4th & Carey Groundwater Remediation Project

and

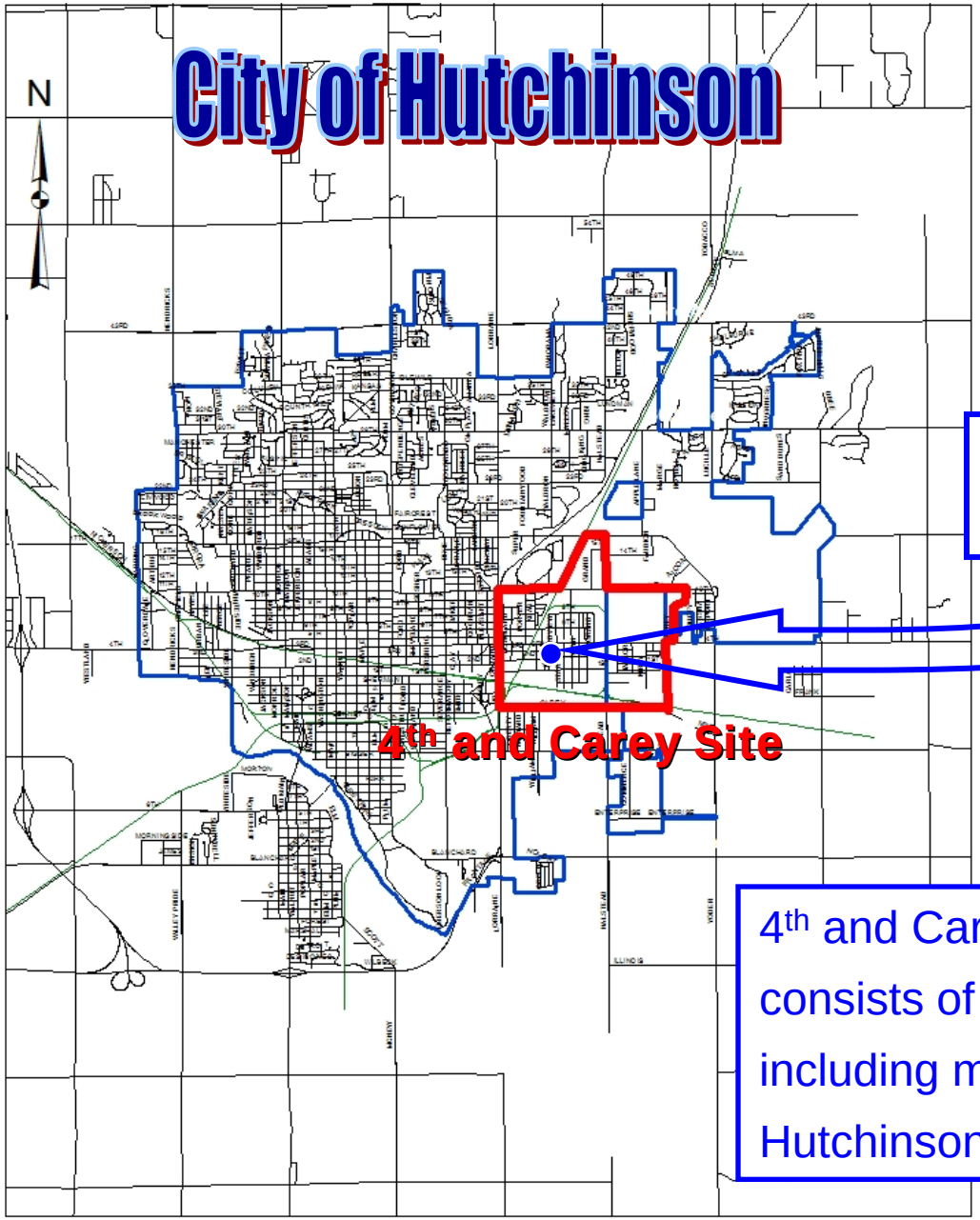
Reverse Osmosis Water Treatment System

Contaminated City Well

Well #8 – 4th and Carey

Groundwater contamination from industry was discovered in the Southeast region of Hutchinson in 1982 and has since progressed over the eastern part of the City

City of Hutchinson



PWS Well #8
Located at
4th Ave. & Carey St.

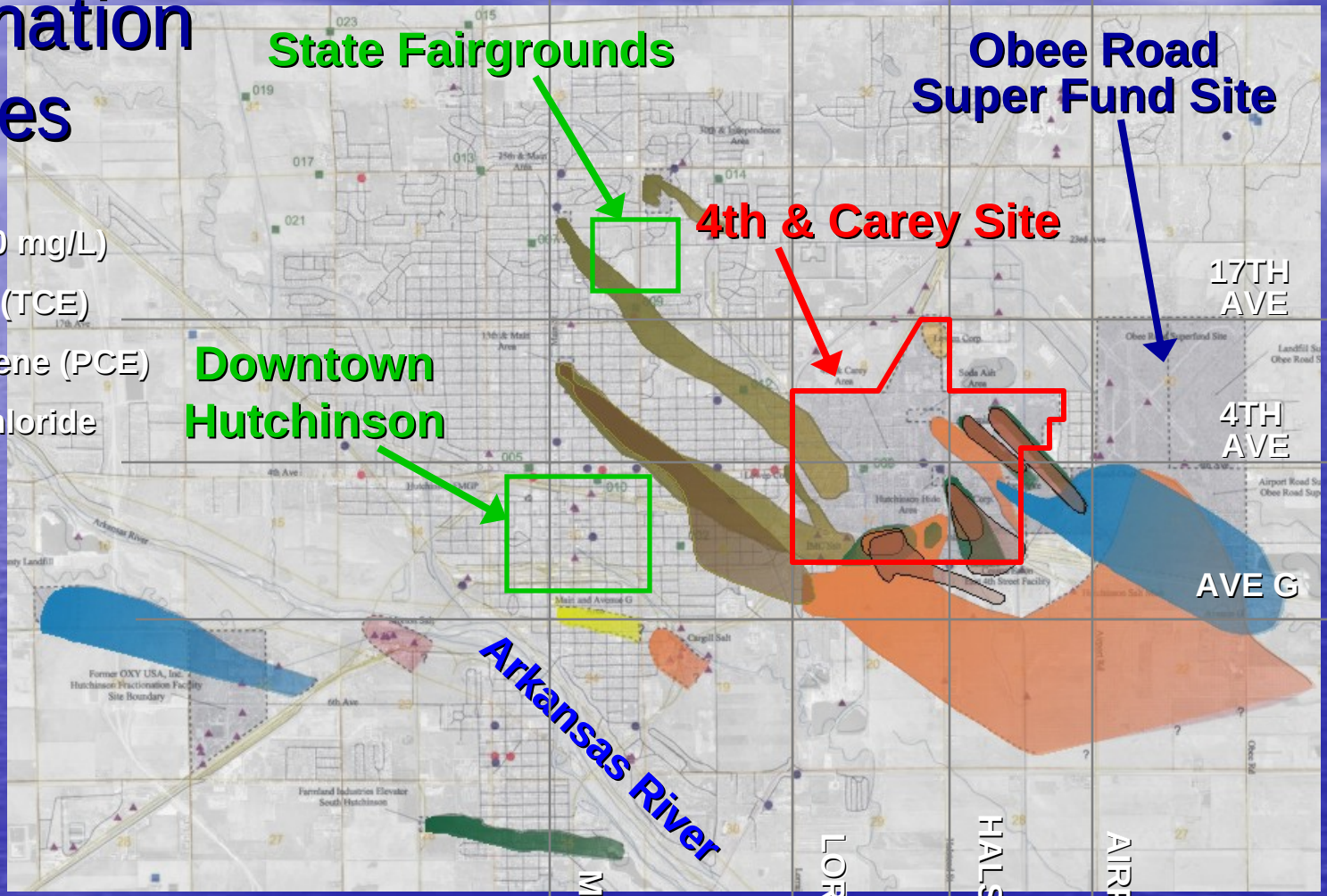
4th and Carey Site consists of 1,240 acres including many of Hutchinson's Industries

