

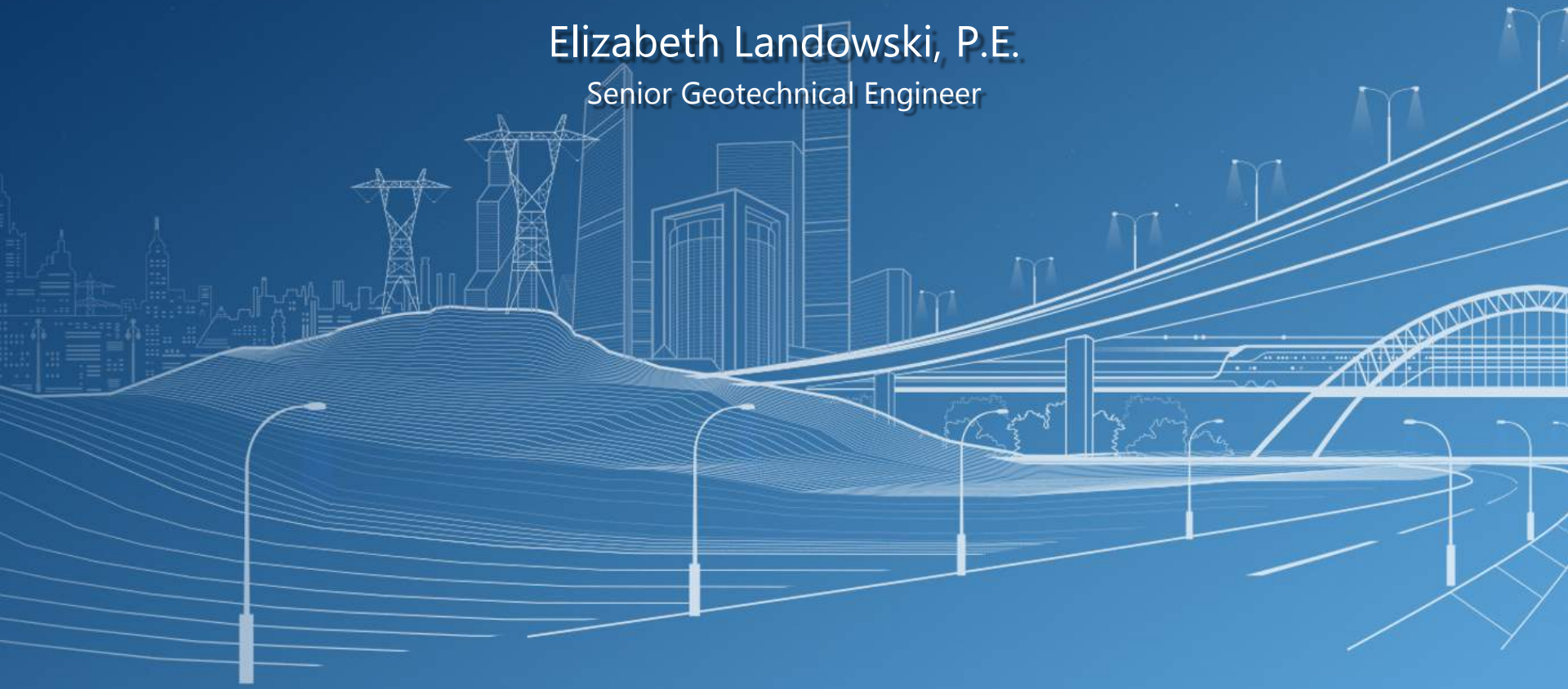


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FLIPPING THE SCRIPT ON INFRASTRUCTURE INVESTMENT

Elizabeth Landowski, P.E.
Senior Geotechnical Engineer



Food
Water
Shelter
Infrastructure



INFRASTRUCTURE FAILURES



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Northeast Blackout

- **August 14, 2003**
- **12 seconds**
- **50 million people**
- **Up to 2 days**
- **Estimated \$500 million in business losses in NYC alone**
- **No public transportation, elevators, some with no water**
- **Improper maintenance**



Photo courtesy of <https://hubpages.com/technology/The-Great-Northeast-Blackout-of-2003>

New Orleans Levees



- **August 29, 2005**
- **Multiple levee breaches**
 - 17th St Canal
 - Lower 9th Ward
- **Over 1,500 lives lost**
- **75-80% of New Orleans was flooded**
- **Lack of surveys**

I-35W Bridge, Minneapolis

- August 1, 2007
- 1000 ft of bridge deck collapsed
- 111 cars fell into the Mississippi
- 13 lives lost
- 145 people injured

