Well Field Analysis

City of Elizabeth City

June 2, 2025

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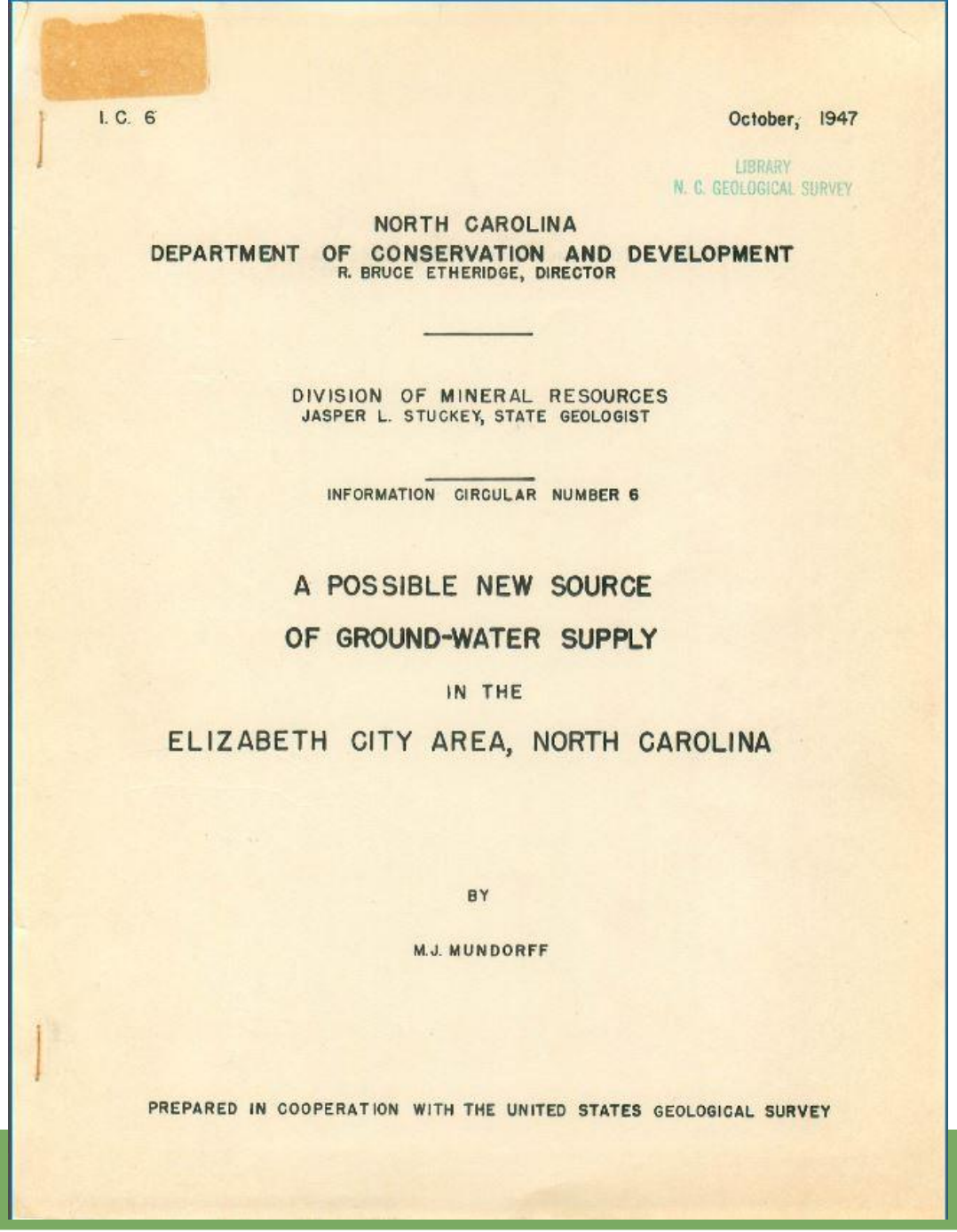
NOT A NEW TOPIC