Groundwater Contamination

CONTAMINANT	POTENTIAL SOURCE
Carbon tetrachloride	Grain fumigant
Chloroform	Degradation product of carbon tetrachloride
Tetrachloroethene (PCE)	Dry cleaning fluid
Trichloroethene (TCE)	Industrial cleaning solvent
Cis-1, 2-dichloroethene	Degradation product of TCE
Trans-1, 2-dichloroethene	Degradation product of TCE
Hydrocarbons	Petroleum

Groundwater Contamination Plumes

- Chlorides (1000 mg/L)
- Trichlorethene (TCE)
- Tetrachloroethene (PCE)
- Carbon Tetrachloride
- Vinyl Chloride



City of Hutchinson

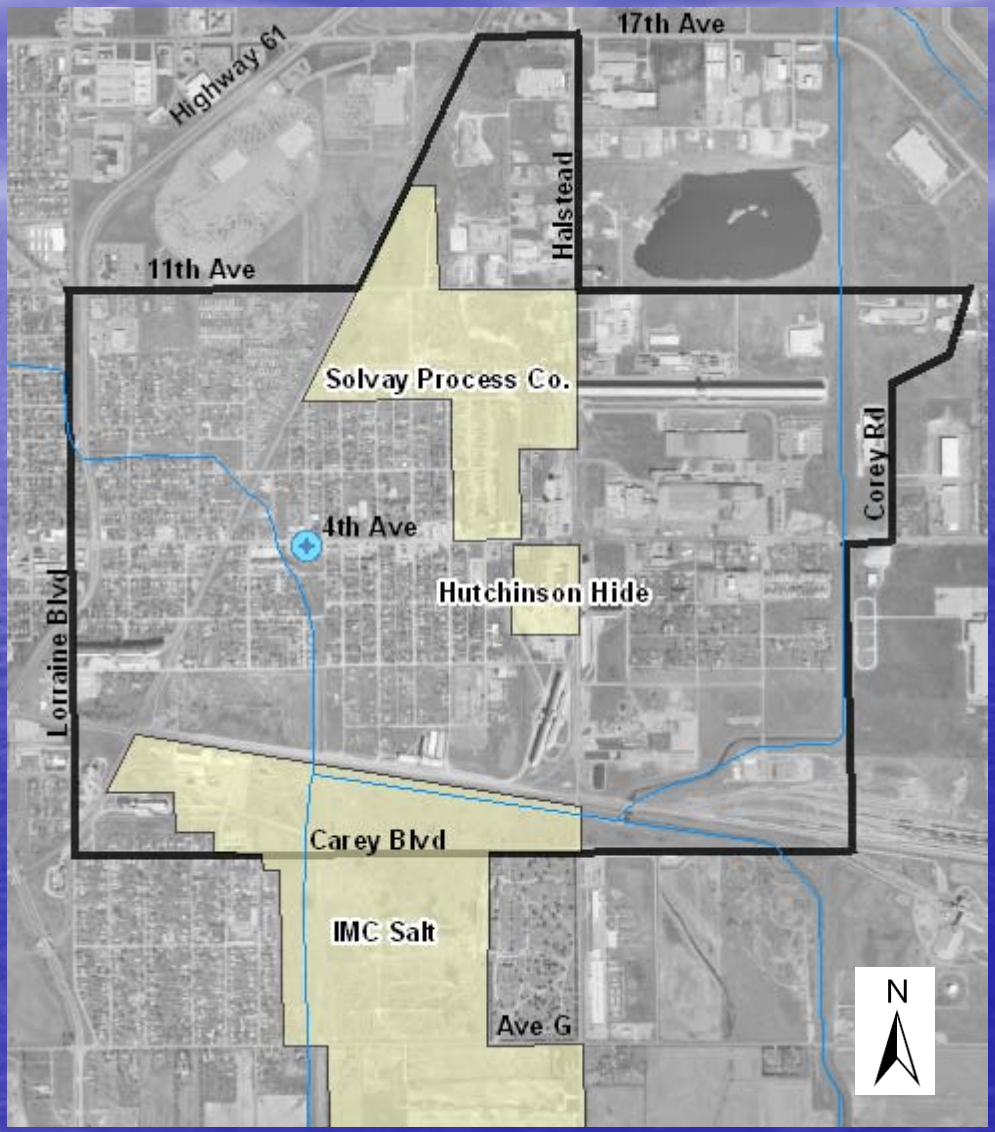
4th & Carey Groundwater Remediation Project History

- KDHE mandate to address source areas and cleanup the contaminated groundwater
- Cooperative effort with industry
- Tax Increment Finance (TIF) District
- Disconnect private water wells in the contaminated areas

Concerns of Standard Remediation Alternatives

- Typical Pump, Treat and Discharge Systems Waste a Significant Amount of Water
- Water Permitting Issues
- High Chloride Levels in Effluent are Highly Regulated and Complicate Cleanup Efforts

Sources of Salt Contamination



*Slide Courtesy of the Kansas Department of Health and Environment (KDHE)

Chloride Levels in Remedial Wells & Treated Effluent

	Chloride Concentrations (mg/L)
RW-1	**722**
RW-2	**402**
RW-3	**502**
Effluent*	**642**

*Suggested TMDL MCL <300 mg/L

CESSNA SITE

Objectives

- Prevent migration of groundwater contaminants to unimpacted areas.
- Remove Groundwater Contaminants in the Southeast Region
- Reclaim Water for Beneficial Use in the Potable Water Supply
- Comply with Federal and State Regulations

