Survey of U.S. Municipal Desalination Facilities

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"One Water…It's Here"

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Context

- ✓ U.S. municipal desalination facilities
- ✓ 50 U.S. States
- ✓ Facilities of size greater than 0.025 mgd
- ✓ A survey – but an effort to contact every facility that could be identified
- ✓ Estimated coverage >90% of all facilities (missing facilities are likely small)
- ✓ Current project: 4th Survey since 1990; covers facilities built in period 2010-2017
- ✓ Overall database is of plants built – not plants currently operating

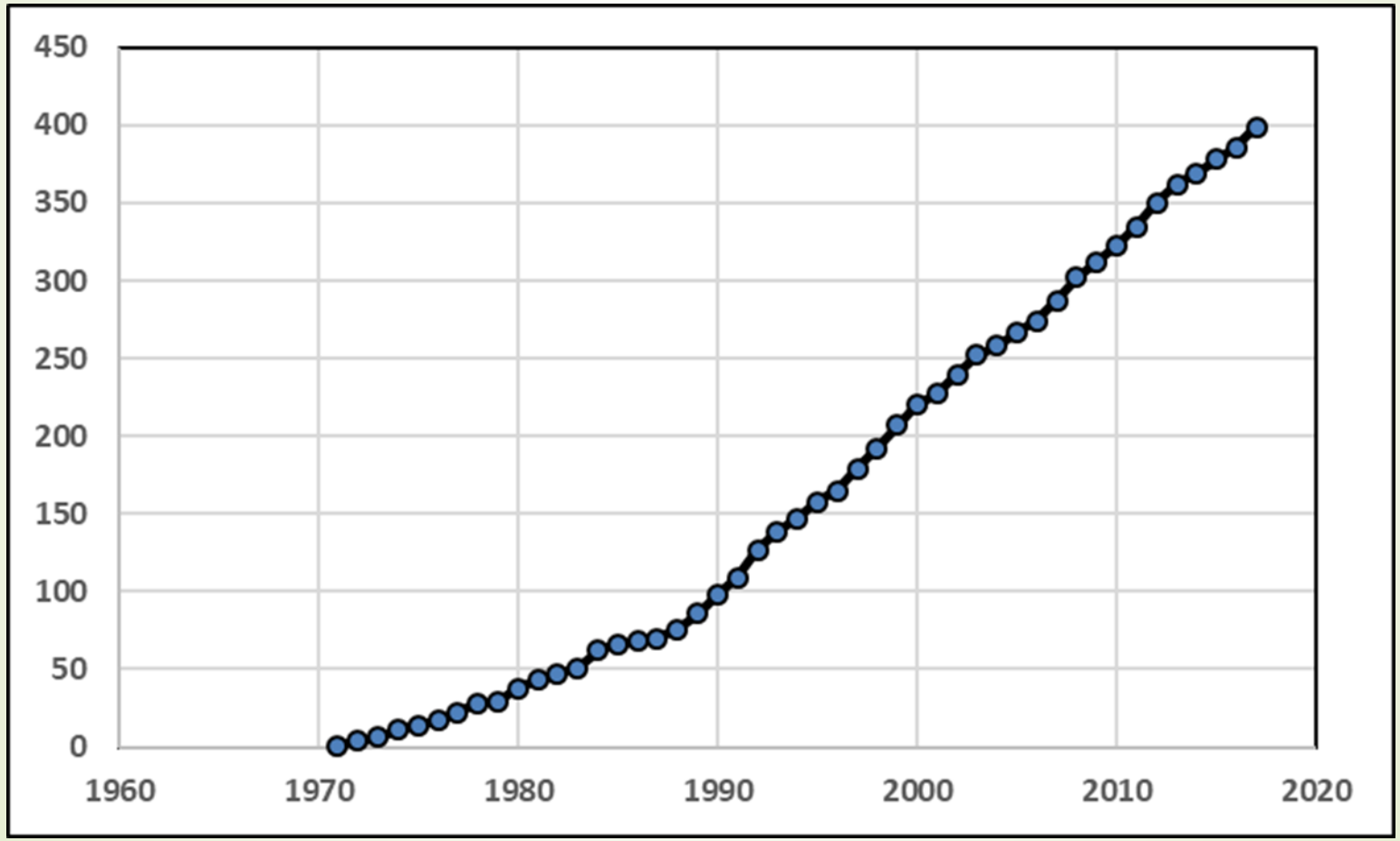
Information Obtained

- Basic information :
  - Facility name
  - Facility owner
  - Contact information
  - Plant type
  - Desalination technology
  - Reason for desalination vs. conventional
  - Year of start-up
  - Desal Design capacity
  - Source water
  - Means of concentrate management
  - Treatment of concentrate

- Additional information :
  - Raw water TDS
  - Pretreatment steps
  - Feed pressure
  - Blending details
  - Plant Design capacity
  - Average production
  - Target TDS of permeate
  - Target TDS of blend
  - Membrane recovery
  - Post-treatment of permeate
  - Age of membrane at last replacement

TOTAL NUMBER – TOTAL CAPACITY

Cumulative Number of U.S. Municipal Desalination Plants Built



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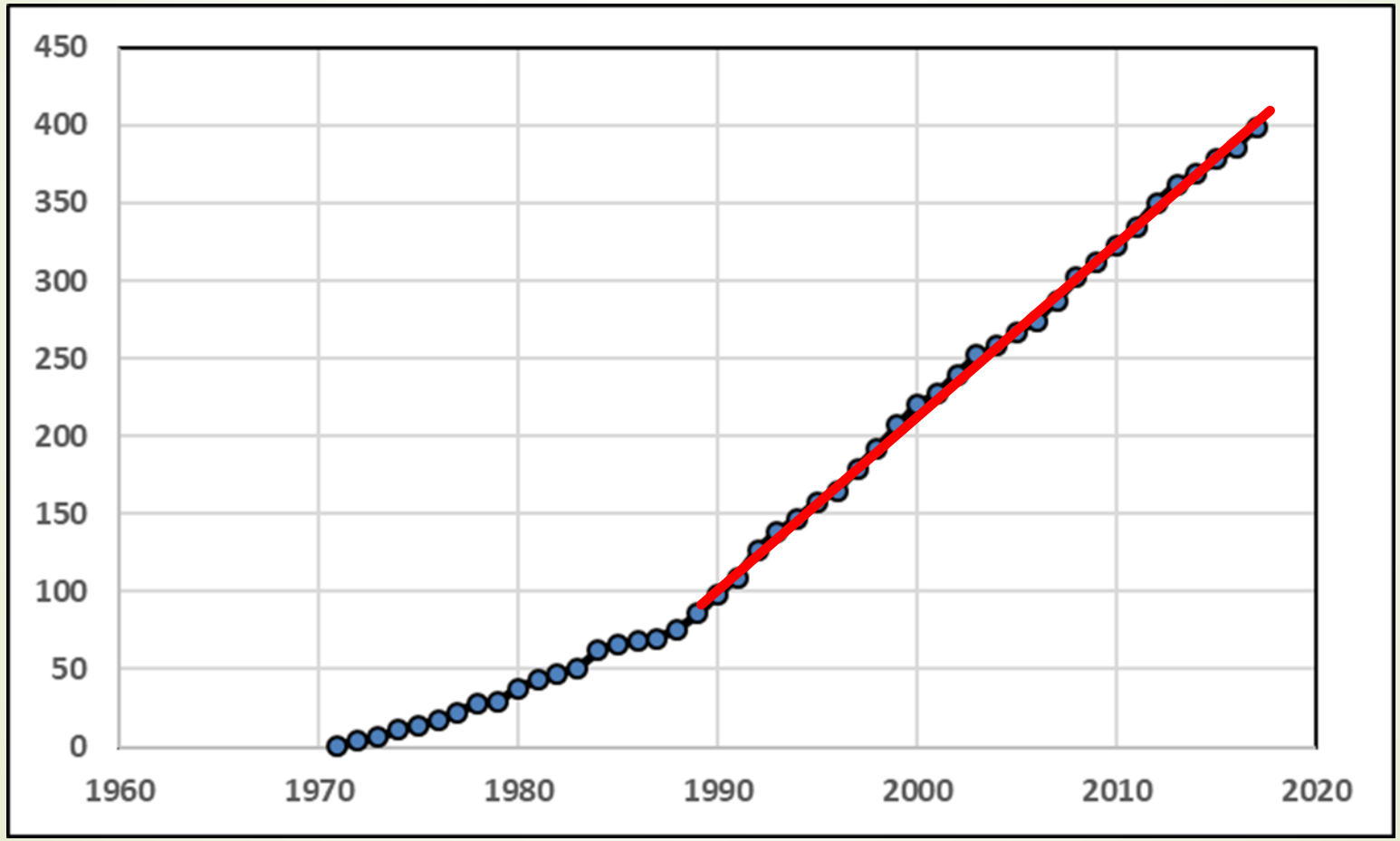
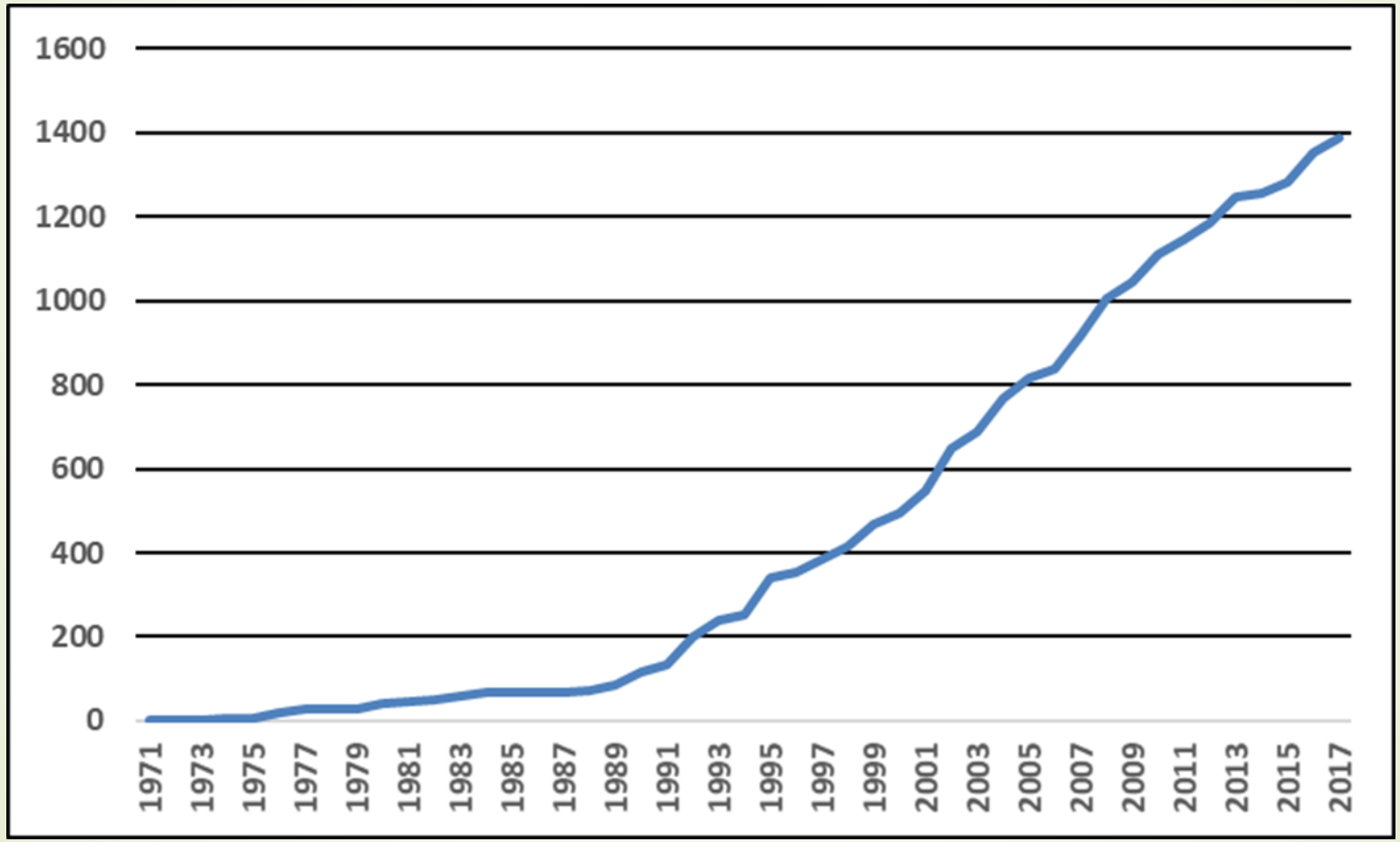