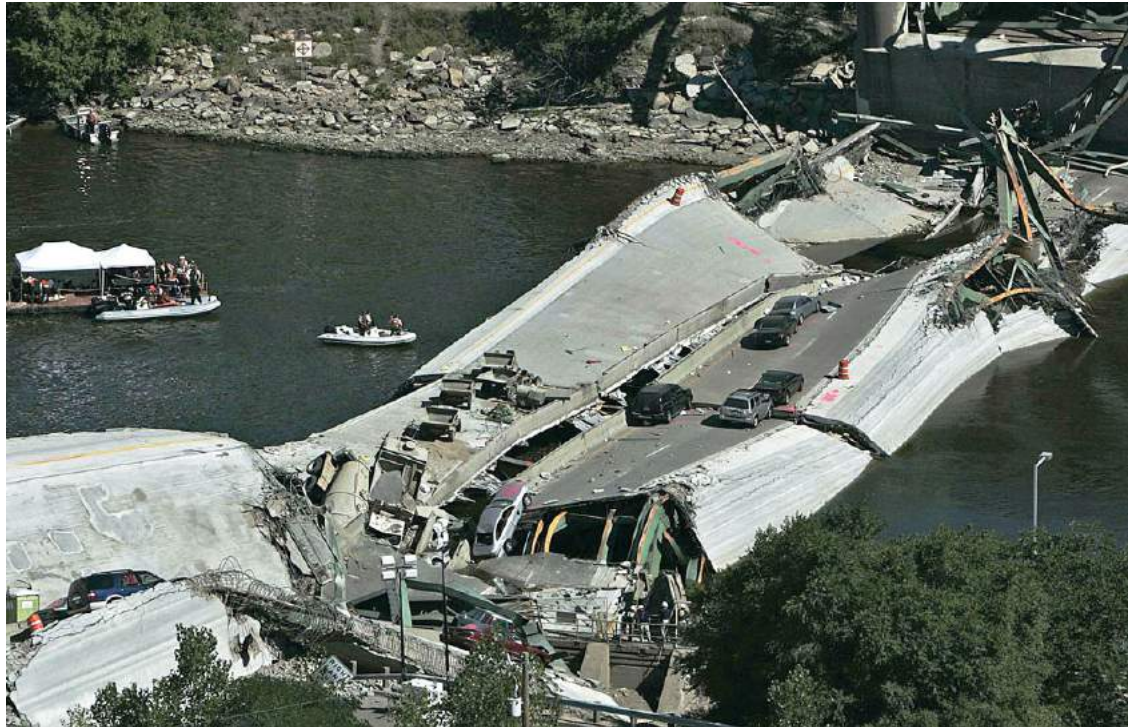


Photo courtesy of <http://dailyreporter.com/files/2013/05/Bridge1.jpg>

*“Contributing to the design error was the failure of Sverdrup & Parcel’s quality control procedures to ensure that the appropriate main truss gusset plate calculations were performed for the I-35W bridge and the inadequate design review by Federal and State transportation officials. **Contributing to the accident was the generally accepted practice among Federal and State transportation officials of giving inadequate attention to gusset plates during inspections for conditions of distortion, such as bowing, and of excluding gusset plates in load rating analyses.**”*

-NTSB Accident Report

Flint, Michigan



Photo courtesy of <http://www.npr.org/sections/thetwo-way/2016/04/20/465545378/lead-laced-water-in-flint-a-step-by-step-look-at-the-makings-of-a-crisis>

"From a regulatory standpoint, to a protection of human health and the environment standpoint, they missed the boat completely. And it is extremely troublesome to me that an agency whose primary role, once again, is to protect human health and the environment came to these decisions, and they never backed off these decisions, no matter how many red flags they saw."

-Chris Kolb, Member, Investigation Task Force

- **2011: City in debit**
- **2012: Attempt to lower water costs**
- **2013: Detroit Water and Sewerage Dept (DWSD) would end service in a year**
- **2014: New pipelines were not completed yet, use Flint River in interim**
 - Citizens complain
 - Additional chlorine added
- **2015: No responsibility**
 - State buys bottled water for the government offices
 - Children become ill
 - Revert back to DWSD
- **2016: Water is still unsafe**

Oroville Dam

- Early 2017
- Oroville, California
- 770 ft high
- 50 years old
- Significant rainfall
- 40-ft deep hole developed in main spillway
- Emergency spillway activated, then showed signs of potential failure
- Nearly 200,000 people evacuated
- New concerns with seepage