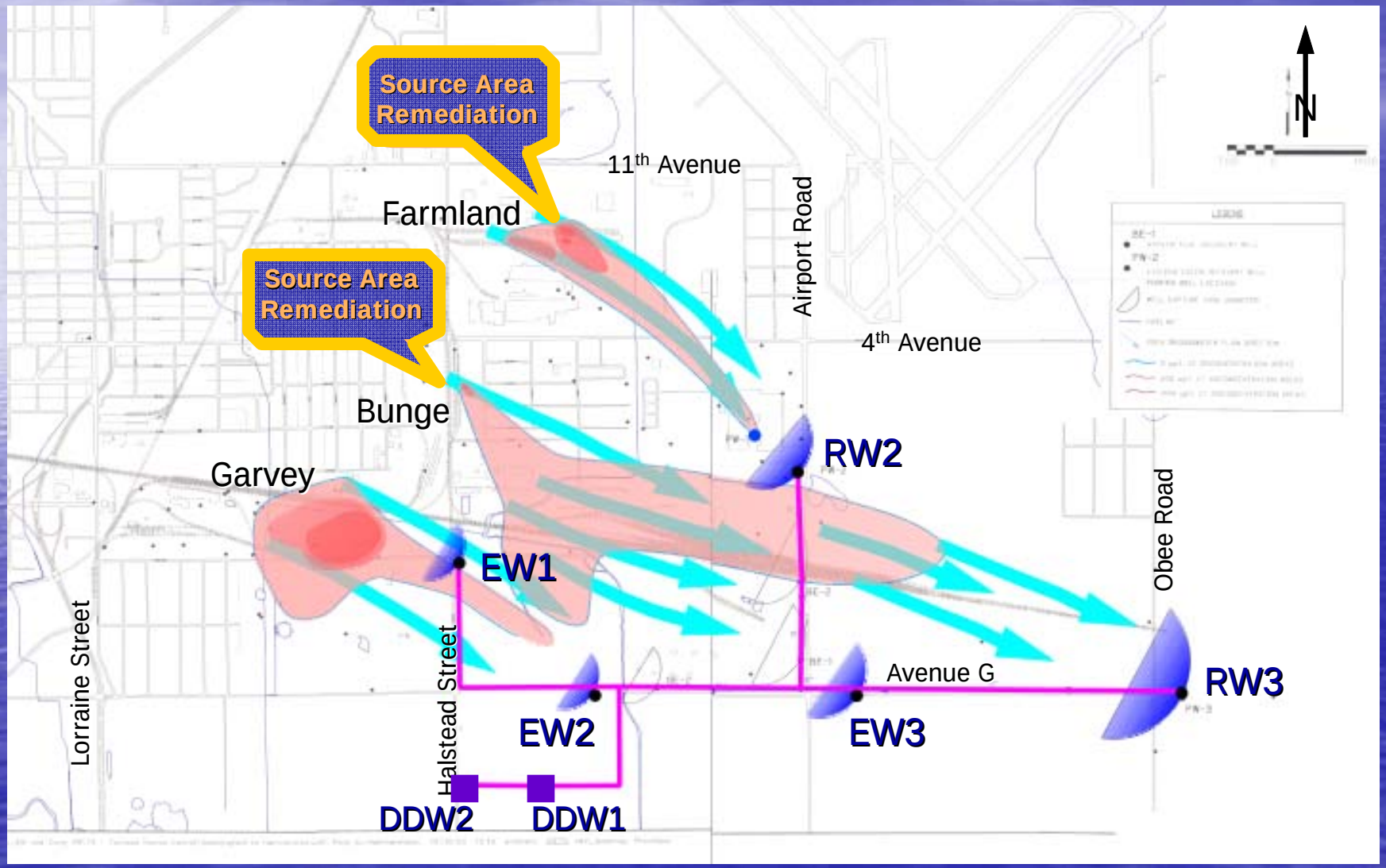
Solutions

- Pump Contaminated Groundwater
- Reverse Osmosis Membrane Filtration - Remove Chloride & Minerals
- Air Strippers – Remove VOC
- Treated Water Blended with the City's Well Water Resulting in Very High Quality Water

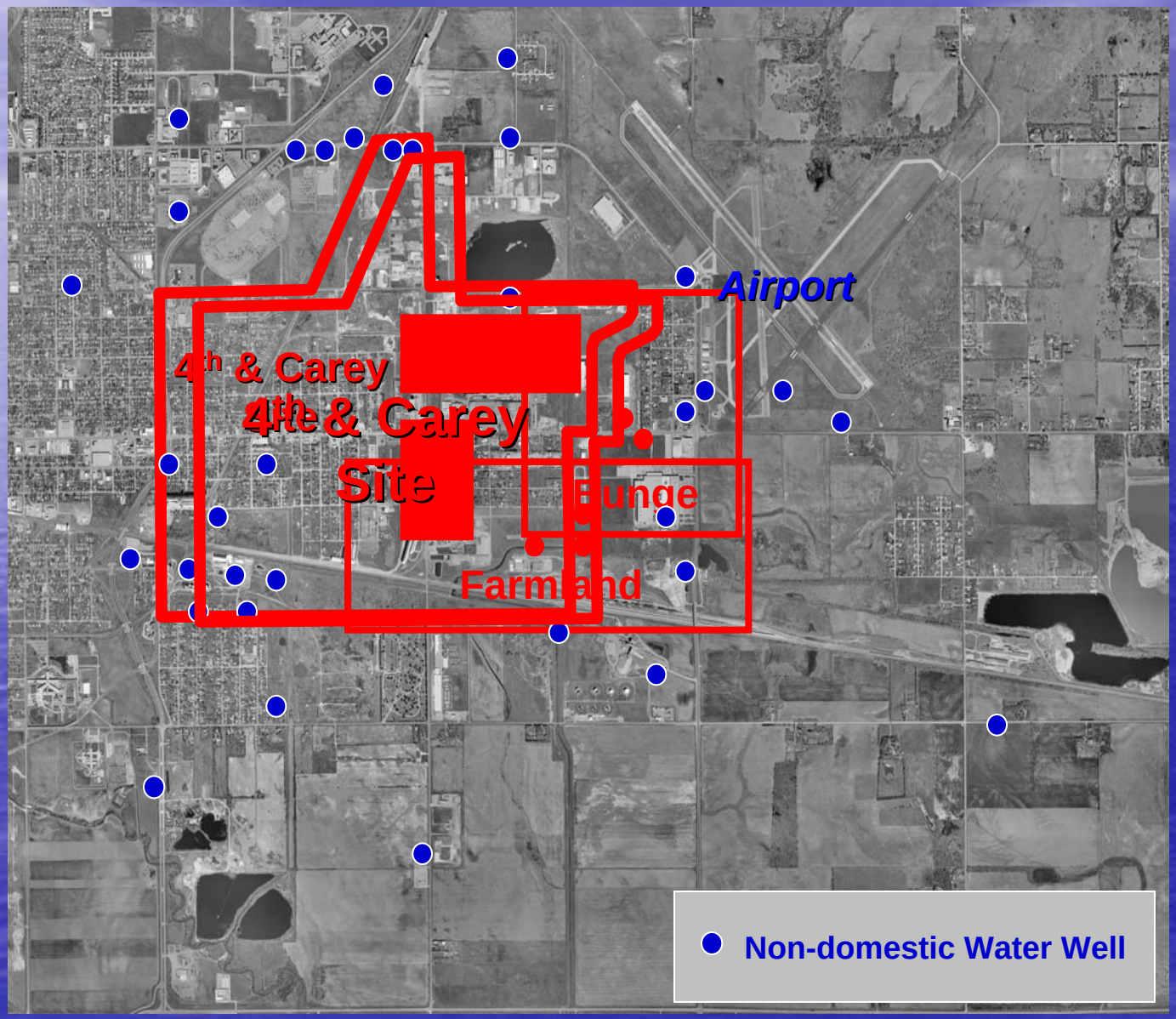
4th & Carey Project Components

1. Source Area Remediation (AS/SVE Treatment Systems for Shallow Source Area Groundwater Contamination – Approx. 30' deep)
2. Downgradient Remediation and Containment (Extraction Wells for Deep Groundwater Contamination – Approx. 60' deep)
3. Reverse Osmosis and Air Stripping Treatment (Hutchinson Water Treatment Center for RO Treated Water and Untreated Municipal Water Blending)
4. Deep Well Disposal (Class I UIC Non-hazardous Deep Disposal Wells)