Cumulative Capacity (mgd) of U.S. Municipal Desalination Plants Built



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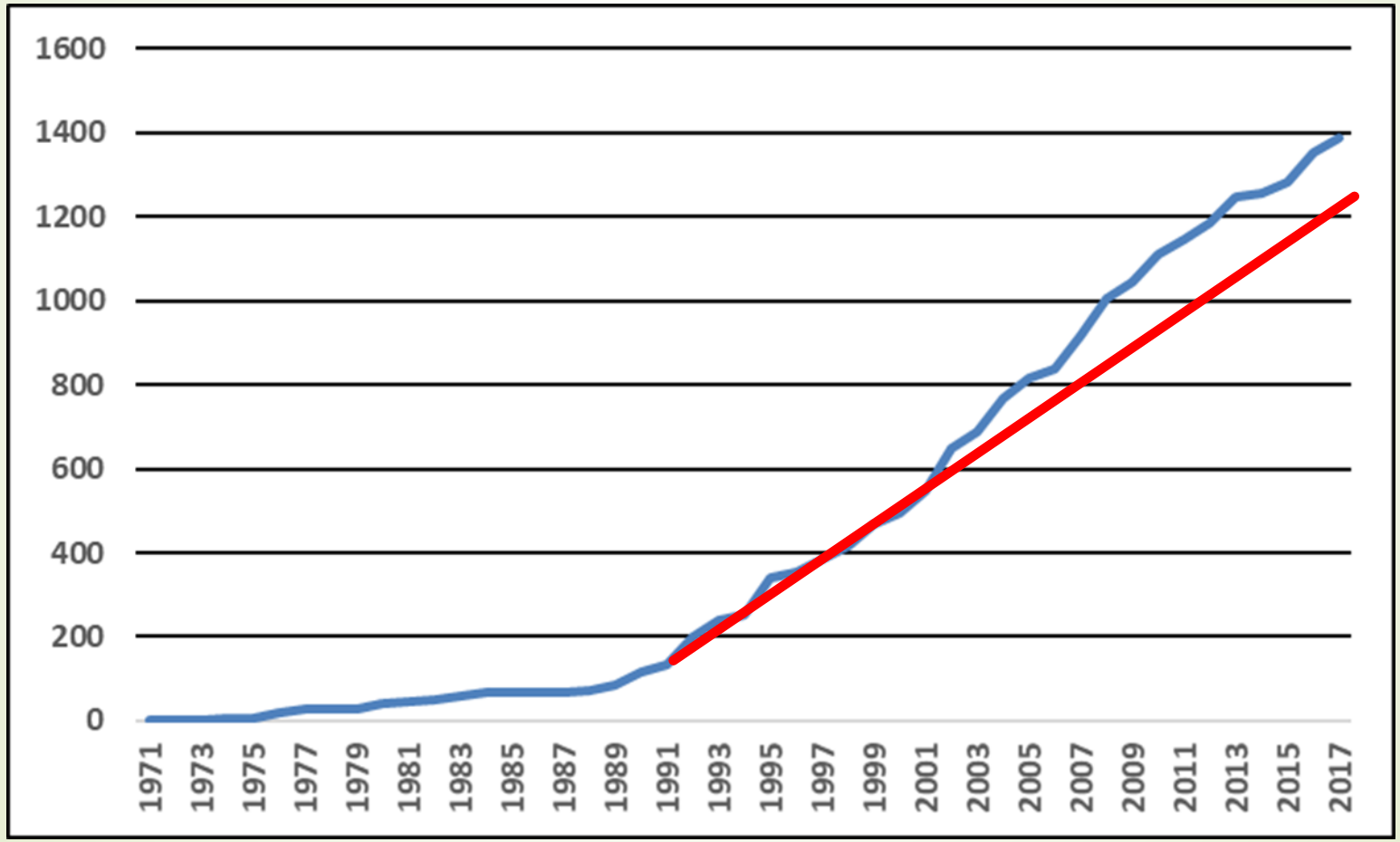


Number of Plants
by State

68% of facilities are in CA, FL, & TX

1971-2017

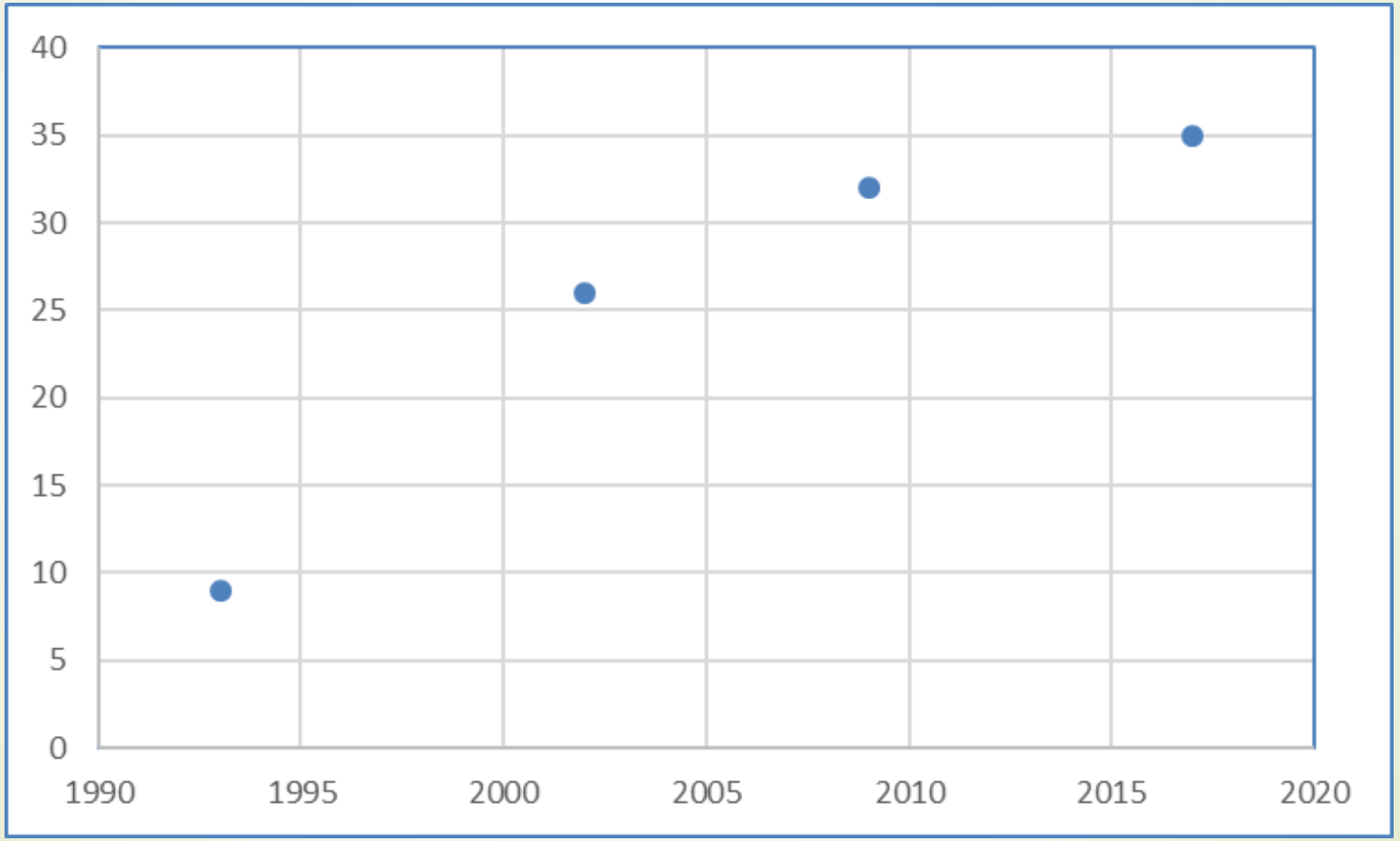
State	Number of Plants	State	Number of Plants
Florida	167	Minnesota	2
California	58	Missouri	2
Texas	53	Nebraska	2
North Carolina	17	Nevada	2
Iowa	16	New York	2
Illinois	12	Oklahoma	2
Arizona	10	Pennsylvania	2
Colorado	10	Alabama	1
Ohio	8	Georgia	1
North Dakota	7	Michigan	1
South Carolina	6	Mississippi	1
Virginia	6	South Dakota	1
Kansas	6	Tennessee	1
Utah	3	Washington	1
Massachusetts	3	Wisconsin	1
Montana	3	West Virginia	1
New Jersey	3	Wyoming	1
Alaska	2		

2010-2017

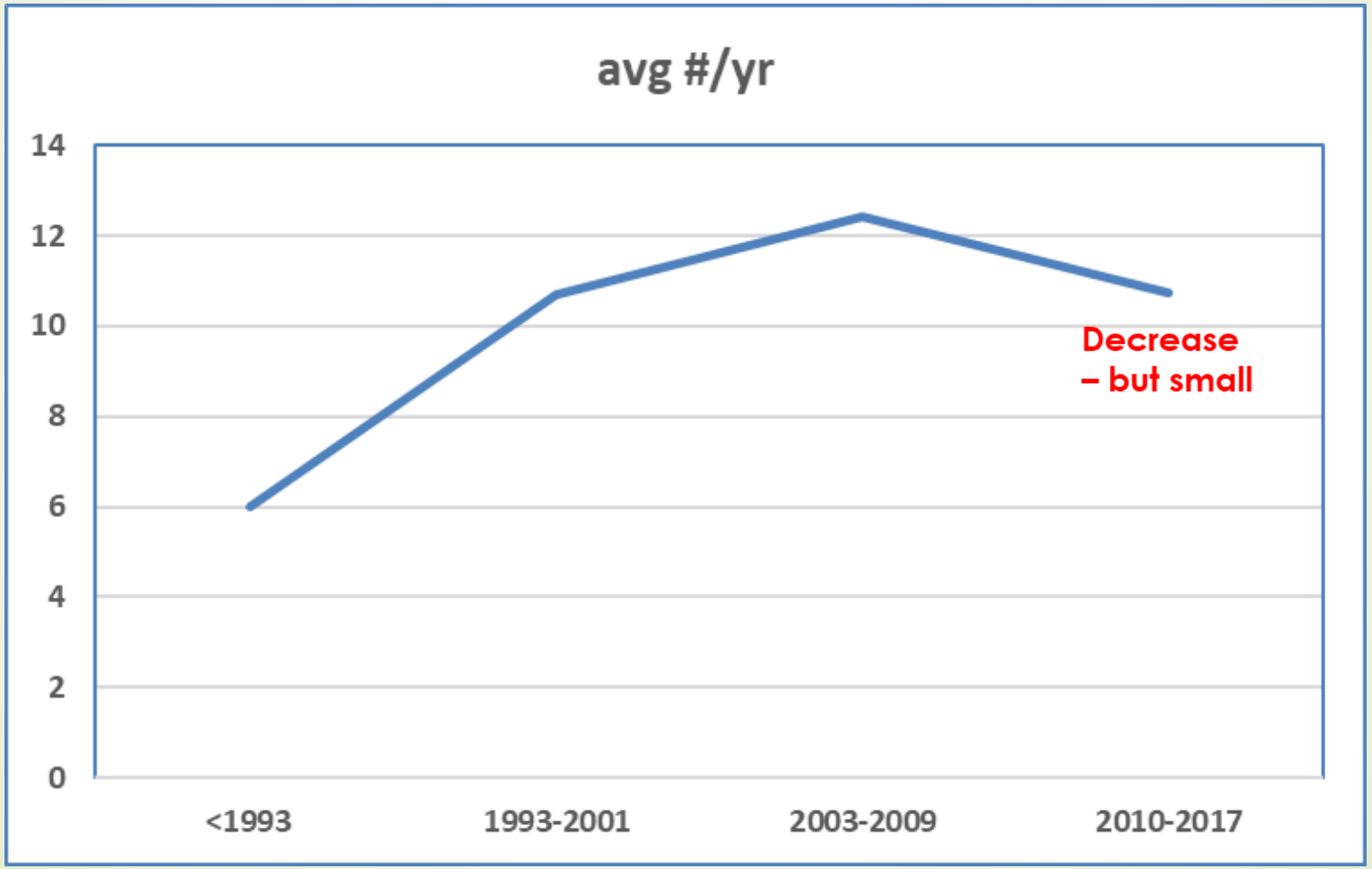
State	Number of Plants
Texas	23
Florida	19
California	13
Iowa	6
North Carolina	5
Colorado	3
Kansas	3
North Dakota	3
Ohio	3
New Jersey	2
Georgia	1
Utah	1
Massachusetts	1
Michigan	1
Tennessee	1
Illinois	1

