FOUR Revolutions: What Will the U.S. Do About Them?

Brig. Gen. Duke DeLuca
President, Miss River Commission
Cmdg Gen, Miss Valley Division USACE
14 May 2014
World’s Largest Naturally Navigable Watershed

41% of U.S. drainage flows through the body of the nation.
Revolution #1: Explosive Growth in US Agricultural Productivity
Revolution #2: Hydrocarbon Production Revolution

- Unconventional Oil and Gas Production Methods
  - Horizontal Drilling, Hydraulic Fracturing of Shale

- US Oil Production:
  - Grew 18% in last year alone
  - US will be World #1 producer in 2015 (more than KSA)

- US Natural Gas Production:
  - US is World #1 producer as of 2013 (more than Russia)

- Affects Many Other Industries including Chemical, Plastics, and all Manufacturing

*In China and India, equivalent degree compared to USA accredited institutions*
Revolution #3: Return of Manufacturing to the US and The Mississippi Valley


Chart showing the comparison of US and China manufacturing output from 1970 to 2009.
Revolution #4: Accelerating Impacts of Climate Change

- Changes to Weather
  - Precipitation more Intense – More Volume in Less Time
  - Increased Runoff from this and development
  - Significant Storm events of high intensity
    - Record number of >$1B events in 2013 (41 - 7 in US)
    - Increasing High Damage weather events 151 since 1980

- Changes to Watershed Functioning – part climate chg
  - Higher Stages with same or less flow as in the past (need new flow line for Mississippi River – underway)
  - Bottom Changes (Geomorphology study underway)
    - Accelerating Sea Level Rise
    - Louisiana Coastal land Loss is Relative SLR

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Percent changes in the amount of precipitation falling in very heavy events (the heaviest 1%) from 1958 to 2012 for each region. There is a clear national trend toward a greater amount of precipitation being concentrated in very heavy events, particularly in the Northeast and Midwest. (Figure source: updated from Karl et al. 2009).
The colors on the map show annual total precipitation changes for 1991-2012 compared to the 1901-1960 average, and show wetter conditions in most areas. The bars on the graph show average precipitation differences by decade for 1901-2012 (relative to the 1901-1960 average). The far right bar is for 2001-2012.

(Figure source: NOAA NCDC / CICS-NC.)
* Including Hurricane Irene, the US has experienced 10 billion-dollar weather events in 2011, as of September 1
This map illustrates the national scope of the dispersion of displaced people from Hurricane Katrina. It shows the location by zip code of the 800,000 displaced Louisiana residents who requested federal emergency assistance. The evacuees ended up dispersed across the entire nation, illustrating the wide-ranging impacts that can flow from extreme weather events, such as those that are projected to increase in frequency and/or intensity as climate continues to change. (Figure source: Kent 2006).
CO₂ Concentrations and Proxy Temperatures from the 400,000+ Vostok Ice Core Data Set

Global Temperature and Carbon Dioxide

Vostok Ice Core Data Temp v. CH$_4$

*Graphic courtesy of NASA, Goddard Institute for Space Studies. (http://www.giss.nasa.gov/research/features/200409_methane/)
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The full record of satellite measurements of the sun’s energy received at the top of the Earth’s atmosphere is shown in red, following its natural 11-year cycle of small ups and downs, without any net increase. Over the same period, global temperature relative to 1961-1990 average (shown in blue) has risen markedly. This is a clear indication that changes in the sun are not responsible for the observed warming over recent decades. (Figure source: NOAA NCDC / CICS-NC).
Separating Human and Natural Influences on Climate

The green band shows how global average temperature would have changed over the last century due to natural forces alone, as simulated by climate models. The blue band shows model simulations of the effects of human and natural forces (including solar and volcanic activity) combined. The black line shows the actual observed global average temperatures. Only with the inclusion of human influences can models reproduce the observed temperature changes. (Figure source: adapted from Huber and Knutti 2012).
Climate models project acceleration in Sea Level Rise starting before 2100 due to climate change. Many Areas through SE Coastal Louisiana See High Rates Now In Excess of 10mm