Catcher's Mitt Concept



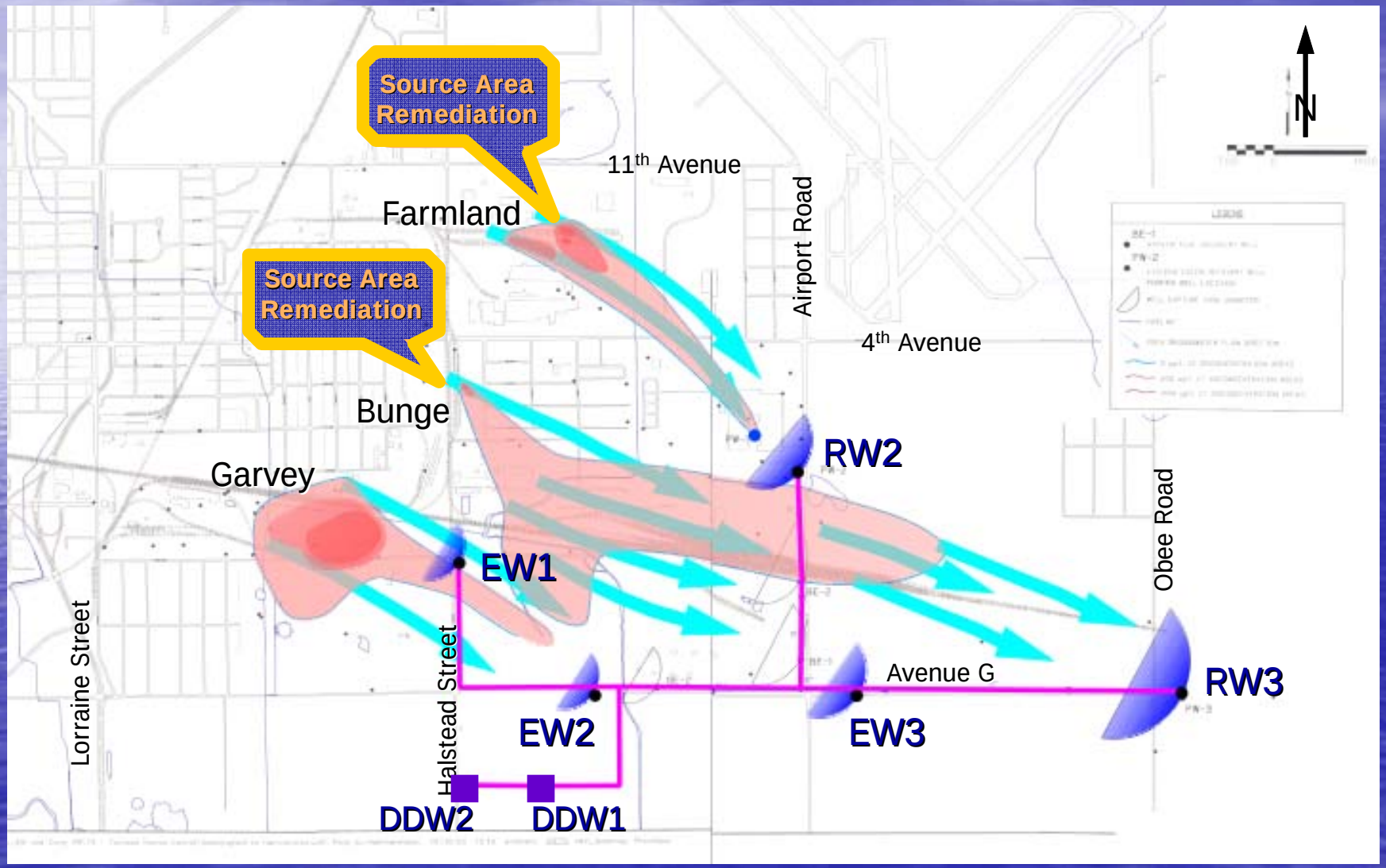
Carbon Tetrachloride Source Area Remediation



Source Area Remediation

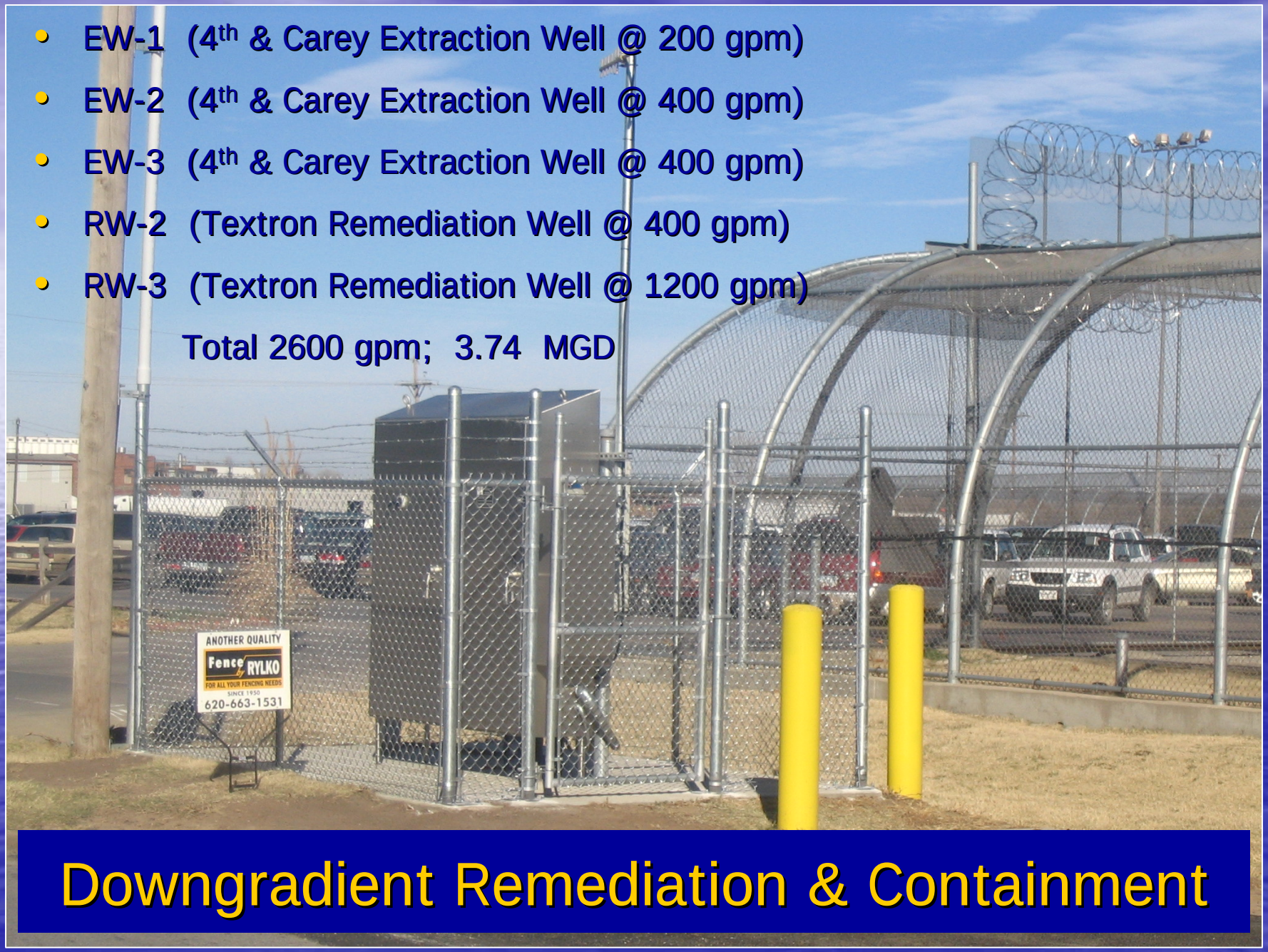
- 3 AS/SVE Treatment Systems at Farmland Elevator
- 1 AS/SVE Treatment System at Bunge Elevator