Number of States Having Plants

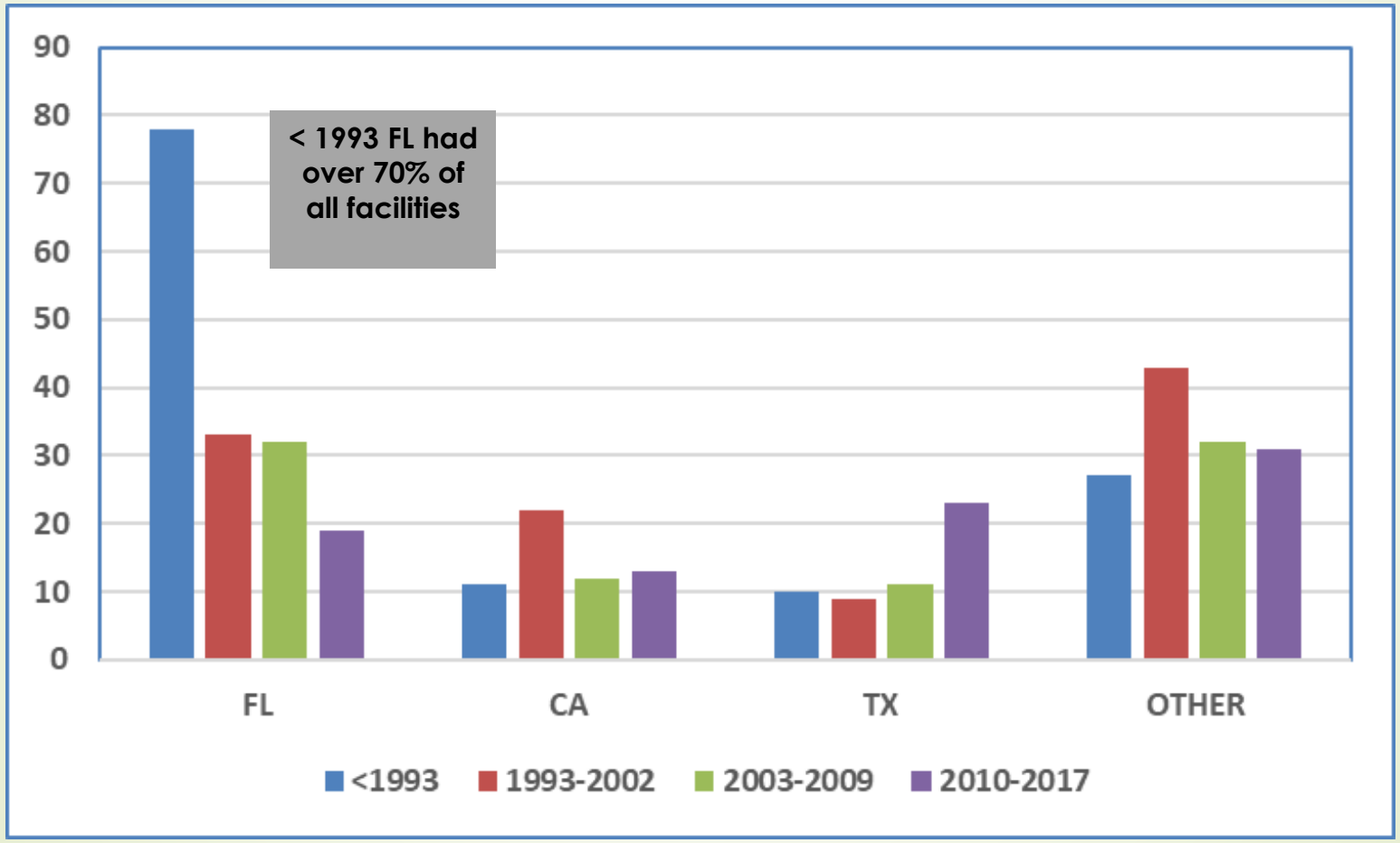
by Time Period



Number of Plants
Average # per Year during the time period

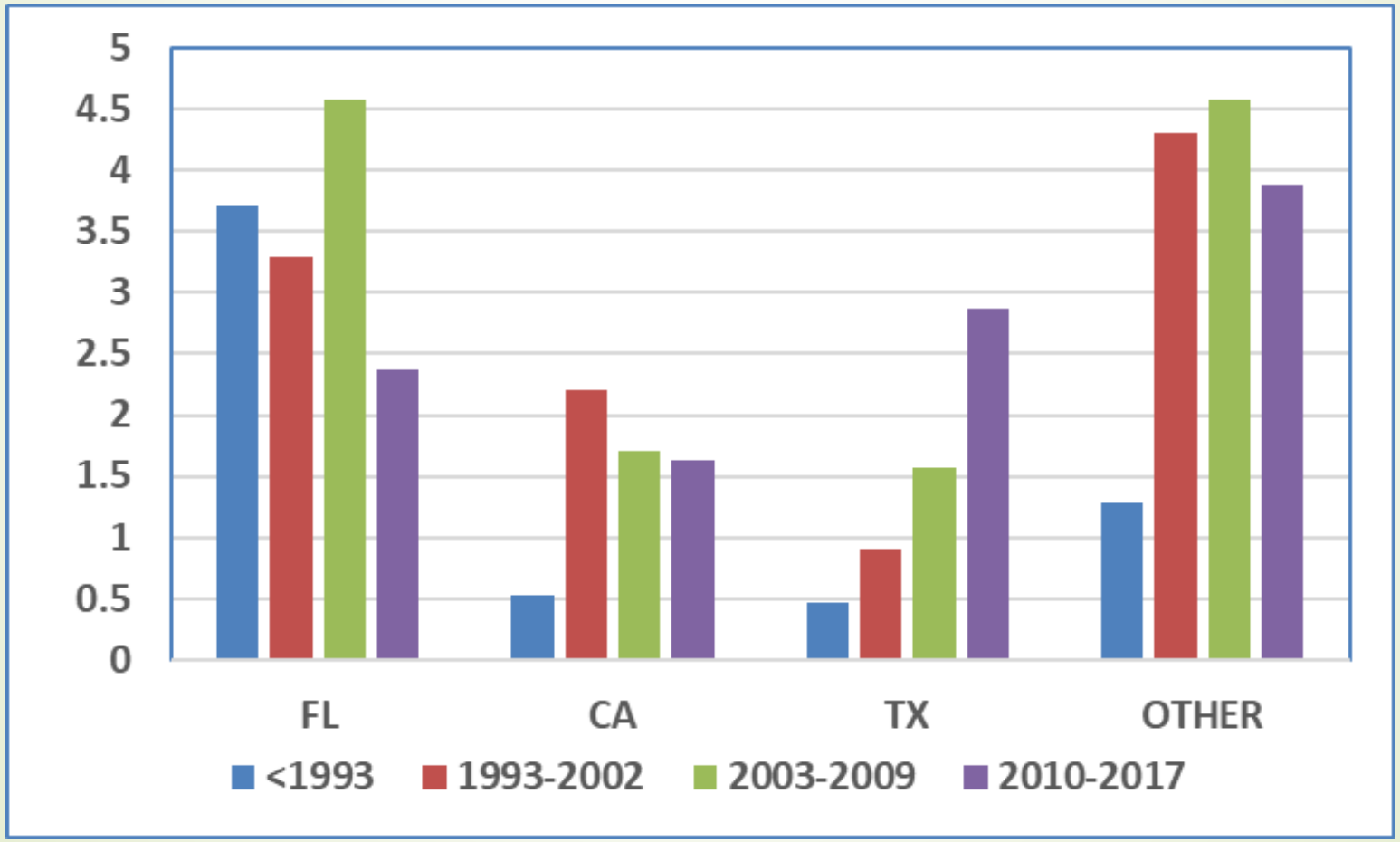


Number of Plants by State and Time Period



Average # of Plants/Year

by State and Time Period



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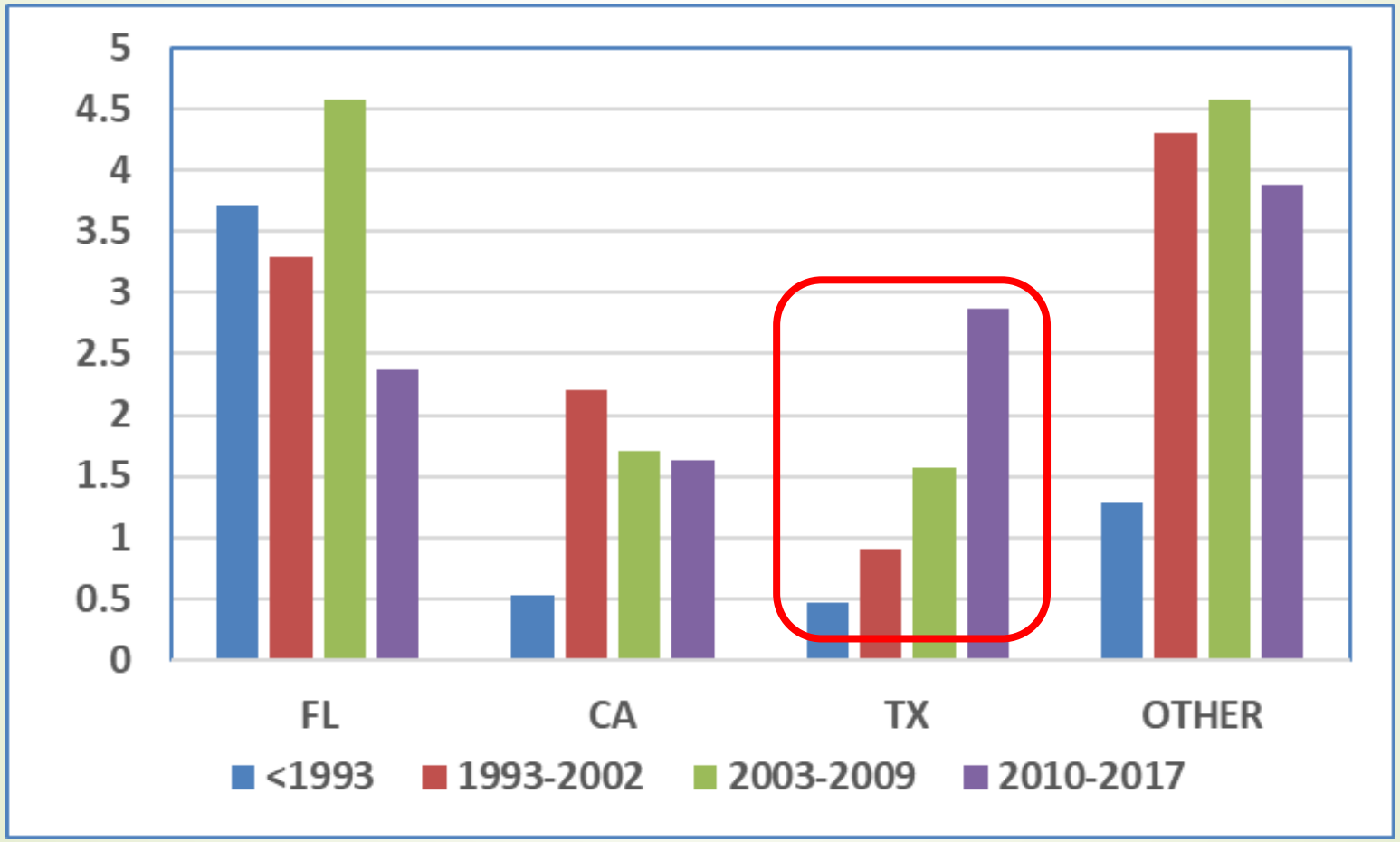


