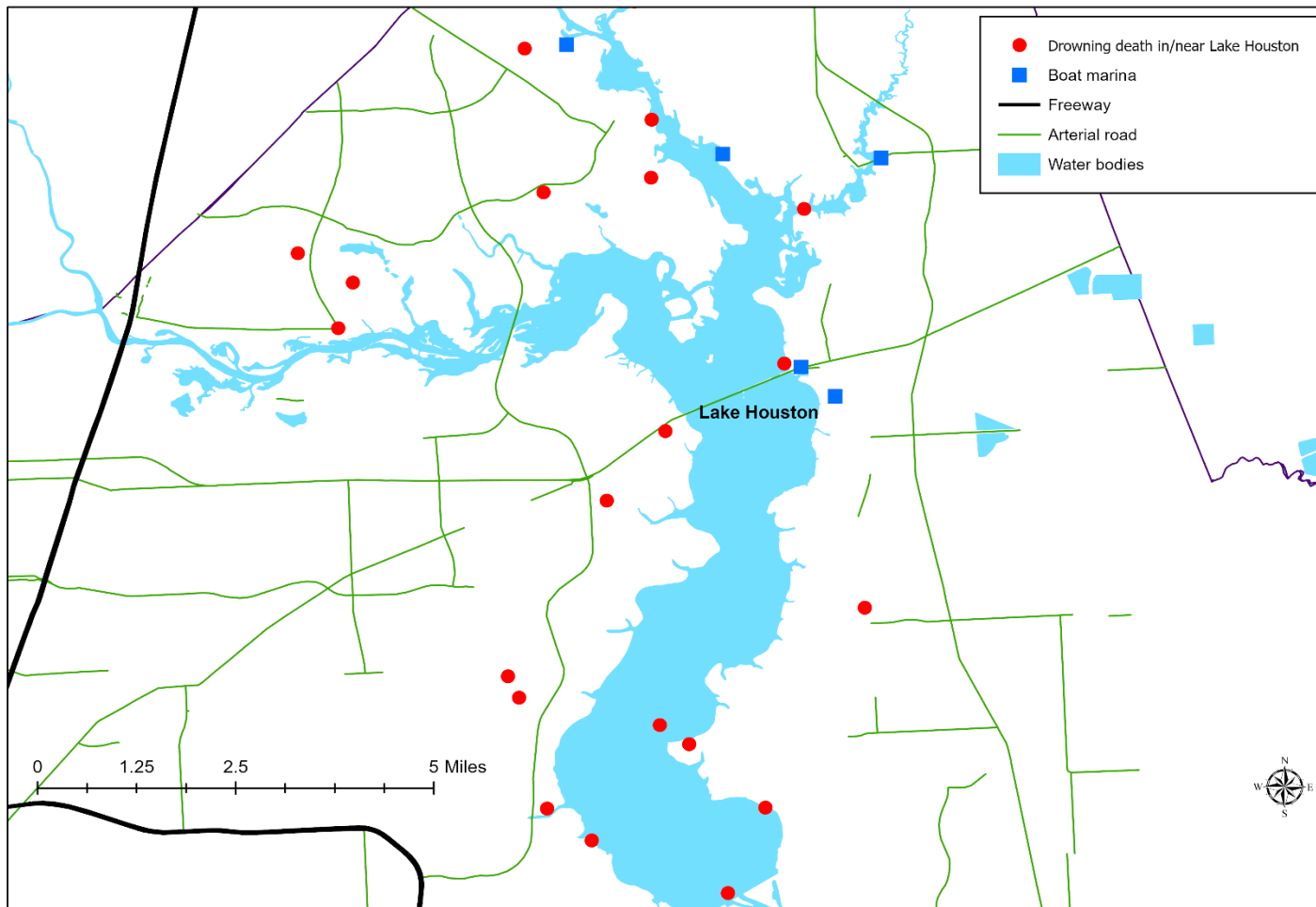


Photo by Ned Levine

Fatal Drownings In/Near Lake Houston: 2016-2022