Grand Isle, Louisiana

Schematic of Potential Sea Level Change out to 2100 with various SLR Scenarios

Note: this an example only, as exact rates and timing of the accelerations are unknown
Within this century, 2,400 miles of major roadway are projected to be inundated by sea level rise in the Gulf Coast region. The map shows roadways at risk in the event of a sea level rise of about 4 feet, which is within the range of projections for this region in this century. In total, 24% of interstate highway miles and 28% of secondary road miles in the Gulf Coast region are at elevations below 4 feet. (Figure source: Kafalenos et al. 2008).
A substantial portion of U.S. energy facilities are located on the Gulf Coast as well as offshore in the Gulf of Mexico, where they are particularly vulnerable to hurricanes and other storms and sea level rise. (Figure source: U.S. Government Accountability Office 2006[^1]).

1927 vs. 2011 Mississippi River Record Flood: From “Levees Only” to “Room for the River”

- 1927 Flood = 16.8 million acres
- 2011 Flood = 6.4 million acres
- $14 billion Investment since 1928
- $234 billion damages prevented (2011)
  - $612 billion since 1928
  - 44 to 1 return on investment
- Over 4 million people protected
- $3 billion annual transportation rate savings
- Untold economic productivity enabled for farms, towns, factories
The Bottom Line:

- Our infrastructure makes delivery of domestic stability and security possible!
- Our infrastructure is degrading
- Our infrastructure is underperforming
- The US is under-investing in its infrastructure
- The US significantly lags other developed nations in its maintenance of prior investments.
- We stand to lose hard-fought ground earned by prior generations through their financial and personal sacrifices.
- Our economic prosperity, standard of living, and environmental quality are at risk.
- Our infrastructure is NOT disposable and should not be treated as such

_The United States is on an unsustainable glide-path!_
Historical Investments by USACE Functional Category
1928 to 2011

Billions of FY 2011 Dollars

Year


~$70.00 per person in the US!

~$56.00 per person in the US!

~$18.00 per person in the US!

Navigation  Flood  Multipurpose  MR&T  Dredging
Markland main chamber gate collapsed into river.

Greenup main chamber gate dropped when anchor point failed.

Monitoring of decaying sidewalls of John Day lock.
Effects of Decreased Investment

Since 2000:
• ~50% increase in down time
• Threefold increase in forced outages!
Issues facing levee systems across the nation.
Effects of Decreased Investment

Since 2000:
• ~50% decrease in availability
• Twofold increase in scheduled outages!
Recent Major Lock Outages

- **Lockport Wall Collapse**
  - Oct 2011
  - Closed 4 days

- **Locks 27 Protection Cell**
  - Sep 2012
  - Closed 6 days
  - $16m in Transportation impacts

- **Marseilles Miter Gate**
  - Mar 2013
  - Closed 7 days

- **Mel Price Main Chamber Liftgate Cables**
  - Closed 6 days
  - $16m in Transportation impacts

- **Red River - Lock 2**
  - Strut Arm Bushing Failure
  - April 2012
  - Closed 15 days

- **Harvey Gate Machinery**
  - Closed 15-18 Feb 2013

- **IHNC**
  - Closed 4-14 Jan 2014
  - Queue 86+

- **La Grange**
  - Dam Allision
  - Closed 10-16 Jan 2014
  - Gate Allision

- **Algiers**
  - 27 Mar – 18 Jul 2013
  - Closed 112 Days
  - $146m in Transportation impacts

- **Marseilles Miter Gate Machinery**
  - Closed - Feb 8-10 2014
Effects of Decreased Investment

Since 2000:

• more than a doubling in delays!

These are actual delays experienced by vessels!
Effects of Decreased Investment

- 707 dams at 557 projects
- DSAC chart includes all USACE dams except one newly constructed dam that has not been assigned a DSAC value.
- Data source: DSPMT, 16 Oct 2013
Water Infrastructure Spending

Between 1962 to 2010...

Total funding increased
% GDP decreased

Greater burden on state and local funding sources as infrastructure ages.