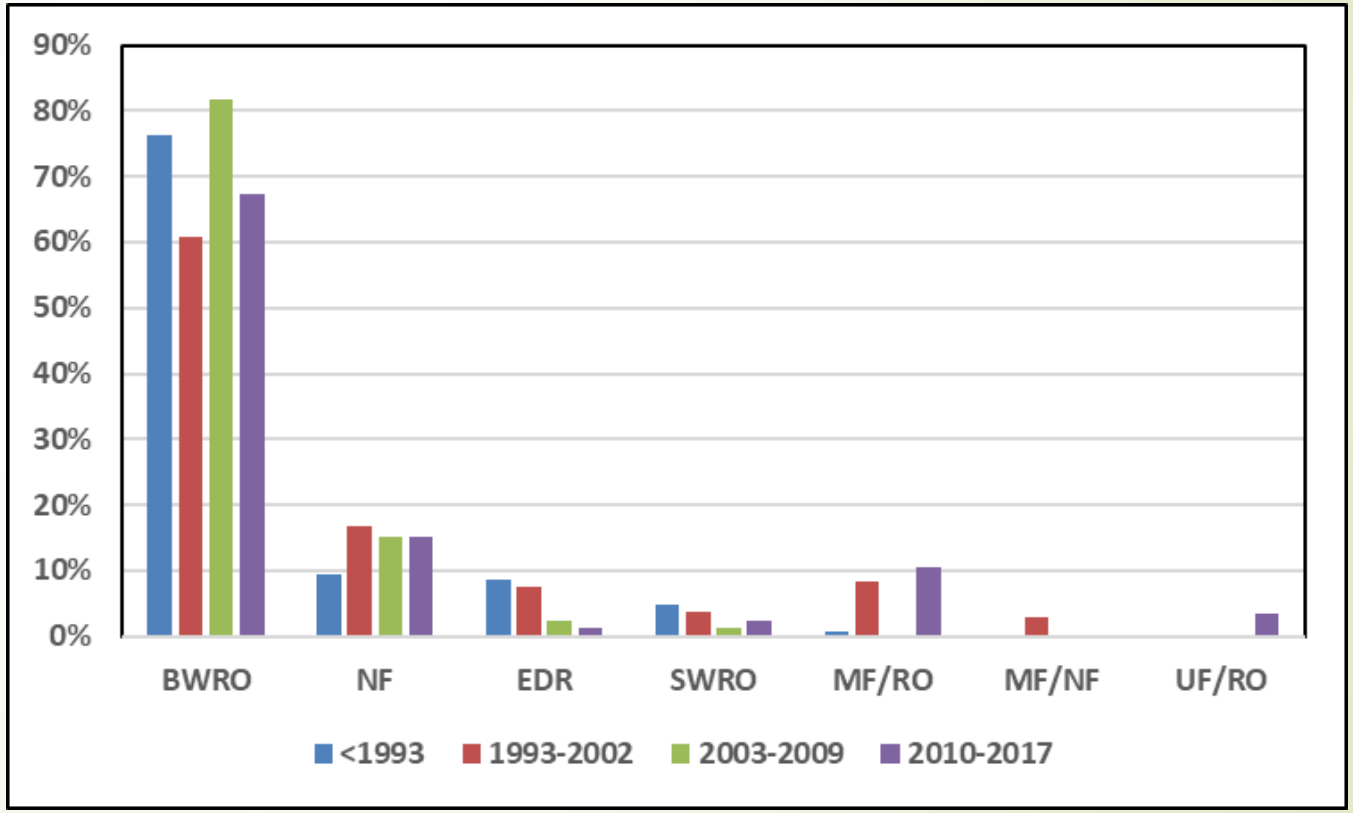
Summary of numbers

- Now > 400 plants
- Fl has almost 3x # of plants than any other state with 157
- FL, CA, TX = 68% of the plants
- In 2010-2017 period, TX had the most plants
- Now, 35 states have plants
- #/yr in recent period - slight decrease from previous period
- TX has significant increase in #/yr for each following survey

TYPES OF MEMBRANE PLANTS

Percentage of Plants
by Membrane Type and Time Period

	number	%
BWRO	296	71.8%
NF	56	13.6%
EDR	22	5.3%
SWRO	13	3.2%
MF/RO	19	4.6%
MF/NF	3	0.7%
UF/RO	3	0.7%



CONCENTRATE MANAGEMENT OPTIONS

Concentrate Management Options

- **1 – FIVE CONVENTIONAL DISPOSAL OPTIONS**
  - **Surface water discharge**
    - Ocean outfall
    - Discharge to river, lake, creek
  - **Disposal to sanitary sewer**
    - Sewer
    - Direct line to WWTP
    - Truck to WWTP
  - **Subsurface injection**
    - Deep well injection
    - Shallow well – beach well
  - **Evaporation pond**
    - Conventional
    - Enhanced
  - **Land application**
    - Irrigation
    - Percolation pond / rapid infiltration basin

- **2 – LANDFILL (for solids)**
  - Dedicated monofil
  - Industrial landfill
- **3 – RECYCLE**
  - To front end of WWTP (for low salinity concentrate)
- **4 – BENEFICIAL USE**
  - Other than irrigation
- **5 – HIGH RECOVERY PROCESSING**
  - Minimum liquid discharge (MLD)
  - Zero liquid discharge (ZLD)
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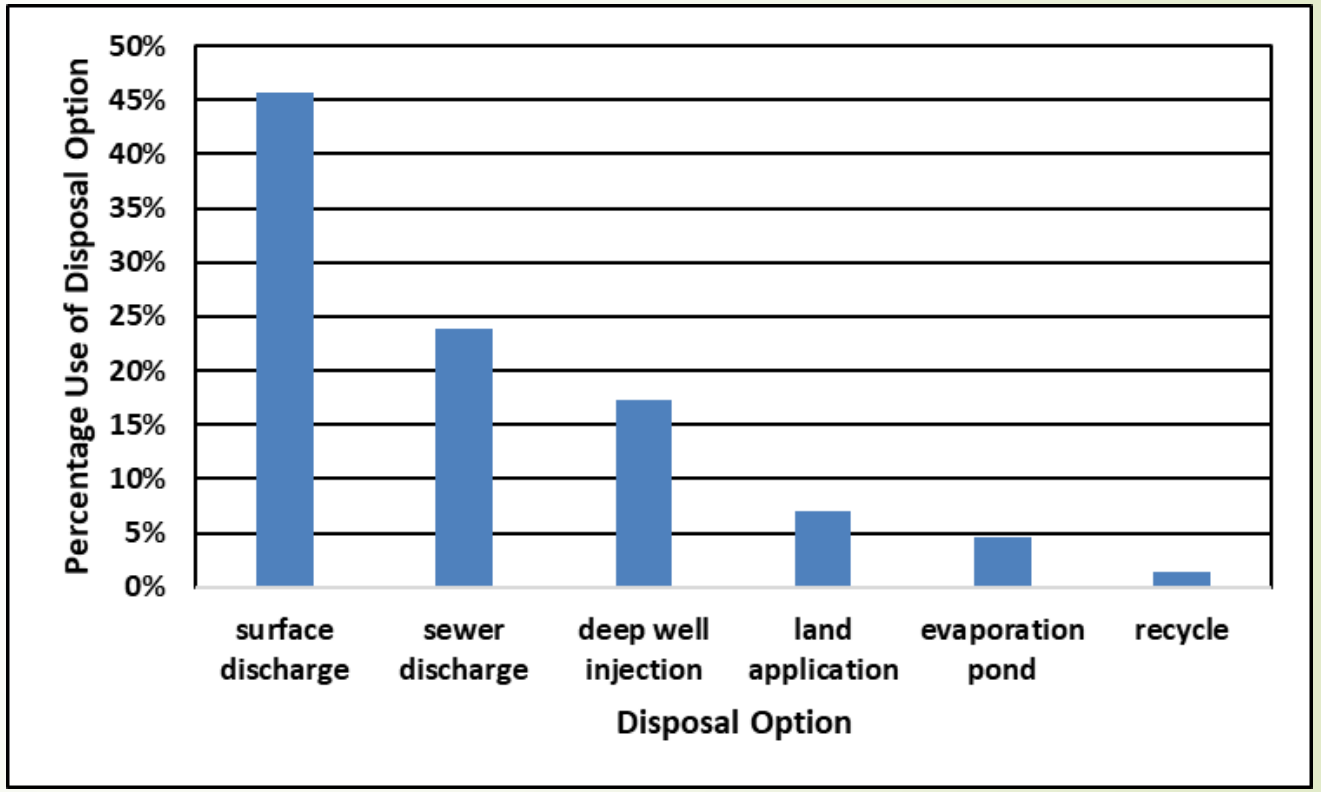
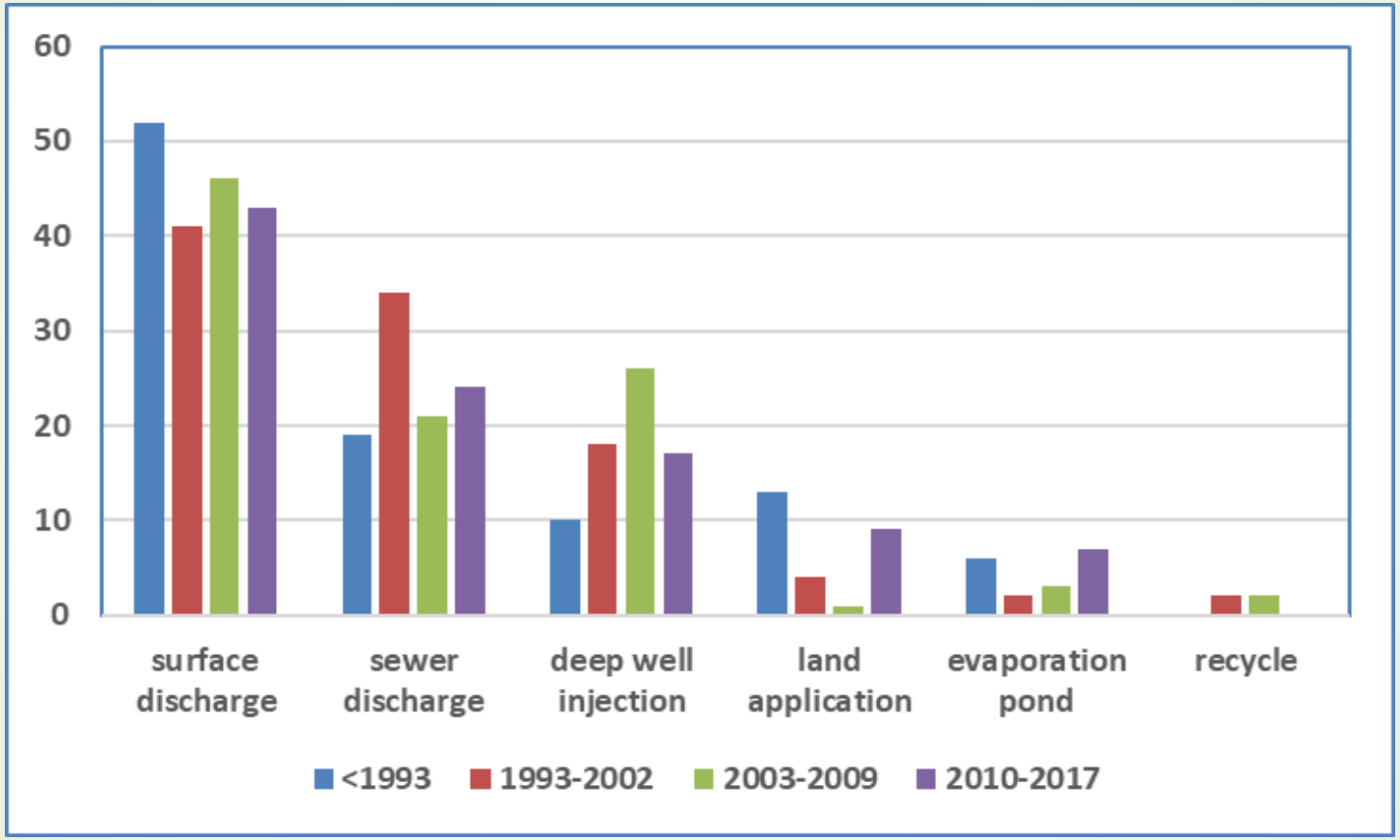
Account for > 98% of municipal facilities