Photo courtesy of <http://www.enr.com/articles/41983-experts-identify-preliminary-causes-for-oroville-dam-spillway-failure>

Other Failures

- Baldwin Hills Reservoir, California (1963)
- Swift Dam, Montana (1964)
- Kansas Avenue Bridge Collapse (1965)
- Silver Bridge, West Virginia and Ohio (1967)
- Buffalo Creek Dams, West Virginia (1972)
- Canyon Lake Dam, South Dakota (1972)
- Green Island Bridge, New York (1977)
- Laurel Run Dam, Pennsylvania (1977)
- Tompkins Hill Road Overpass, California (1980)
- Lawn Lake Dam, Colorado (1982)
- Mianus River Bridge, Connecticut (1983)
- Hatchie River Bridge, Tennessee (1989)
- Meadow Pond Dam, New Hampshire (1996)
- Hoan Bridge, Wisconsin (2000)
- California Electricity Crisis (2000-2001)
- Hope Mills Dam, North Carolina (2003)
- Silver Lake Dam, Michigan (2003)
- Big Bay Dam, Mississippi (2004)
- Ka Loko Dam, Hawaii (2006)
- NYC Steam Explosion (2007)
- Lake Delton, Wisconsin (2008)
- Cedar Rapids and Iowa City Railway, Iowa (2008)
- Delhi Dam, Iowa (2010)
- Jay Cooke State Park Swinging Bridge, Minnesota (2012)
- Water Main Break at UCLA, California (2014)
- Numerous Dam Breaches, South Carolina (2015)
- I-10 Bridge, California (2015)
- Bob White Covered Bridge, Virginia (2015)

INFRASTRUCTURE REPORT CARD



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ASCE's Infrastructure Report Card

Categories

- | | |
|-------------------------|-----------------------|
| Aviation | • Ports |
| Bridges | • Public Parks |
| Dams | • Rail |
| Drinking Water | • Roads |
| Energy | • Schools |
| Hazardous Waste | • Solid Waste |
| Inland Waterways | • Transit |
| Levees | • Wastewater |

Source: ASCE Infrastructure Report Card <http://www.infrastructurereportcard.org/>



ASCE's Infrastructure Report Card

Criteria

- **Capacity**
- **Condition**
- **Funding**
- **Future Need**
- **Operation and Maintenance**
- **Public Safety**
- **Resilience**
- **Innovation**

Grades

- **A: Exceptional, Fit for the Future**
- **B: Good, Adequate for Now**
- **C: Mediocre, Requires Attention**
- **D: Poor, at Risk**
- **F: Failing/Critical, Unfit for Purpose**

Source: ASCE Infrastructure Report Card <http://www.infrastructurereportcard.org/making-the-grade/what-makes-a-grade/>

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Source: ASCE Infrastructure Report Card <http://www.infrastructurereportcard.org/making-the-grade/what-makes-a-grade/>

Current State of Infrastructure

D+

Source: ASCE Infrastructure Report Card <http://www.infrastructurereportcard.org/>



Current State of Infrastructure

Grades by Category

Aviation: D

Bridges: C+

Dams: D

Drinking Water: D

Energy: D+

Hazardous Waste: D+

Inland Waterways: D

Levees: D

Ports: C+

Public Parks: D+

Rail: B

Roads: D

Schools: D+

Solid Waste: C+

Transit: D-

Wastewater: D+

Source: ASCE 2017 Infrastructure Report Card <http://www.infrastructurereportcard.org/>