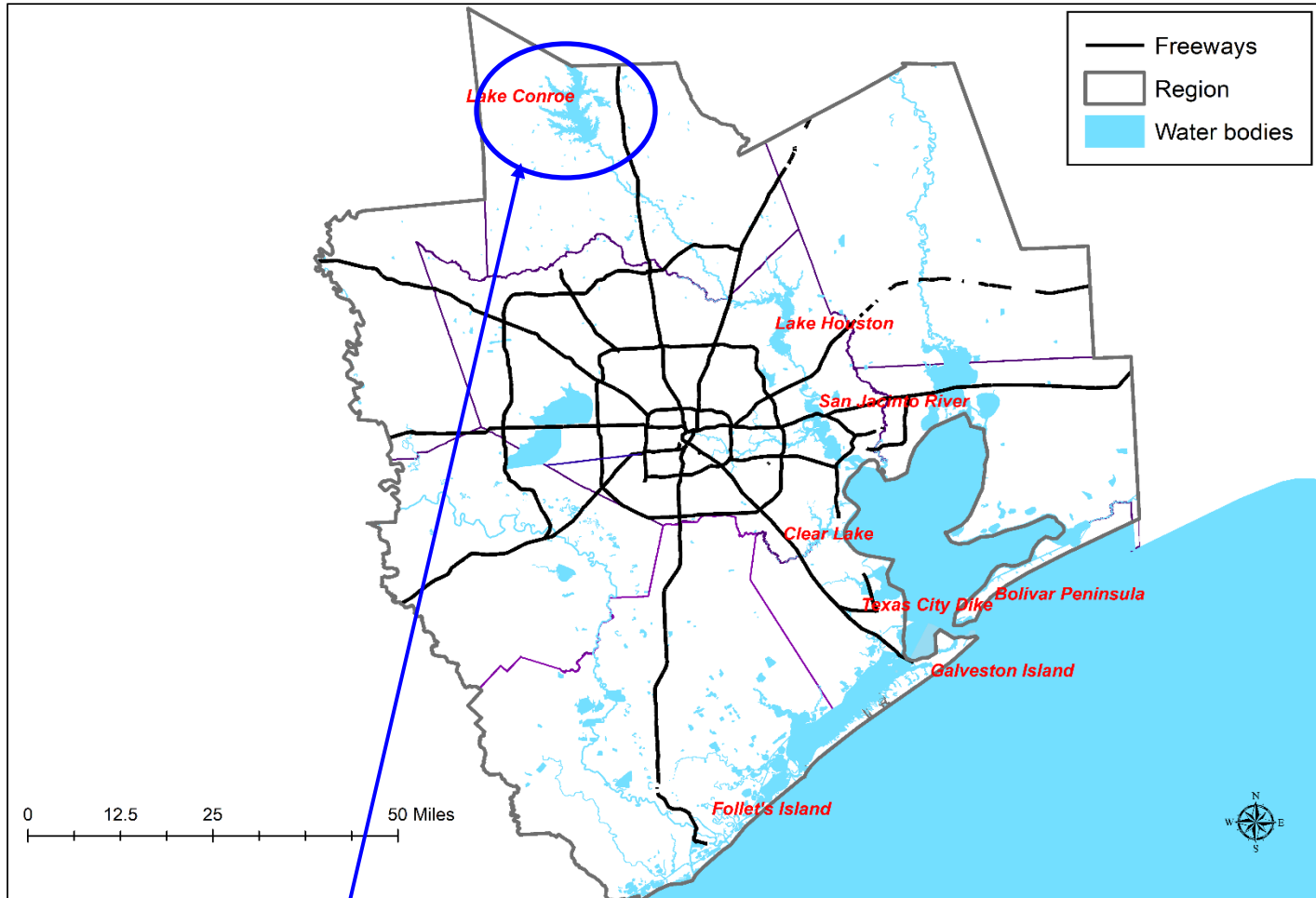
N=11 Natural Water Drownings; 5 Pool Drownings; 5 Bathtub Drownings