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N. C. GEOLOGICAL SURVEY

NORTH CAROLINA
DEPARTMENT OF CONSERVATION AND DEVELOPMENT
R. BRUCE ETHERIDGE, DIRECTOR

DIVISION OF MINERAL RESOURCES
JASPER L. STUCKEY, STATE GEOLOGIST

INFORMATION CIRCULAR NUMBER 6

A POSSIBLE NEW SOURCE OF GROUND-WATER SUPPLY IN THE ELIZABETH CITY AREA, NORTH CAROLINA

BY

M.J. MUNDORFF

PREPARED IN COOPERATION WITH THE UNITED STATES GEOLOGICAL SURVEY

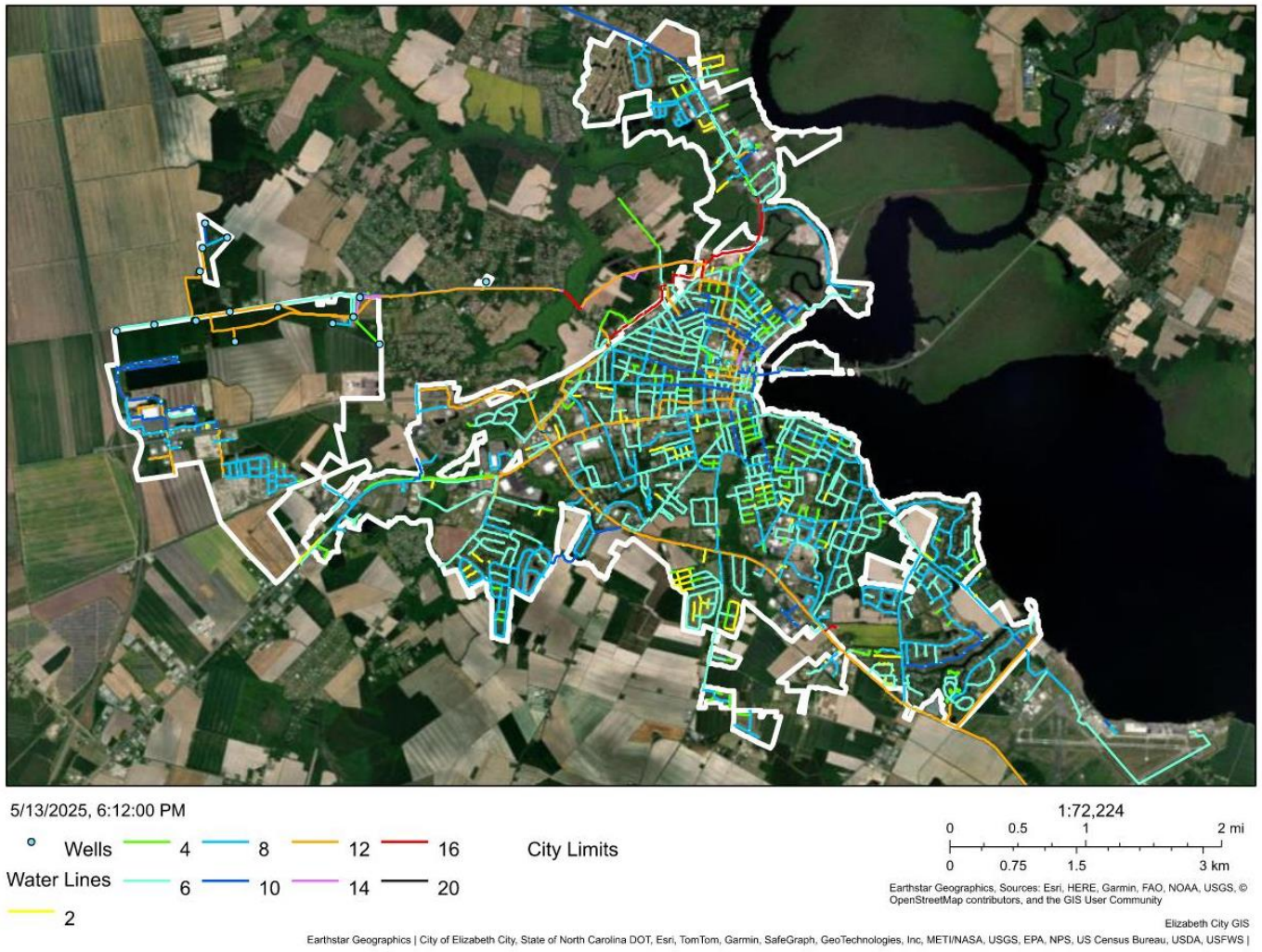
AGENDA

- Current System
- Well Study Overview – Shorter Term
- Well Study Overview – Longer Term
- Timeline
- Funding
- Q&A