Catcher's Mitt Concept



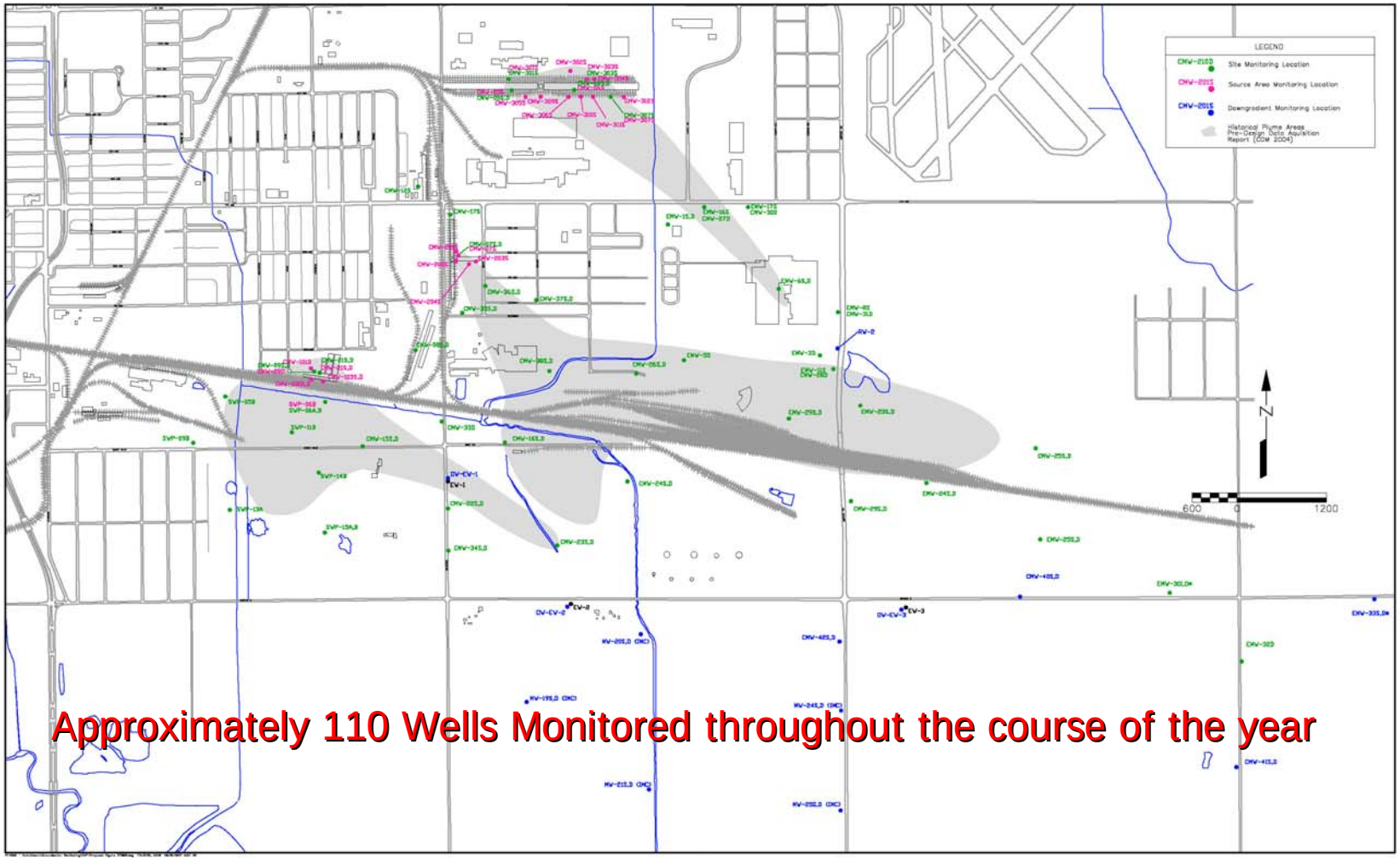
- EW-1 (4th & Carey Extraction Well @ 200 gpm)
- EW-2 (4th & Carey Extraction Well @ 400 gpm)
- EW-3 (4th & Carey Extraction Well @ 400 gpm)
- RW-2 (Textron Remediation Well @ 400 gpm)
- RW-3 (Textron Remediation Well @ 1200 gpm)