Source: Congressional Budget Office based on data from the Office of Management and Budget, the Census Bureau, and the Bureau of Economic Analysis. For details, see the appendix.
United States Relative to Other Nations

Low investment in infrastructure!
(equivalent to Greece)
Relative Quality of US Infrastructure


1. Hong Kong
2. Singapore
3. Germany
4. France
5. Switzerland
6. United Kingdom
7. Netherlands
8. United Arab Emirates
9. South Korea
10. Spain
11. Japan
12. Luxembourg
13. Canada
14. United States
15. Austria


Not even among the top 15!
# 2013 Report Card for America’s Infrastructure

*by the American Society of Civil Engineers*

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<tr>
<th>Category</th>
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<tr>
<td>Aviation</td>
<td>D</td>
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<td>C</td>
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<td>Bridges</td>
<td>C+</td>
<td>Public Parks &amp; Recreation</td>
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<td>D</td>
<td>Solid Waste</td>
<td>B-</td>
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<td>D-</td>
<td>Transit</td>
<td>D</td>
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<tr>
<td>Levees</td>
<td>D-</td>
<td>Wastewater</td>
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America’s Cumulative G.P.A.

A = Exceptional  
B = Good  
C = Mediocre  
D = Poor  
F = Failing  

Estimated investment needed by 2020 = $3.6 trillion
Represents the added expenditures necessary to sustain the CW capital stock value at current levels through 2045. On average, this amounts to an annual expenditure of nearly $7 billion from 2012 through 2045.

Capital Stock Value 2012-2045, Assuming Current Rate of Decline (Position 2)

- $265 Billion
- $192 Billion
- $130 Billion

Maintain 2011 Capital Stock (Position 1)
Comparison of Gross Domestic Product

GDP (2014 USD)

- United States
- China
- Japan
- Germany
- United Kingdom
- Brazil
- Russian Federation
## Louisiana vs. The Netherlands

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Louisiana v. Netherlands

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Conclusion

- Our infrastructure makes delivery of domestic stability and security possible.

- We are losing hard-fought ground earned by prior generations through their financial and personal sacrifices.

- Our economic prosperity, standard of living, and environmental quality are increasingly vulnerable to threats posed by aging infrastructure and increase potential for failure.

- We have benefitted from the investments of our forefathers but have done little to assure this heritage will be passed on to future generations.

- Our sense of resolve to secure a sound economic and environmental footing for future generations should be no less than that of those who sacrificed to provide us with the same.

- Our glide path is unconscionable.

10:1 return on investment… we should aim to do better.
USACE – A Leader in STEM

4,012,770 9th Graders in 2001 in the USA

70% graduated high school in 2005

32.4% college ready in 2005

6% choose a STEM Major

4% earn STEM Degree (166,530 grads)

China: 1.9M “Engineer” graduates
763K received an equivalent* degree
10% globally employable.
= 76,400 globally employable grads

India: 793K “Engineer” graduates
497K received an equivalent* degree
25% globally employable.
= 124,400 globally employable grads

USA: 166K STEM graduates
166K received an accredited degree
81% globally employable.
= 134,460 globally employable grads

• China and India have no standard definition of the word “Engineer” (includes auto mechanics, IT Specialists, varies based on needs of the government)

• “Quantity instead of Quality” Program Goals in both India and China

• In China and India, if you’ve taken ONE STEM related class, you’re counted as an ‘Engineer’ in education

• The Chinese Government is notorious for inflating statistics to compete with global leaders (i.e. manufacturing, GDP) The Indian Government is more realistic, but not by much

*In China and India, equivalent degree compared to USA accredited institutions
Nothing is As Easy As It Looks or Sounds

SCISSORS BEAT PAPER

WWII

Because Scissors always beat paper.
Questions
Tonnage on Domestic Waterway Network

Note: Figure shows door-to-door annual shipment volumes (tonnages) by 4-digit Performance Monitoring System Commodity Class and annual shipment volumes (tonnages, dollar-valued trades) to and from U.S. seaports and foreign countries, broken down by 4-digit Harmonized Schedule Commodity Codes.

Data From U.S. Army Corps of Engineers
Compare...