STAGGERING STATISTICS

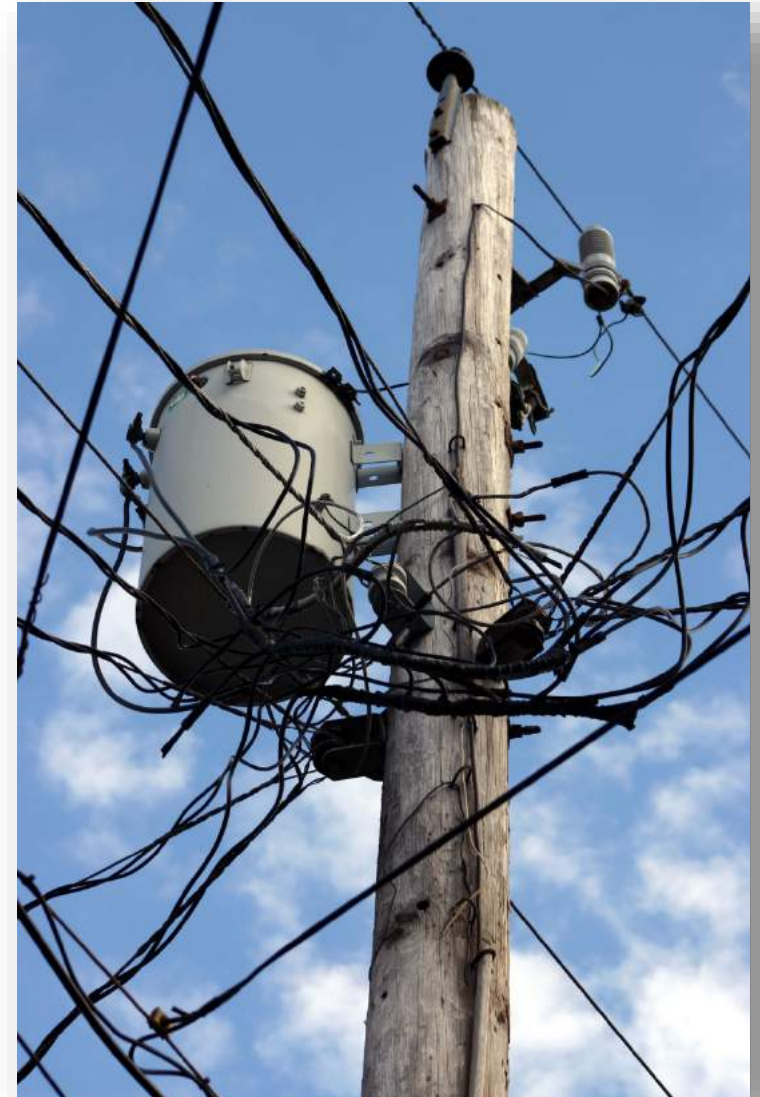


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Electrical Grid

- **Since early 1900s**
 - 10,000 power plants
 - 160,000 miles of high voltage transmission lines
 - 160,000,000 utility poles
- **Outages of ≥ 100 MW ($\approx 75,000$ homes) doubled since 1990s**
 - America: 214 mins/yr of blackouts
 - Britain: 70 mins/yr
 - Japan: 6 mins/yr