Percent of Plants
Using Concentrate Management Options

DISPOSAL OPTION	%
surface discharge	46
sewer discharge	24
deep well injection	17
land application	7
evaportion pond	5
recycle	1



Disposal Option % Use
by Time Period



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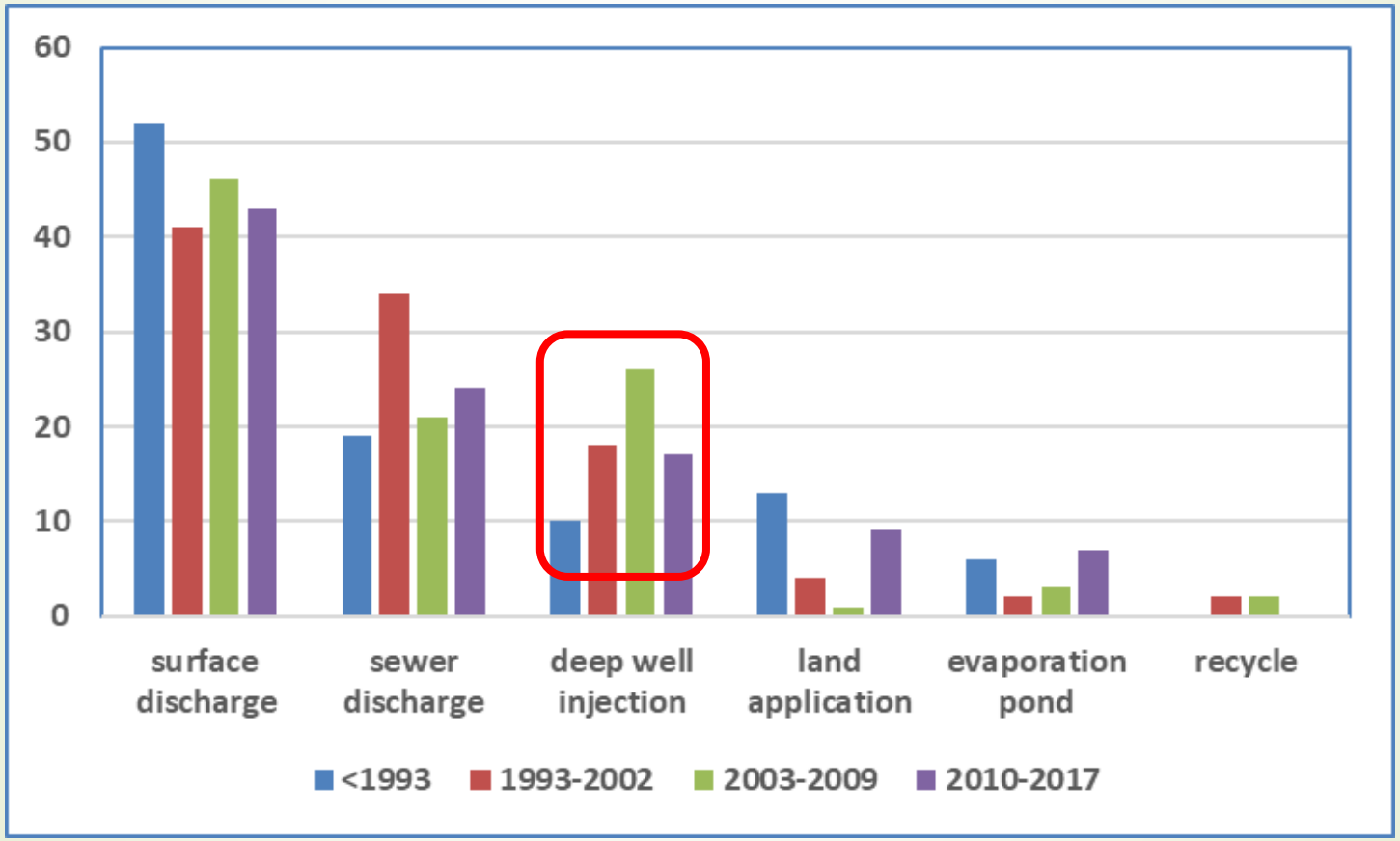
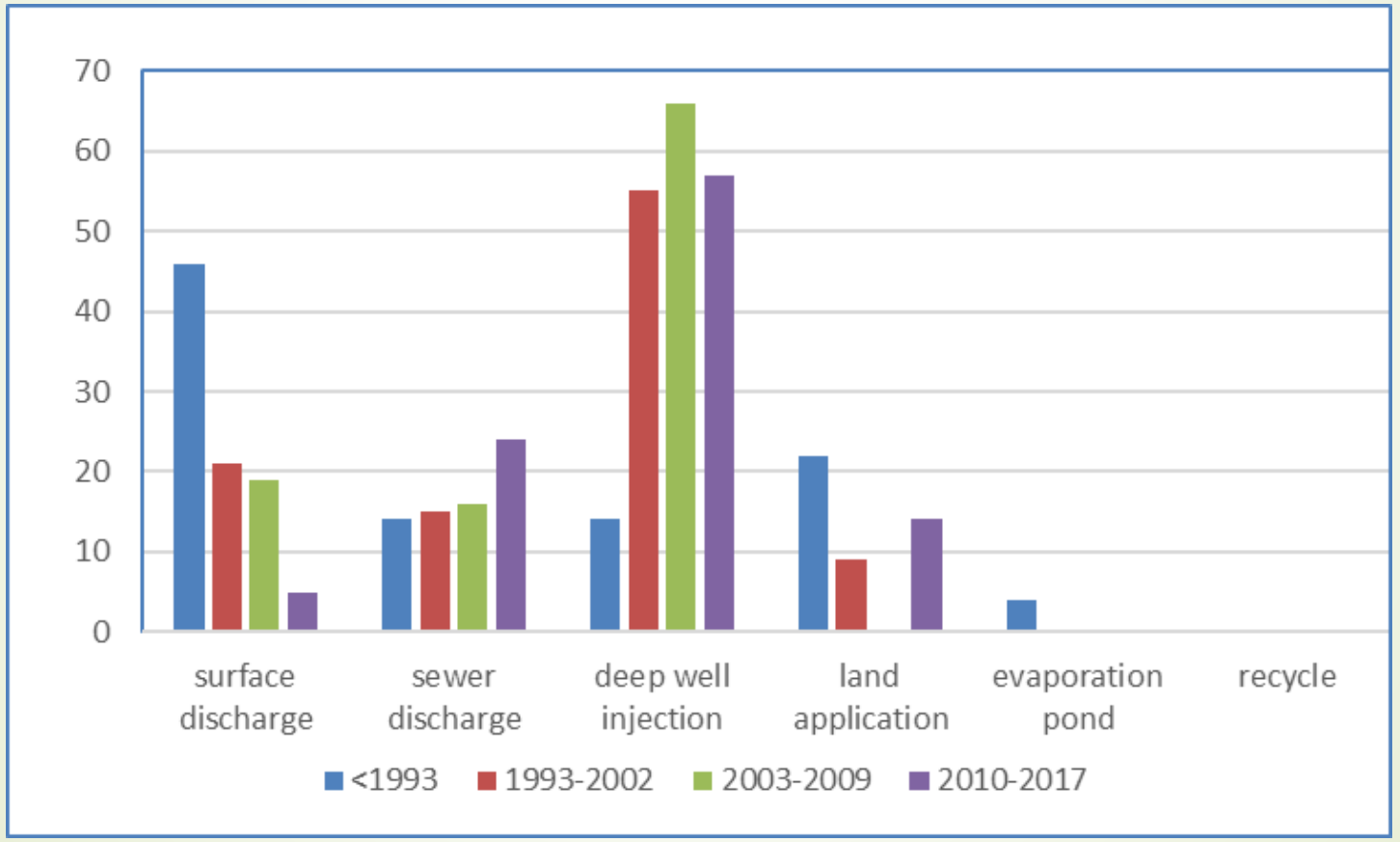


Disposal Option Use (%)

FLORIDA by Time Period



Disposal Option Use (%)

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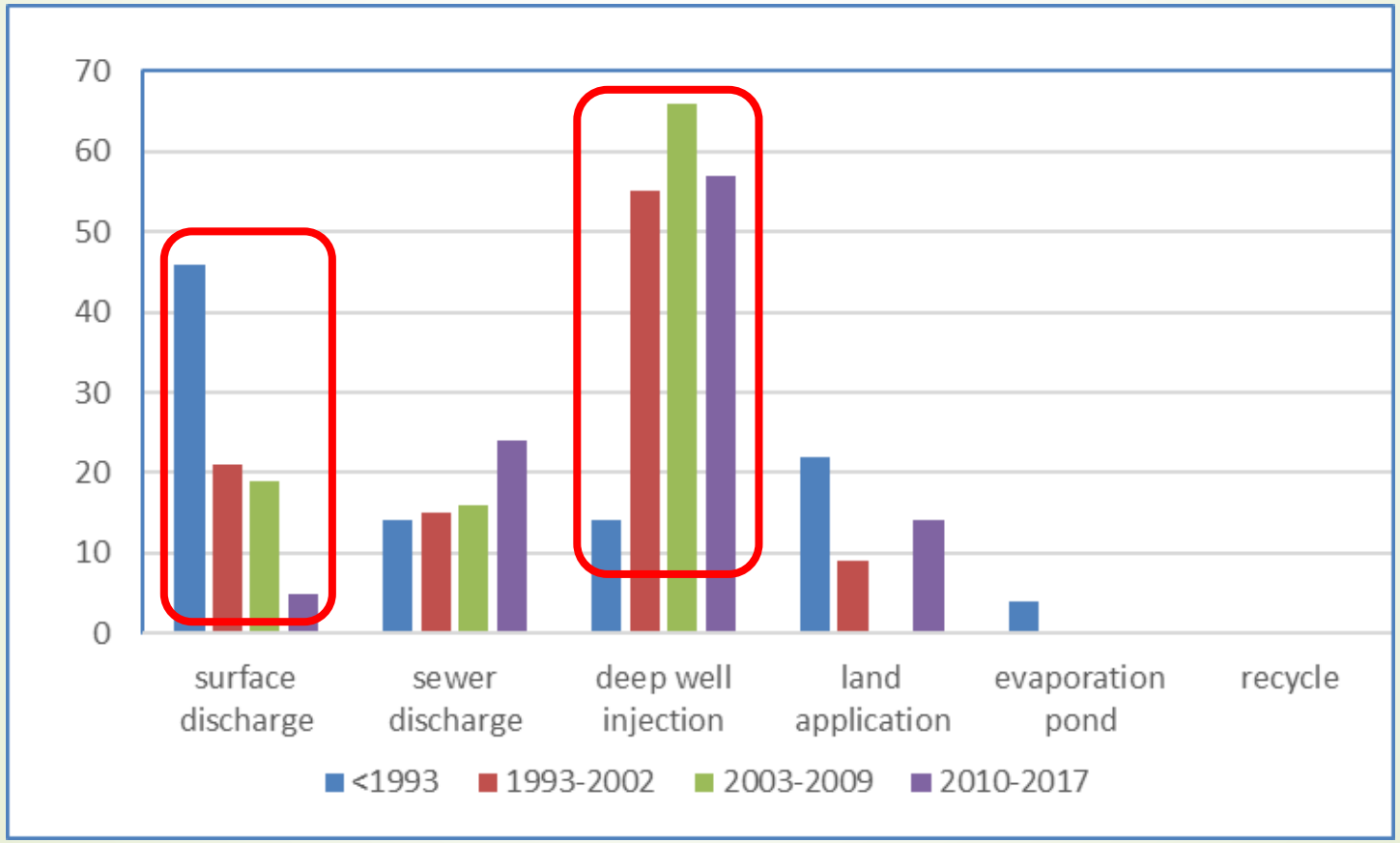
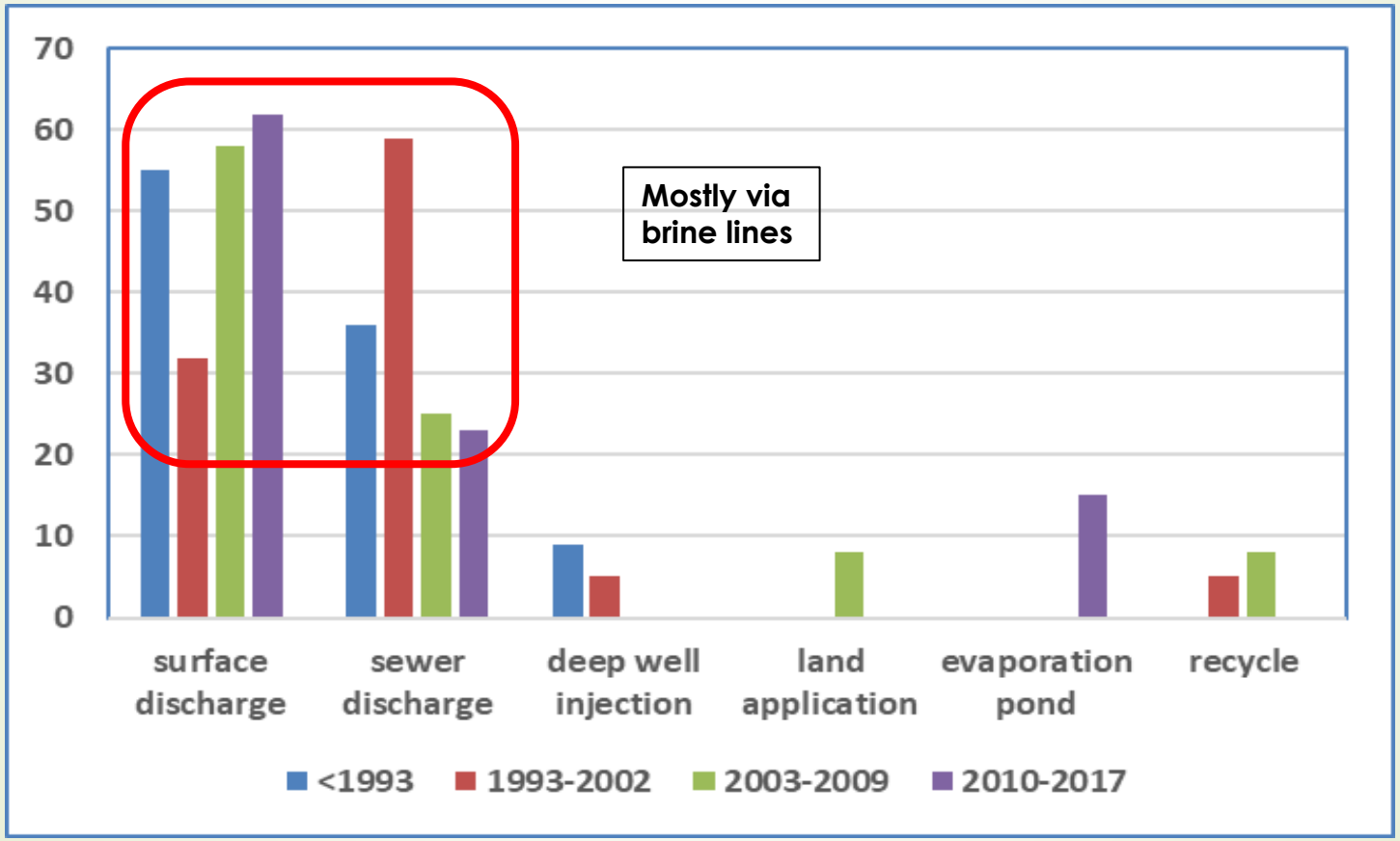