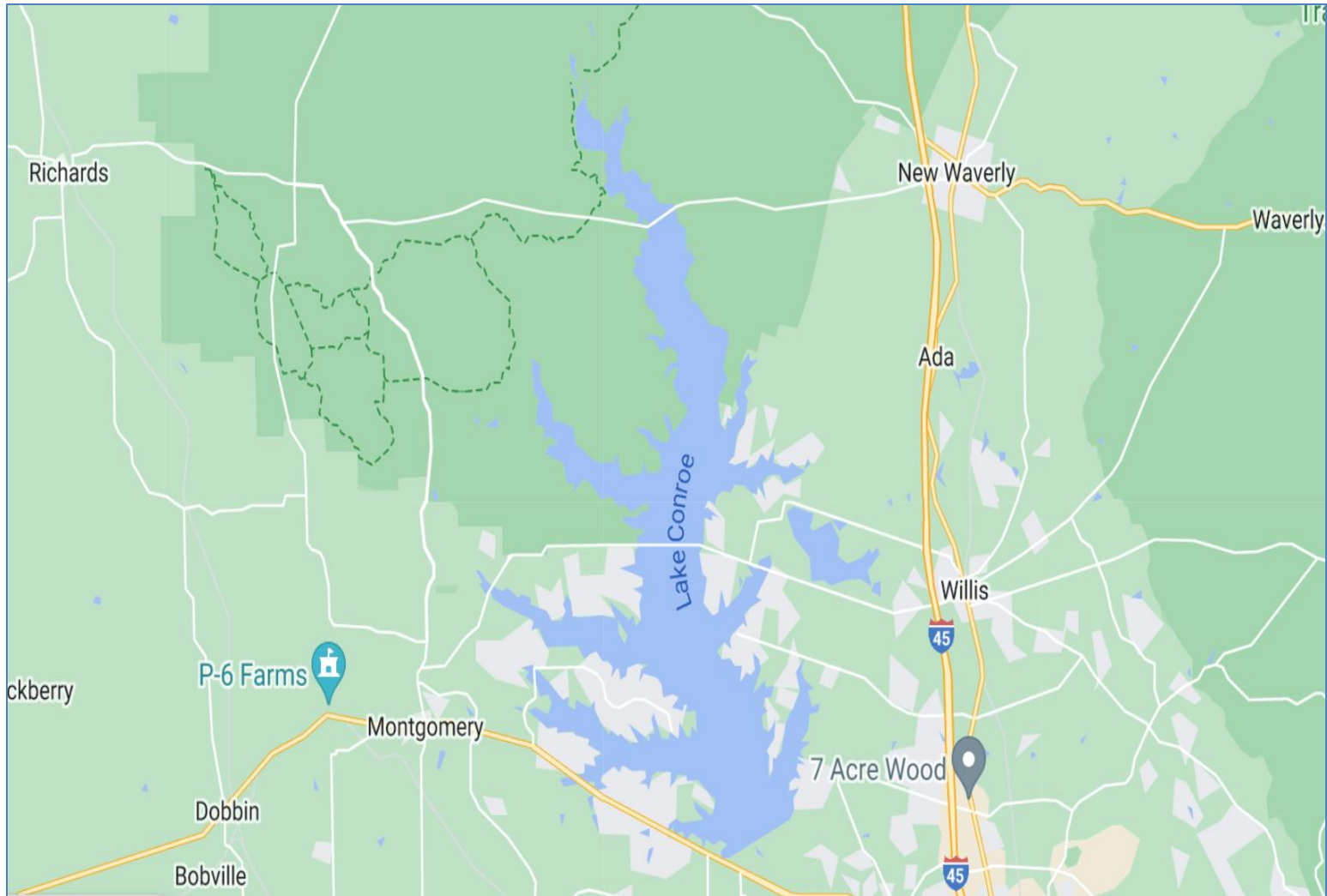


Lake Conroe

Major Locations for Open Water Drownings

Places Where Many Fatal Drownings Occurred







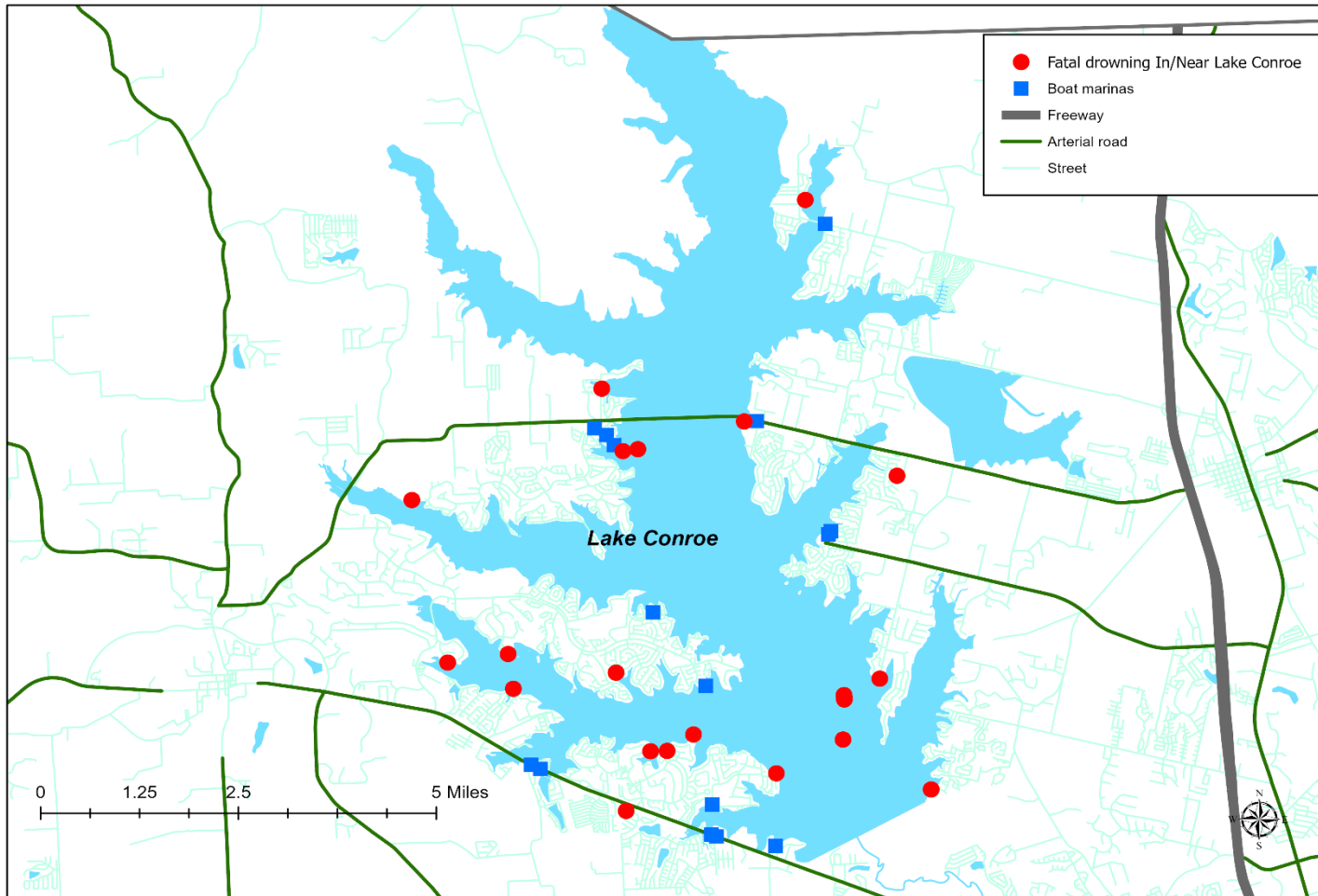
From: <https://archive.lakeconroe.com/photos/aerials.cfm>



From: <https://www.conroeedc.org/quality-of-place/recreation/>

Fatal Drownings In/Near Lake Conroe: 2016-2022

N=24 Drownings in Lake Conroe, 1 Drowning in Bayou, 2 Drownings in Pools



What Can Be Done to Reduce Drownings?

Actions for Local Governments and Private Organizations

- **Increase swimming lessons for youth**
 - Minorities and economically challenged
- **Increase life jacket use for:**
 - Children
 - People with limited swimming skills
 - Boaters
 - Reinforce public information
 - Loaner life jackets at high-risk locations
- **Improved signage at high-risk locations**
 - Placed where risk is located
 - Alcohol use
- **More lifeguards**
 - Beach patrol
- **Engineering to eliminate hazards**
 - Barriers (*e.g., at river parks*)

Community Advisory Group - Houston

- **Established: October 2023**
- **Mission: Foster safe aquatic environments in Houston & Harris County**
- **Meet monthly: 2nd Tuesday at 11:00 am**
- **Local Stakeholders**

YMCA, Harris County Aquatics

City of Houston Water Safety Inspection

Houston Health Department

Harris County Public Health

Greater Houston Safe Kids

Baylor College of Medicine; McGovern Medical School

Parent advocates

Houston Apartment Association

Texas EMSC

For Contact Information

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