CURRENT SYSTEM

Current Water Supply/Treatment System

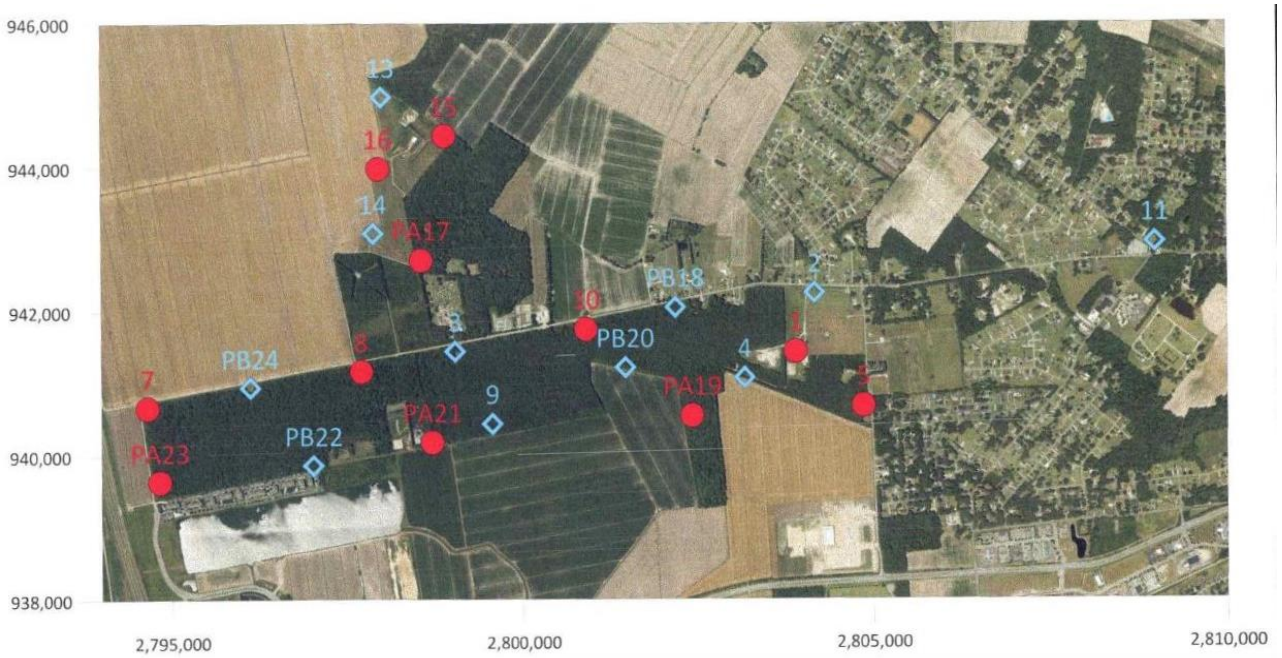
- **Existing WTP Capacity of 5 MGD**
- **14 Existing Groundwater Wells**
  - Initial PWS Well Yield of 3.27 MGD
  - Actual Well Yield of 2.95 MGD
  - All withdrawing water from the Yorktown aquifer
  - Wells located along raw water main infrastructure directed to WTP
  - Well Management Strategy alternates pump cycles during the day and night
  - Well 6 no longer active – likely poorly sized screening. Lost 2 more wells since conversation started.
- **Aging WTP Repair and Maintenance**



WELL STUDY OVERVIEW
SHORTER TERM

Well Study Overview – Shorter Term

- Minimize Impact on Existing Wells and Raw Water Infrastructure
- Optimize Well Spacing and Capacities
- Maintain Alternating Pumping Strategy
- Potential to add 3 replacement Wells & up to 8 New Yorktown Wells
- Anticipated Additional Yield of 864,000 GPD
- Brings Well Yield up to 3.81 MGD
- Start with Test Well to confirm quality and quantity of water
- Drill permanent production well 20’ away
- Convert Test Well into Observation (Valuable Hydrogeologic Assessment Tool)
- Can Phase Well Development However City Needs



Possible Future Wells:

State Plane East NAD 83 Ft.	State Plane North NAD 83 Ft.	Well Name	Pump Capacity G.P.M.	DAY B Flow G.P.D.	NIGHT A Flow G.P.D.	TOTAL Flow G.P.D.
2,798,554	942,713	PA17	200	0	144,000	144,000
2,802,421	940,553	PA19	200	0	144,000	144,000
2,794,831	939,638	PA23	50	0	36,000	36,000
2,798,709	940,183	PA21	200	0	144,000	144,000
2,802,185	942,055	PB18	200	144,000	0	144,000
2,801,465	941,222	PB20	200	144,000	0	144,000
2,796,116	940,943	PB24	50	36,000	0	36,000
2,797,022	939,864	PB22	100	72,000	0	72,000
				396,000	468,000	**864,000**