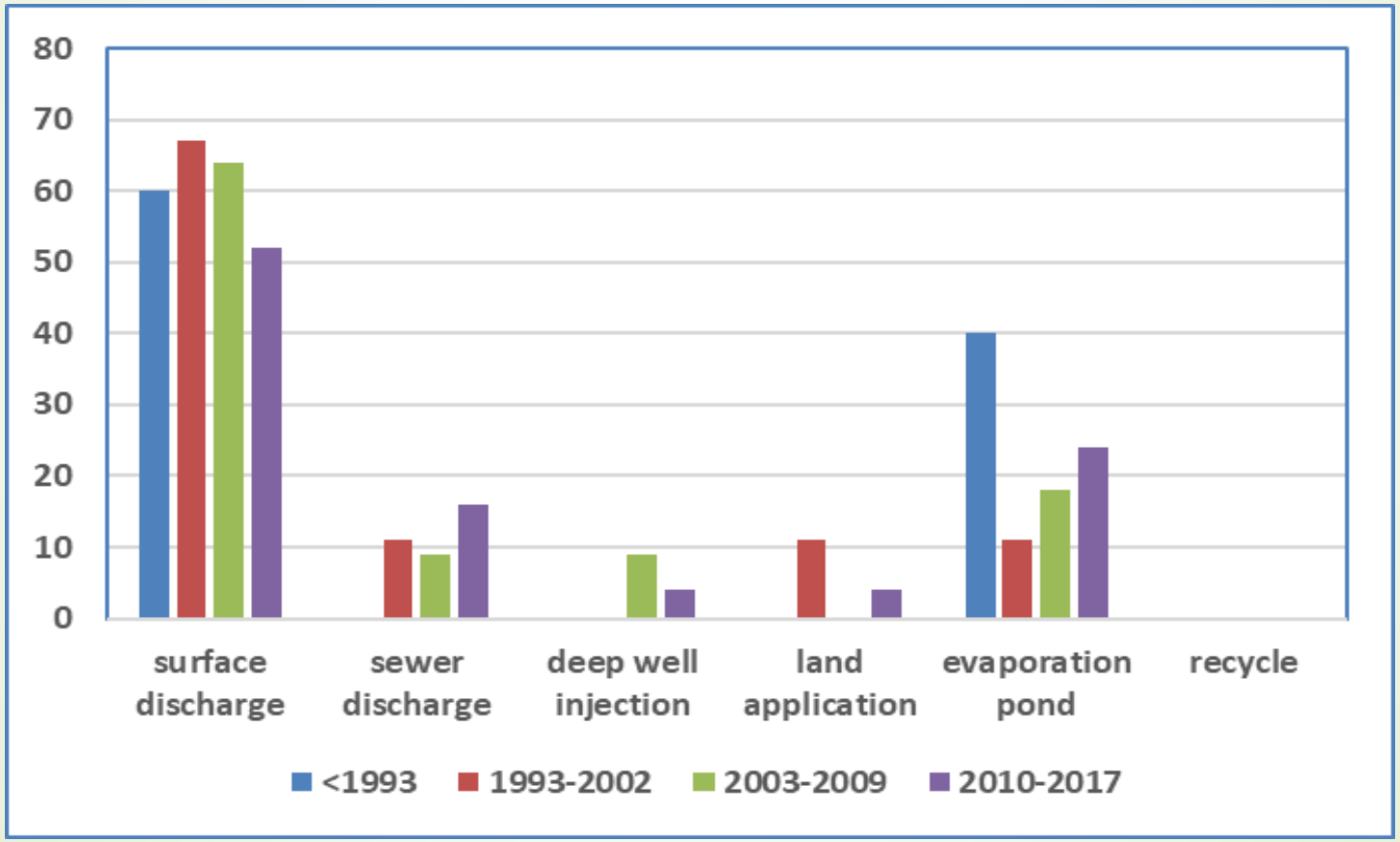
Disposal Option Use (%)

CALIFORNIA by Time Period



Disposal Option Use (%)

TEXAS by Time Period



Disposal Option Use (%)

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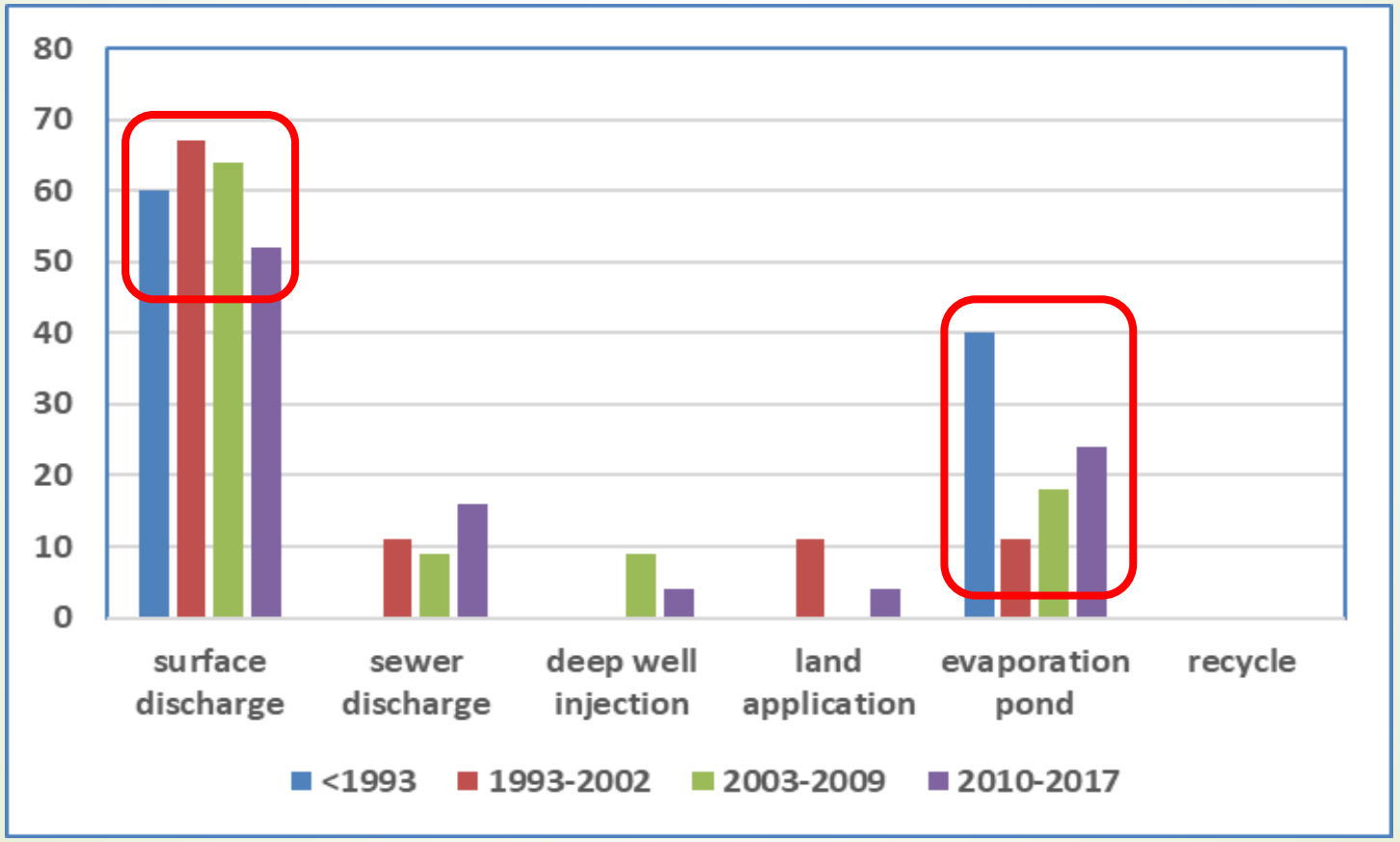
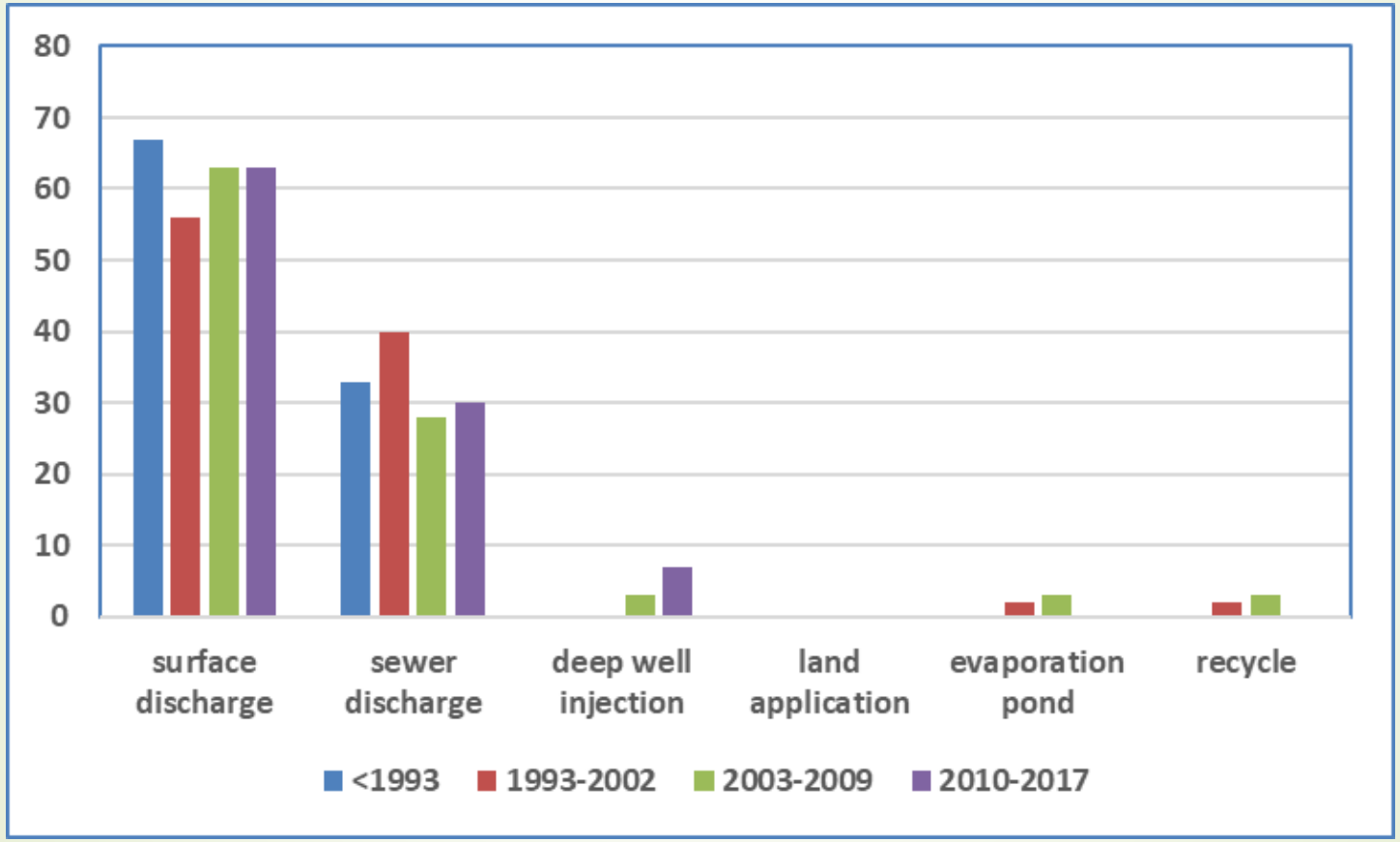