Total 2600 gpm; 3.74 MGD



Downgradient Remediation & Containment

Monitoring Network



Approximately 110 Wells Monitored throughout the course of the year

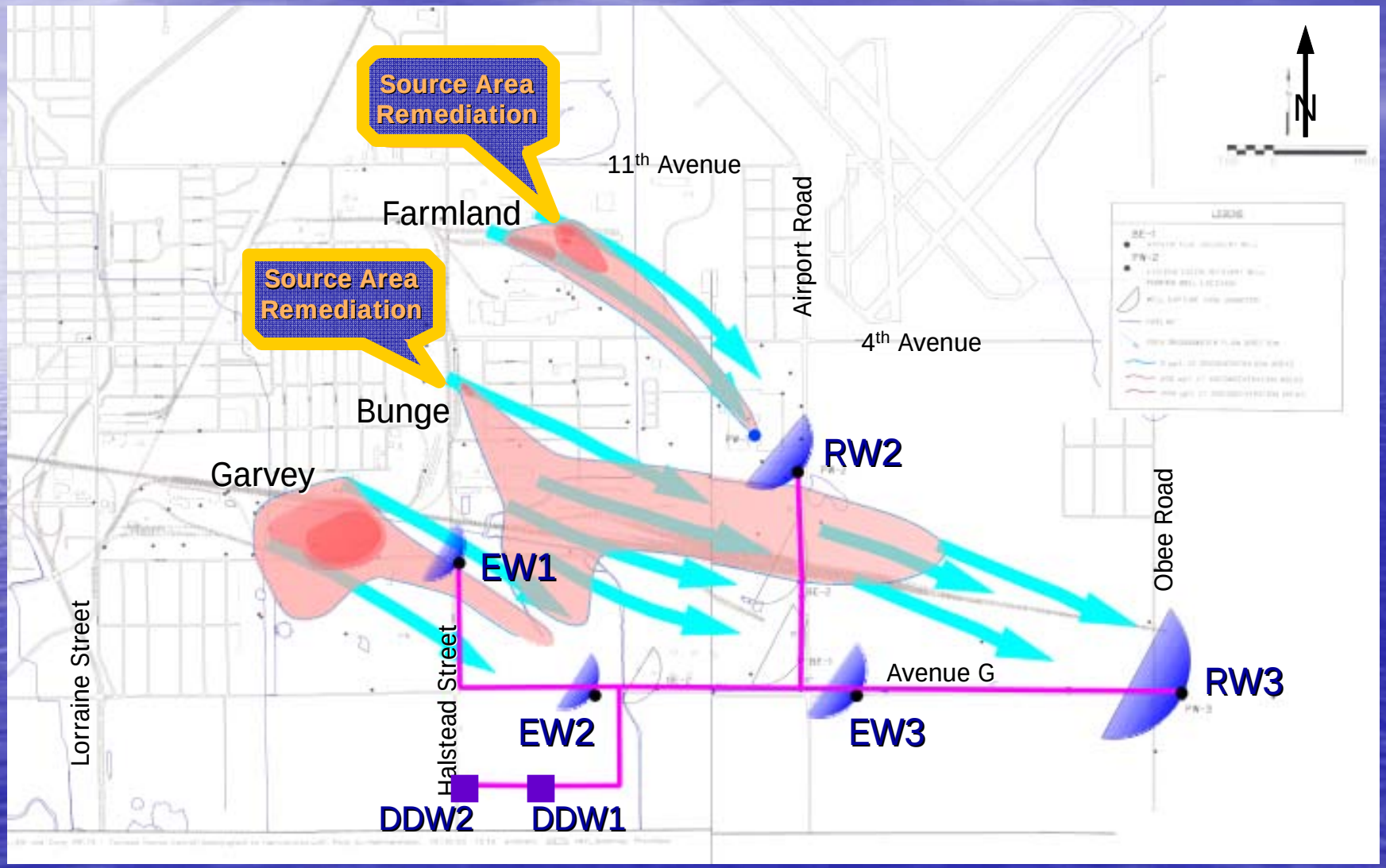
CDM

4th and Carey Site
Monitoring Network

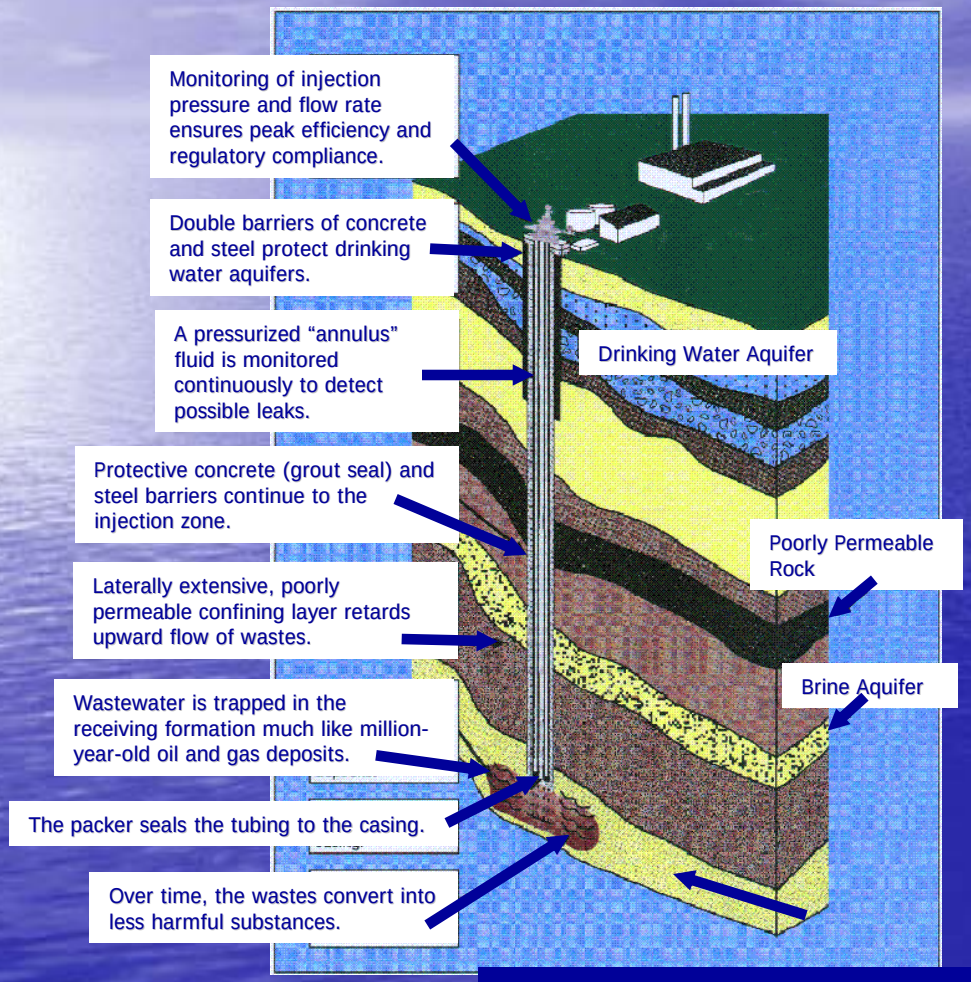
Remediation System Performance/Observations

- Significant reduction in VOCs observed at source areas.
- Plume migration towards extraction wells as planned.
- Results to date are very encouraging.

Catcher's Mitt Concept



Class I Non-hazardous Deep Disposal Well



Arbuckle Formation
4,000 to 4,800 feet deep

- DDW-1

(Deep Disposal Well #1 @ 1250 gpm)

- DDW-2

(Deep Disposal Well #2 @ 1250 gpm)