Cargo Capacity

- **ONE BARGE**
  - 1,500 TON
  - 52,500 BUSHELs
  - 453,600 GALLONS

- **ONE 15 BARGE TOW**
  - 22,500 TON
  - 787,500 BUSHELs
  - 6,804,000 GALLONS

- **ONE JUMBO HOPPER CAR**
  - 112 TON
  - 4,000 BUSHELs
  - 33,870 GALLONS

- **ONE 100 CAR TRAIN**
  - 11,200 TON
  - 400,000 BUSHELs
  - 3,387,000 GALLONS

- **ONE LARGE SEMI**
  - 26 TON
  - 910 BUSHELs
  - 7,865 GALLONS

Equivalent Units

- **ONE BARGE**
  - 13.4 JUMBO HOPPER CARS

- **ONE 15 BARGE TOW**
  - TWO 100 CAR TRAINS

- **ONE LARGE SEMI**
  - 870 LARGE SEMIS

Equivalent Lengths

- **ONE 15 BARGE TOW**
  - .25 MILE

- **TWO 100 CAR TRAINS**
  - 2.4 MILES

- **870 LARGE SEMIS**
  - 11.5 MILES
    (BUMPER TO BUMPER)

One 15 barge tow takes 870 large semi truck off of our highways!
Our people enjoy a **quality of life** unmatched in the world. We …

- **Lead** **secure lives** along the river or tributary.
- **Enjoy** fresh air and the surrounding fauna, flora and forests while hunting, fishing and recreating.
- **Travel** easily, safely and affordably.
- **Drink from** and use the abundant waters of any river, stream or aquifer.
- **Choose from** an abundance of affordable basic goods and essential supplies that are grown, manufactured and transported along and by the river to local and world markets.

Balancing the nation’s needs for:

- National security & flood protection & management
- Environmental sustainability & recreation
- Infrastructure & energy
- Water supply & water quality
- Movement of goods; agriculture & manufacturing

Leveraging local citizens’ input, international dialogue, science, engineering, technology and public policy

**America’s Watershed: a 200-year working vision**

*An Intergenerational Commitment*

The Mississippi watershed is 41% of the US, 31 States, 1.25 million square miles, over 250 tributaries.

**join the dialogue …**

visit [www.mvd.usace.army.mil/mrc](http://www.mvd.usace.army.mil/mrc) or email cemvd-ex@usace.army.mil
We Can’t Wait

Advancing 7 key infrastructure projects at 5 East Coast ports:
- NY / NJ
- Charleston
- Savannah
- Jacksonville
- Miami
Corps Mission-Related Investments

More than a tenfold increase in GDP since 1928!

Similar level of investment will not keep pace with GDP.

Decreasing levels of investment magnify the effect.
Patterns in Global Spending in Infrastructure

The United States must raise infrastructure spending by 1 percentage point of GDP to meet future needs

Gap between historical spend and estimated future spending need

% of GDP

<table>
<thead>
<tr>
<th>Country</th>
<th>Estimated need</th>
<th>Actual spend</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>3.6</td>
<td>-1.0</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>3.3</td>
<td>-0.9</td>
</tr>
<tr>
<td>Germany</td>
<td>2.8</td>
<td>-0.6</td>
</tr>
<tr>
<td>Canada</td>
<td>3.4</td>
<td>-0.7</td>
</tr>
<tr>
<td>France</td>
<td>2.9</td>
<td>-0.6</td>
</tr>
<tr>
<td>Sweden</td>
<td>3.3</td>
<td>-0.7</td>
</tr>
<tr>
<td>Australia</td>
<td>3.7</td>
<td>4.4</td>
</tr>
<tr>
<td>Japan</td>
<td>5.0</td>
<td>2.6</td>
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SOURCE: McKinsey Global Institute analysis
Distribution of US Infrastructure Investment Shortfall by 2020

32% of the shortfall ($372B) involves infrastructure associated with Corps authorities!

- Water
- Ports
- Waterways
- Levees
- Dams
- Power generation

Estimated infrastructure investment shortfall for the United States

- Surface Transport (roads, highways, bridges, transit)
- Water and Wastewater
- Other transport (airports, rail, ports, inland waterways)
- Other infrastructure (electricity, dams, levees, waste)

Does not include additional infrastructure items in ASCE report such as schools, public parks, and recreation.

Source: American Society of Civil Engineers; US Department of Transportation; McKinsey Global Institute

Approximately $200.00 per person per year (the equivalent of one latte per week)
GDP per person at Purchasing Power Parity and share of global population, 2014 forecast

63,000 Structurally Deficient (SD) Bridges in the U.S.

250 million crossings in 2013 on SD Bridges