Disposal Option Use (%)

OTHER STATES by Time Period



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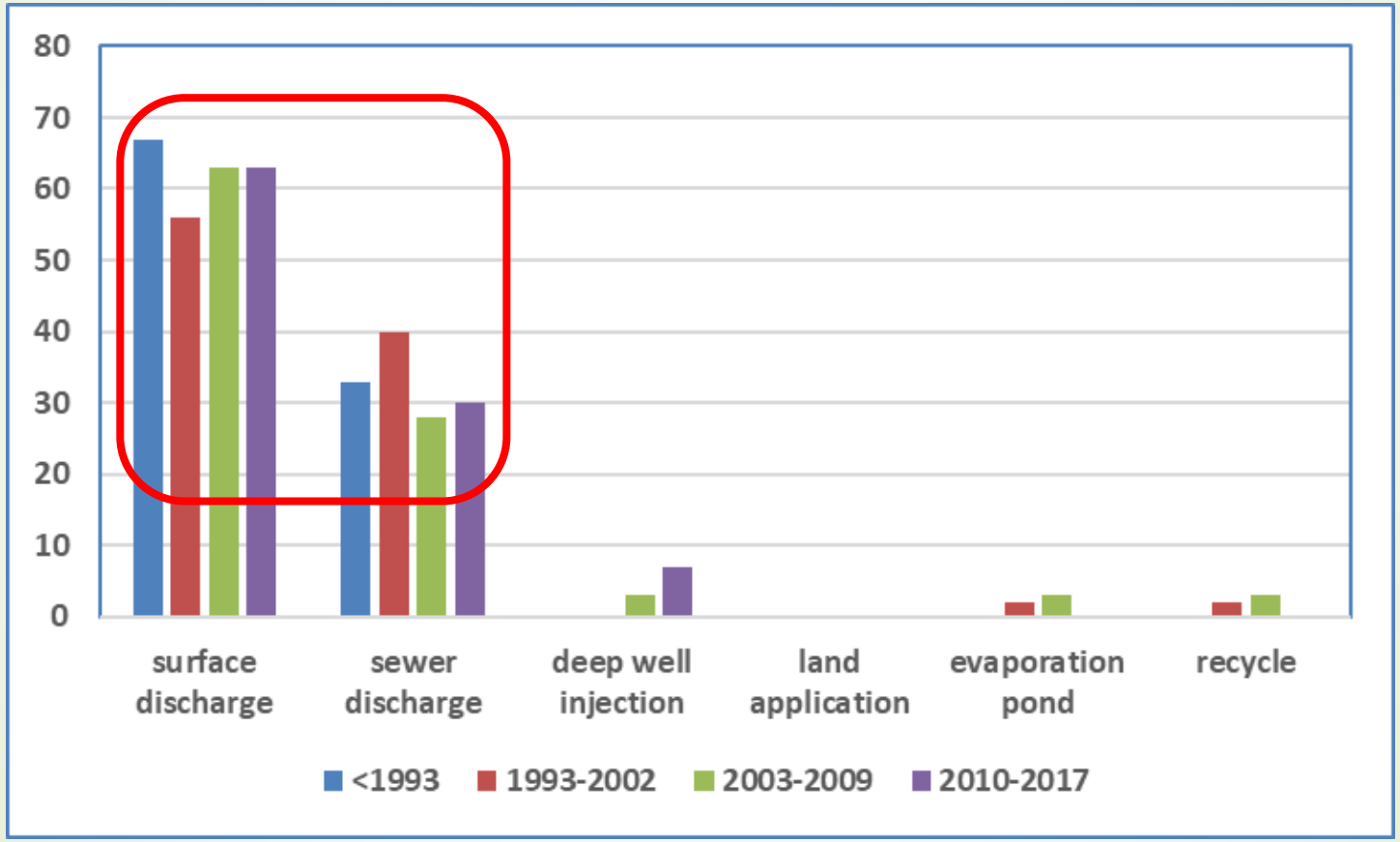
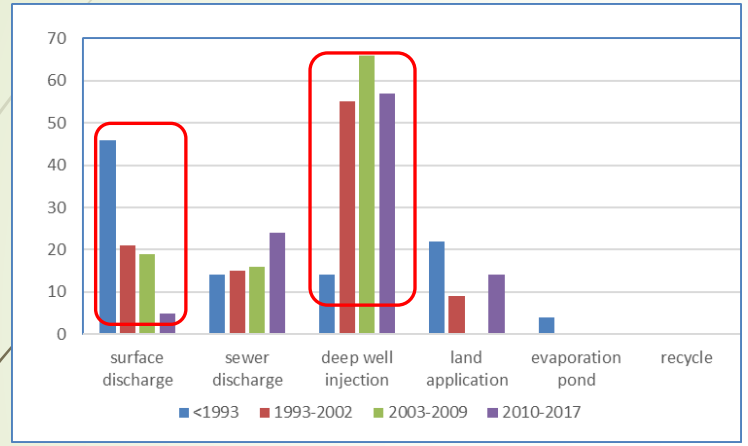


Composite Look

FLORIDA



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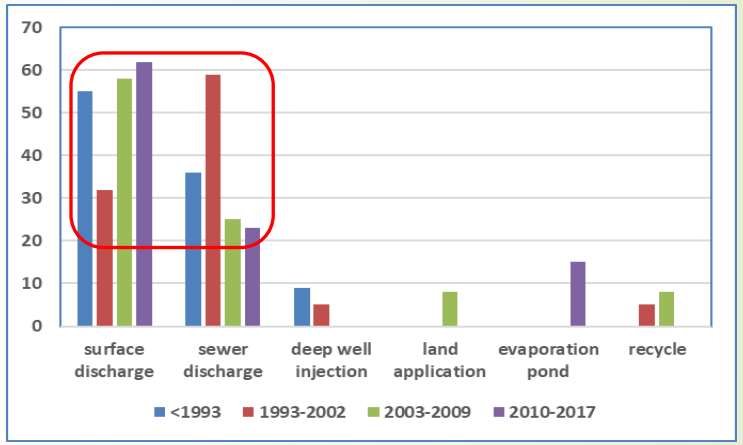

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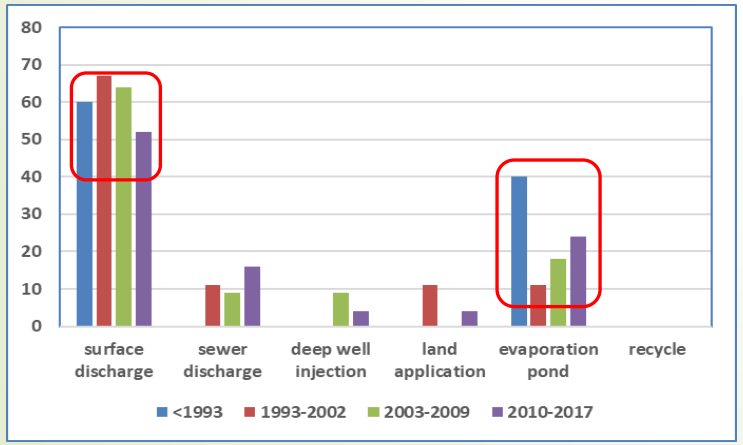

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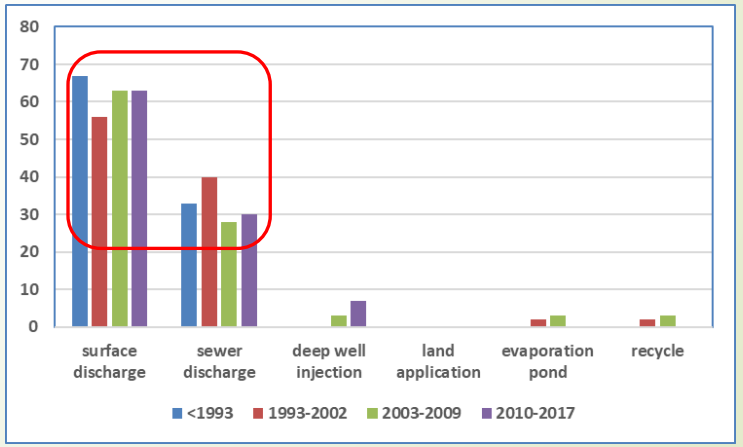


Disposal Options

of States Using

	Percent use	Number of states
surface discharge	45	27
discharge to sewer	25	24
deep well injection	17	5
land application	7	4
evaporation ponds	4	4
recycle	1	3

	TOTAL	FL	CA	TX	KS	AZ	PA	CO
deep well injection	69	62	2	2	1	0	0	2
land application	27	23	1	2	0	1	0	0
evaporation ponds	21	3	2	13	0	3	0	0
recycle	4	0	2	0	0	1	1	0

Summary of disposal option use

>98% of plants use one of the 5 conventional disposal options

Discharge to surface water and to sanitary sewer account for 71% of the plants

Use of the 5 conventional disposal options varies widely by location

Few states use of deep well injection, evaporation pond and land application

- DWI – 5 states with FL having 90% of these
- EP – 4 states
- LA – 3 states with FL having 85% of these