WELL STUDY OVERVIEW
LONGER TERM

Well Study Overview – Longer Term

- **The City Could Continue to Select New Yorktown Aquifer Well Sites Throughout the City**
  - Raw Water Infrastructure Does Not Exist and Would Be Costly and Disruptive
- **Salt Water Intrusion in Yorktown Aquifer is Expected Over Time**
- **Transition to Reverse Osmosis is an eventuality**
- **Deeper Wells within the Castle Hayne Aquifer**
  - Provide More Stability Hydraulically and Better Overall Water Quality
  - Potentially Requires Different Treatment Method(s)
- **Redundancy with Additional 5-7 MGD WTP**

Well Study Overview – Longer Term

- **Step 1: Drill Test Well(s) into Castle Hayne Aquifer to Determine Water Quality and Quantity**
- **Wide Range 400-1200 GPM Per Well**
  - If 5 MGD Target, May Need 6-14 Wells
- **Quality of Water Determines Treatment Methodology (Examples: Nanofiltration, Low Pressure Reverse Osmosis, High Pressure RO)**
- **Potential for Wellhead Treatment at each New Well**
- **More Likely Need New Centralized WTP**
- **RO Involves Reject Water**
  - Discharge (NPDES)
  - Water Quality Model required (discharge to freshwater not permitted unless impact is minimal)
- **Can Add Train(s) Within WTP to Increase Capacity (Plug & Play)**

TIMELINE

Time/Costs

SHORTER TERM YORKTOWN WELLS:

- **Design & Permitting Approx. $400k**
- **CA / CO Approx. $150k**
- **Each Well Site Approx. $500K-$800k**
- **Need about $6-7mil**
- **Approx. 2 Year Process**
  - Starts with PWS Well Location Approval
  - Test Well
  - Analysis for Well Construction and Screen Specification
  - Design & Permitting
  - Bidding
  - Construction with CA/CO
  - Certification & Final Approval

LONGER TERM CASTLE HAYNE WELLS:

- **5-7 Year Process**
  - Test Well(s)
  - WQ Analysis / Treatment Determination
  - Determination if proposed discharge allowed. Speculative Effluent Limits
  - Engineering Alternatives Analysis (EAA)
  - SEPA EA/EIS?
  - Potential property and/or easements for WTP and discharge piping
  - Design/Permitting/NPDES
  - Well Drilling
  - WTP Construction
- **6 MGD New RO WTP $115 million in 2023 (could be on low range today and doesn't include discharge piping)**

Time/Costs Cont.

Critical Phase 1A Immediate Short Term			
Underscore/Emphasize the loss of 3 wells with a goal to restore former wells lost at minimum. **Immediate Short Term Estimates to bring (3) wells back online.**			
D&P	$ 150,000.00		$ 150,000.00
CA&CO	$ 60,000.00		$ 60,000.00
Avg Per Well (adding 3)	$1,950,000	High NTE cost to add (3)	$ 2,400,000.00
Total Apprx (Low Cost)	**$ 2,160,000.00**	Total (Apprx High Cost)	**$ 2,610,000.00**
Anticpated Yield for (3) Wells to restore former state	**324,000**	**Gallons Per Day**	

Proactive Phase 1B Immediate Short Term			
D&P	$ 400,000.00		$ 400,000.00
CA&CO	$ 150,000.00		$ 150,000.00
Avg Per Well (adding 8)	$5,200,000	High NTE cost to add (3)	$ 6,400,000.00
Total Apprx (Low Cost)	**$ 5,750,000.00**	Total (Apprx High Cost)	**$ 6,950,000.00**
Anticpated Yield for (8) Wells to restore former state	**864,400**	**Gallons Per Day**	

Q:

- **Why Can't Raw Water Be Drawn From River?**
  - Surface water subject to what flows downstream; PFAS, petroleum
  - Turbidity, periodic salinity
  - BacT, CT
  - Much more expensive (Orders of Magnitude Higher)
  - New Raw Water Intake, New Off-Line Storage, New WTP, Infrastructure
  - Higher Grade Operator, Maintenance

FUNDING

FUNDING SUCCESS

FEMA

$1+ billion

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LAND & WATER CONSERVATION FUND LWCF COALITION

STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

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ARC APPALACHIAN REGIONAL COMMISSION

YOU'VE GOT QUESTIONS

WE'VE GOT ANSWERS

THANK
YOU!