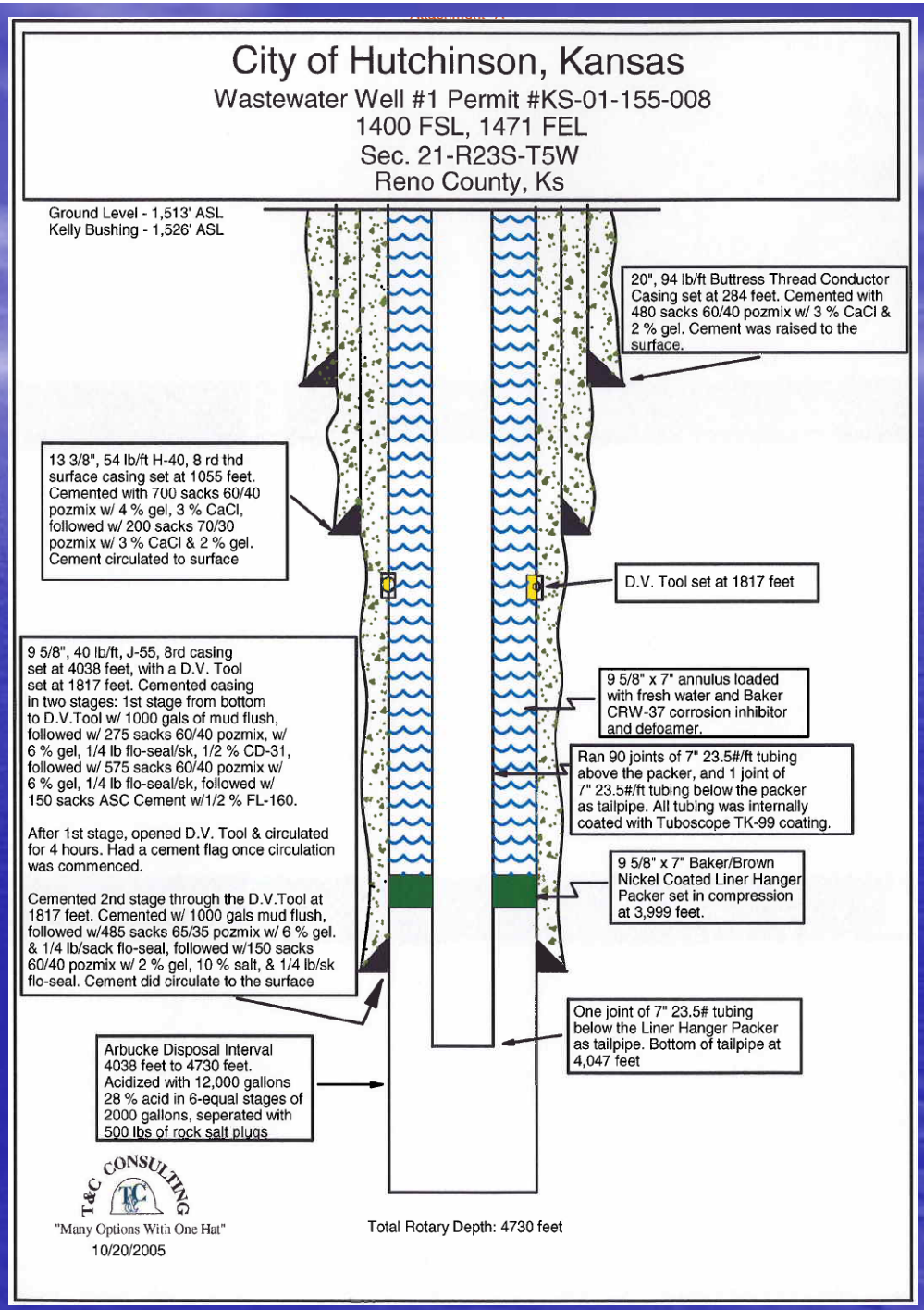
- DDW-3

(Future Disposal Well #3 @ 1250 gpm)