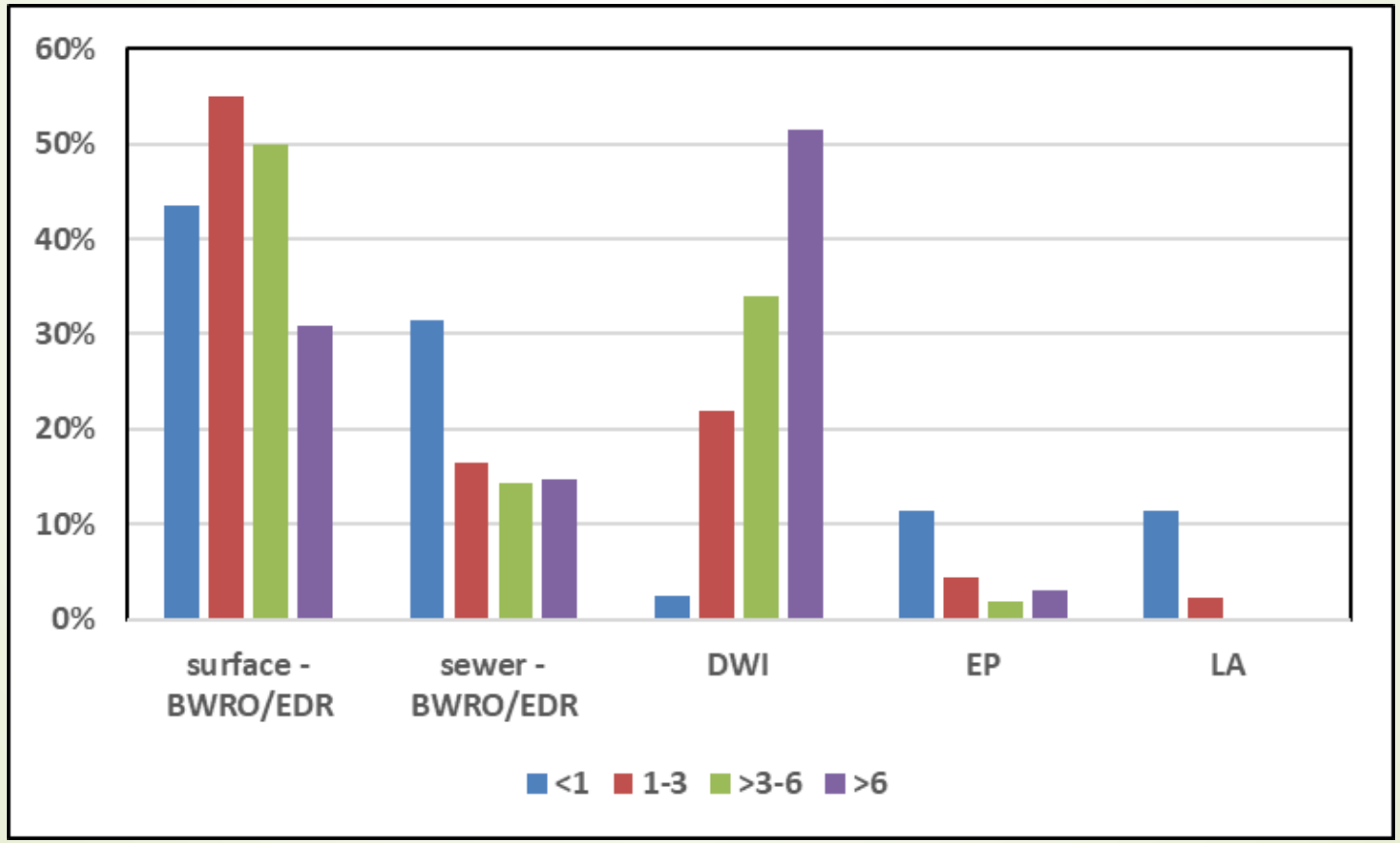
PLANT SIZE

Plant Size (mgd) by State

2010-2017 installations

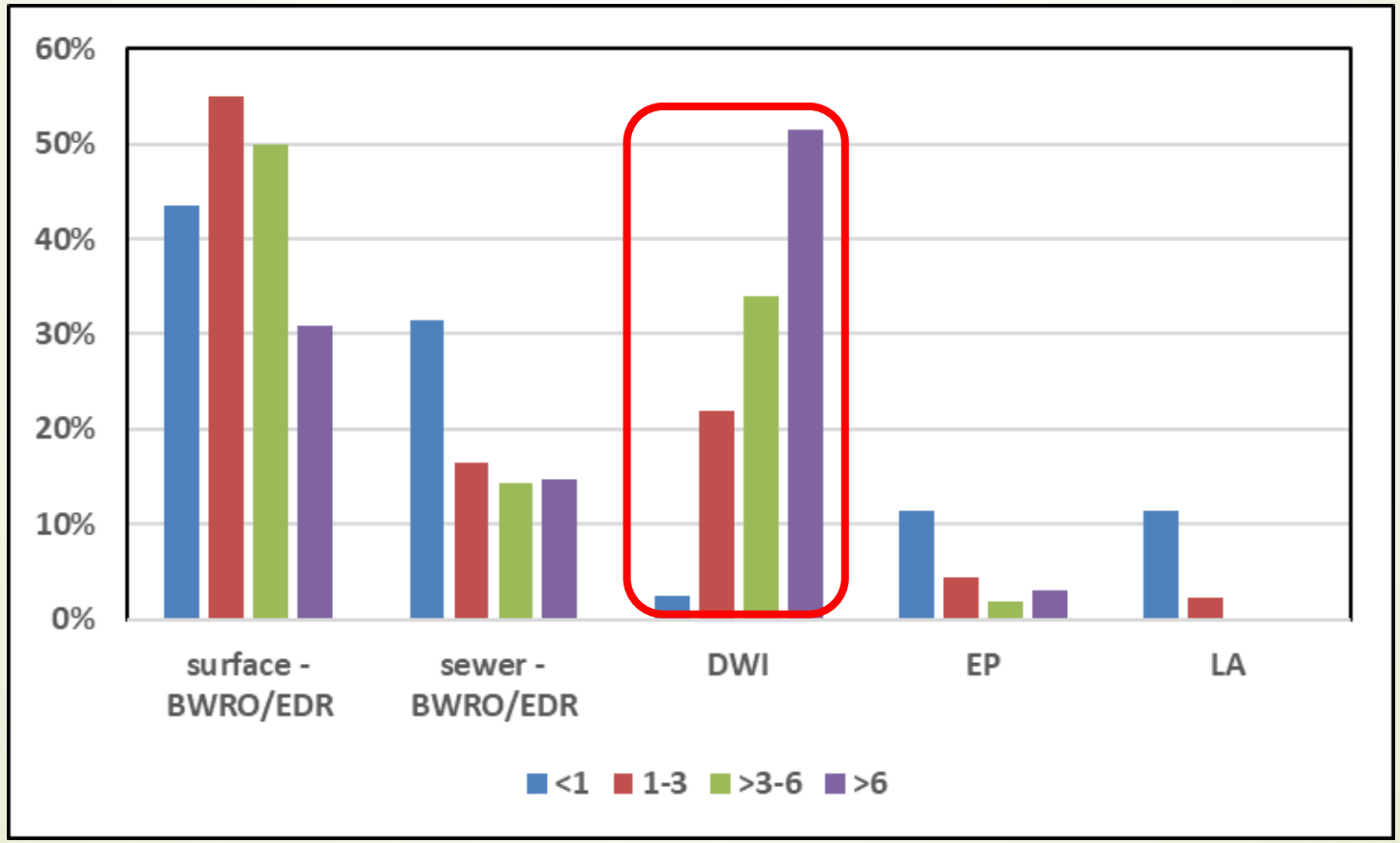
	average capacity (mgd)	
California	7.36	(3.81 without Carlsbad)
Florida	5.88	
Other	2.87	
Texas	1.51	(1.12 without San Antonio)

Disposal Option Use (%)
by Plant Size (mgd)



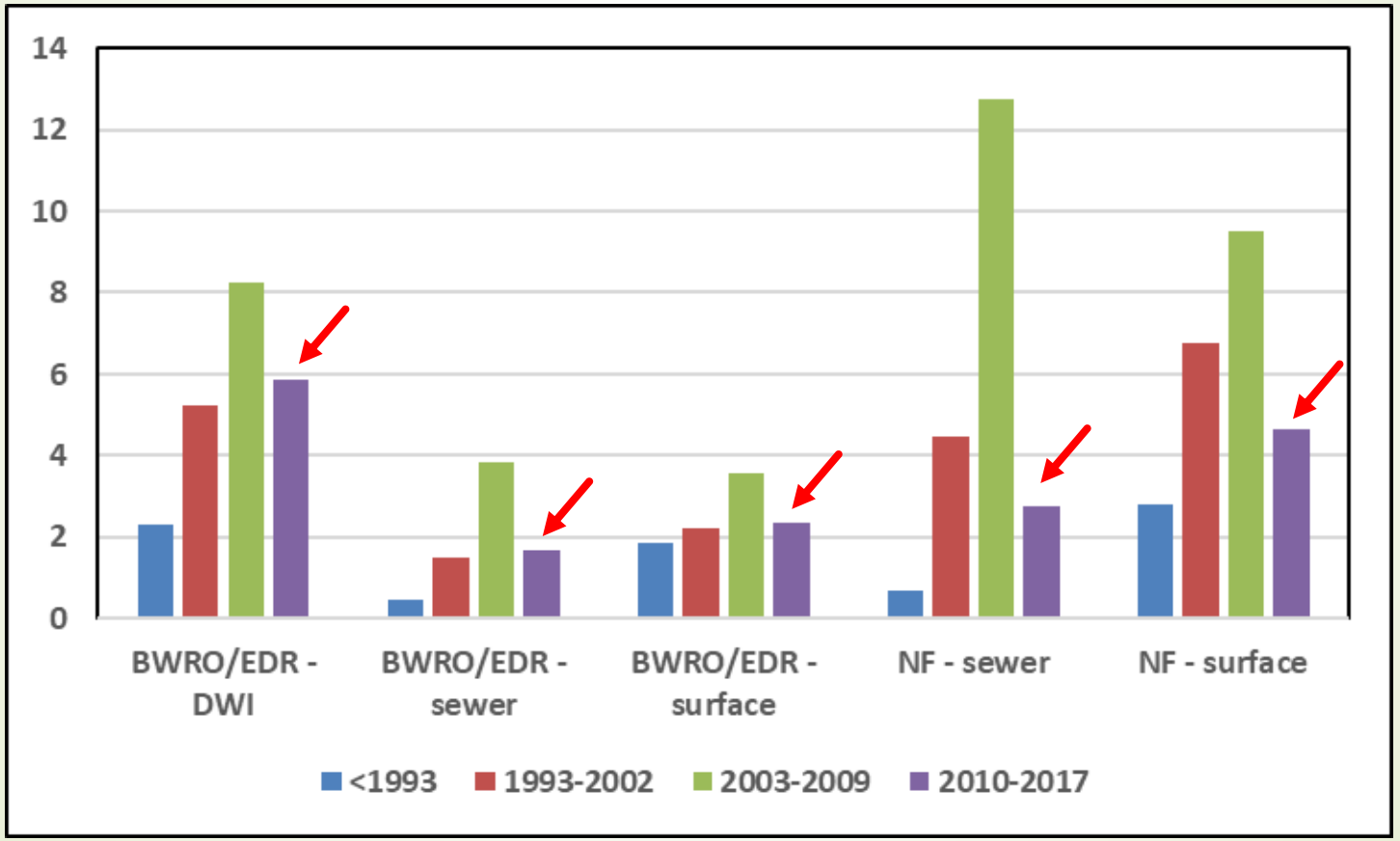
Disposal Option Use (%)

by Plant Size (mgd)



Average Plant Size (mgd)

by Disposal Option and Time Period



Summary of plant size

Plant size varies by state; FL has largest avg. size (neglecting CA Carlsbad facility)

Avg. size varies with type of disposal option:

- Surface discharge – used with all sizes
- Sanitary sewer – % use decreases with size
- Deep well injection - % use increases with size
- Evaporation pond and land application – used only with small size

Avg. size increased significantly in each of first 3 surveys; decreased in the 2010-2017 survey

Contact Information

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