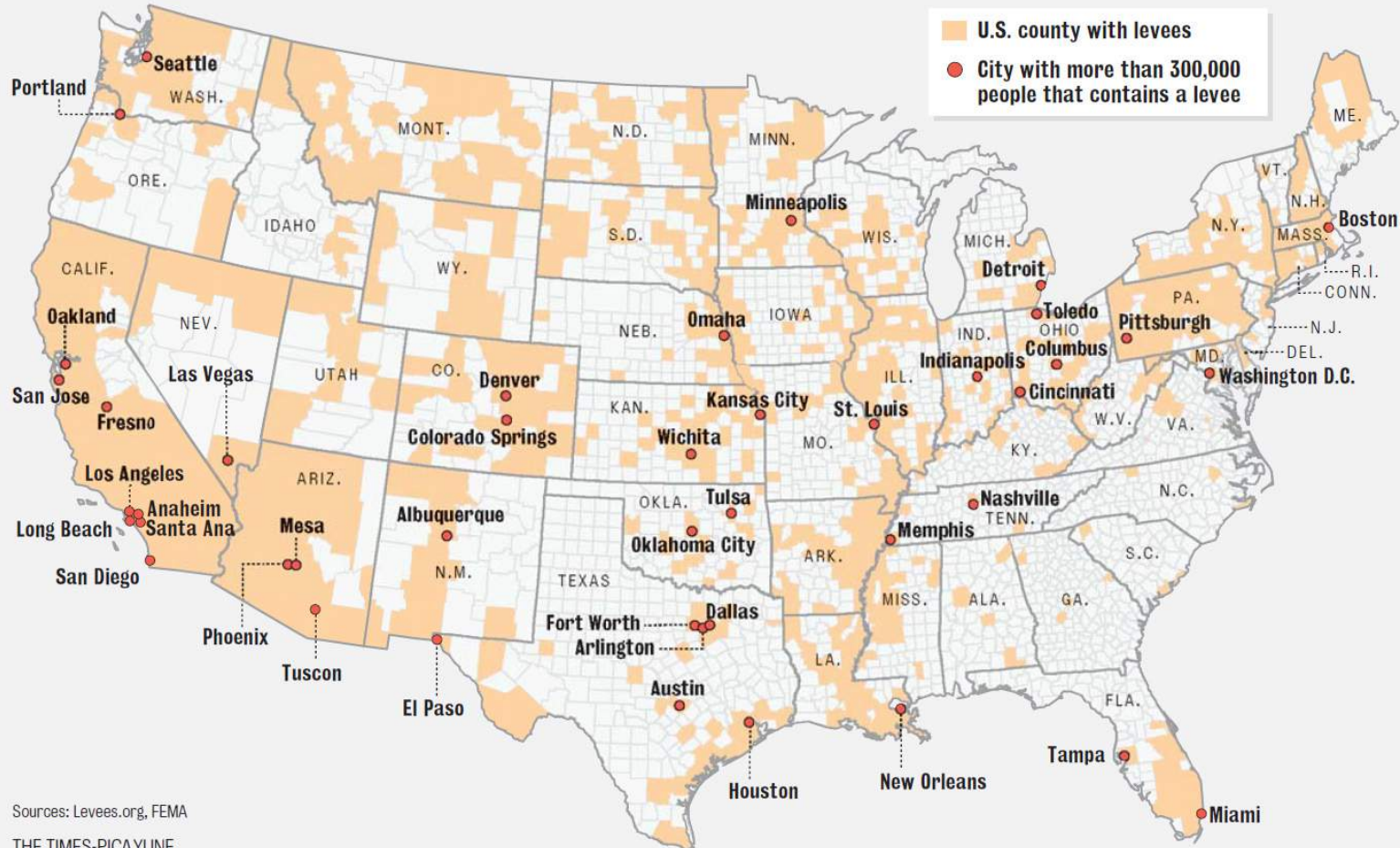


Levees



Levees

LEVEES EVERYWHERE There are 881 counties in the U.S. with levees. Those counties contain more than 50 percent of the nation's population.



THE TIMES-PICAYUNE

Levees

- **Protect against flooding**
- **Miles of levees:**
 - 30,000 miles
 - Est. 100,000 miles
- **Average age: 50 years**
- **Protection:**
 - Two-thirds of Americans
 - \$1.3 trillion in property
- **Est. \$80 billion over ten years**
- **WRRDA2014 - \$395 million**



Bridges



Bridges



Bridges



- **Over 600,000 bridges in the US**
- **39% are 50 years or older**
- **1 in 11 are structurally deficient**
- **188 million trips over these deficient bridges every day**
- **Est. \$123 million**

New I-35W Bridge

Photo courtesy of <http://www.newsline.dot.state.mn.us/archive/09/sep/16.html>

- **September 2008**
- **\$234 million**
- **Design life: 100 years**
- **10 lanes**
- **Light-rail ready**
- **Innovative**
 - Sensors
 - Materials
 - Carbon absorbers



Water



Photo courtesy of <http://newsroom.ucla.edu/releases/california-water-agencies-dont-know-how-much-their-pipes-leak-ucla-report-finds>

- **6 Billion gallons lost**
 - NYC: 10%
 - Atlanta: 14%
 - Buffalo: 40%
 - California: ??
- **240,000 water main breaks/yr**

Wastewater

- **Combined Sewage and Stormwater Systems**
 - 700 cities
 - 900 billion gallons
 - St. Louis: 13 billion gallons



Photo courtesy of <http://exeternh.gov/publicworks/wastewater-reports>

Dams



- 90,580 dams in US
- Average age: 56 yr
- 4,500 over 100 yr
- Approx. 15,500 considered high hazard
- Approx. 2,100 are deficient HH
- Mostly overseen by states: \$60 billion
- USACE: \$25 billion for HH over 50 years
- USBR: \$2 billion for HH and SH over 15 years

Global Infrastructure

Ranking of the Nations based on Infrastructure by the World Economic Forum:

1. Hong Kong
2. Singapore
3. Netherlands
4. United Arab Emirates
5. Japan
6. Switzerland
7. Germany
8. France
9. United Kingdom
10. Spain

\$4.6 trillion

National Society of Professional Engineers: Code of Ethics

“Engineers, in fulfillment of their professional duties, shall hold paramount the safety, health, and welfare of the public.”

Order of the Engineer: Obligation

"As an Engineer, I shall participate in none but honest enterprises. When needed, my skill and knowledge shall be given without reservation for the public good. In the performance of duty and in fidelity to my profession, I shall give the utmost."

Tau Beta Pi (Engineering Honor Society): Code of Ethics of Engineers

“Engineers shall hold paramount the safety, health, and welfare of the public in the performance of their professional duties.”

WHAT NOW?



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Food
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QUESTIONS?

DISCUSSION?

Last Week Tonight with John Oliver: Infrastructure Movie Trailer





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Thank You!

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