Current Capacity 2500 gpm; 3.6 MGD

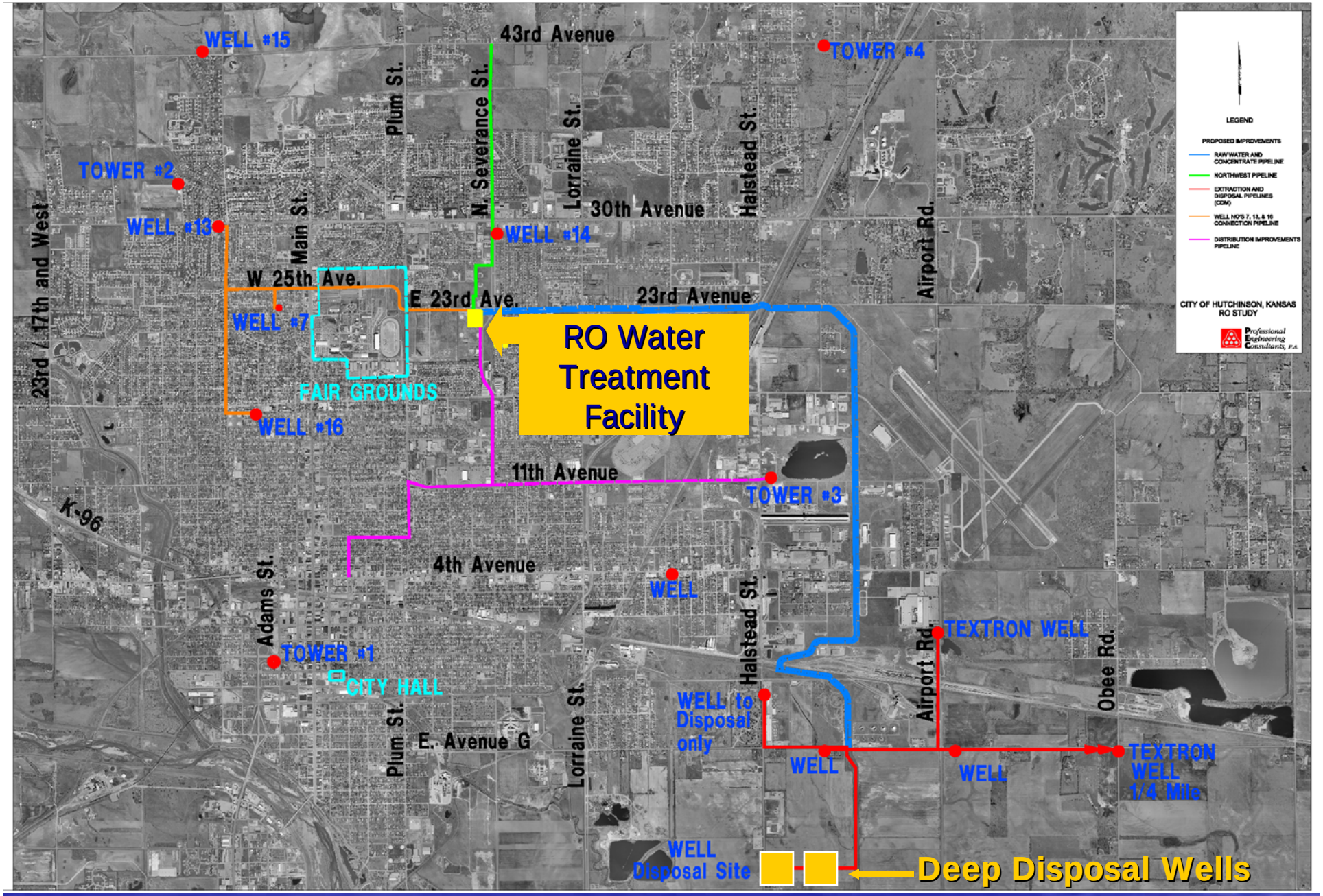
Future Capacity 3750 gpm; 5.4 MGD

City of Hutchinson Class I UIC Well #1 Construction

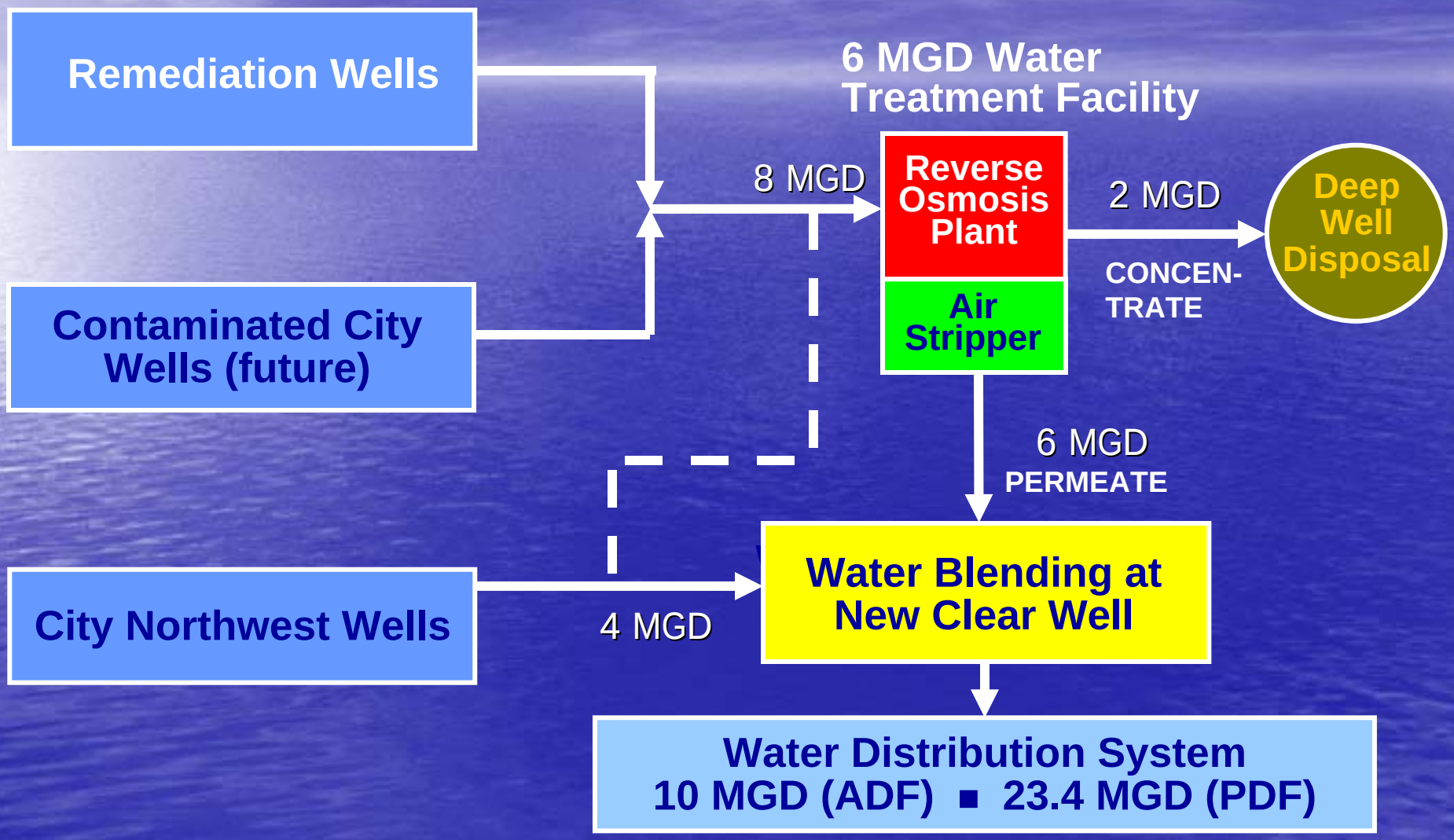


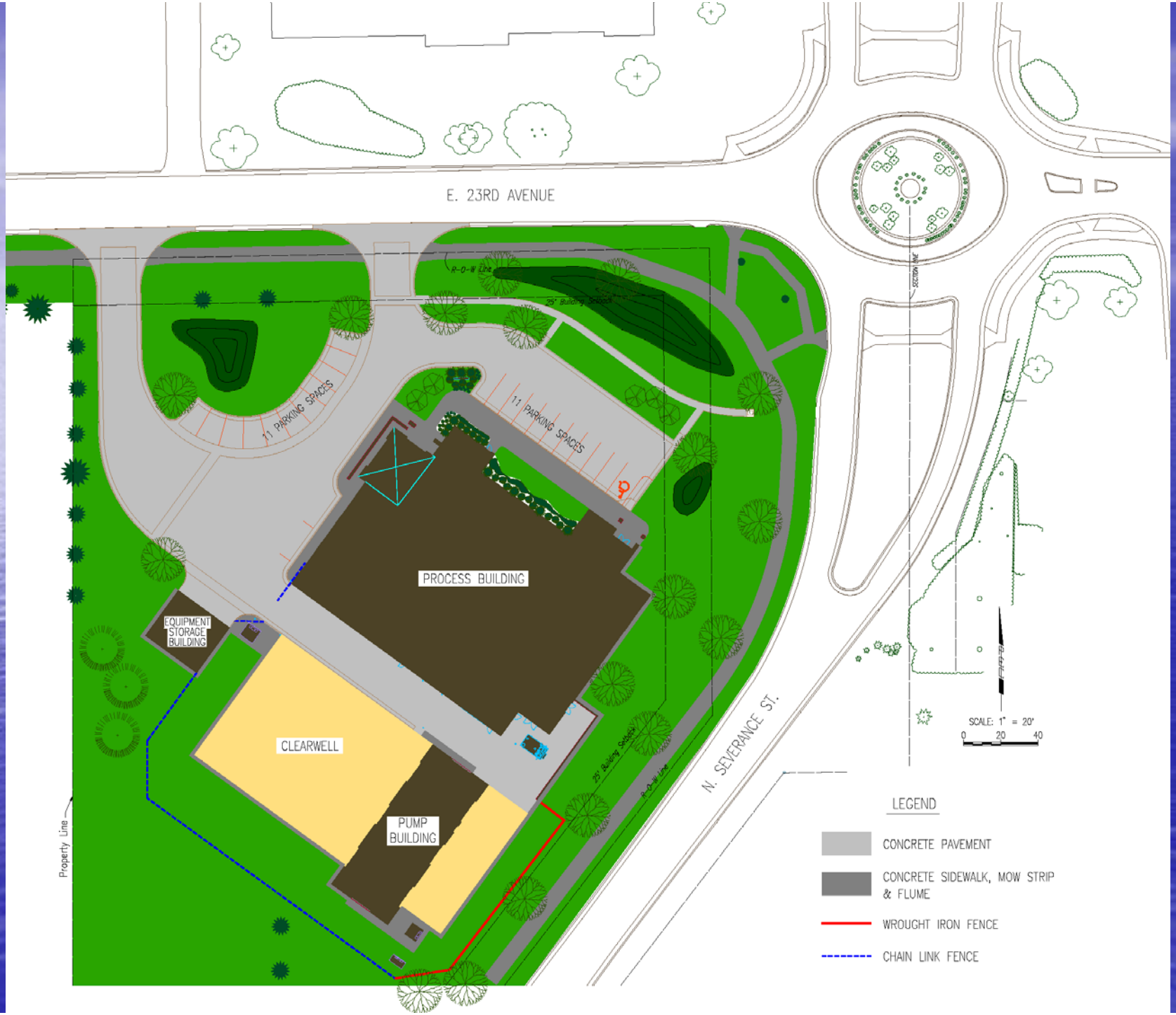
Arbuckle Formation
4,000 to 4,800 feet deep

Deep Disposal Well System


WELL #15
43rd Avenue
TOWER #4
Plum St.
N. Severance St.
Lorraine St.
Halstead St.
TOWER #2
WELL #13
Main St.
30th Avenue
WELL #14
Airport Rd.
W 25th Ave.
E 23rd Ave.
23rd Avenue
WELL #7
23rd / 17th and West
RO Water Treatment Facility
FAIR GROUNDS
WELL #16
11th Avenue
TOWER #3
K-96
4th Avenue
WELL
Adams St.
TEXTRON WELL
TOWER #1
CITY HALL
Obee Rd.
WELL to Disposal only
E. Avenue G
WELL
WELL
TEXTRON WELL 1/4 Mile
WELL Disposal Site
Deep Disposal Wells
LEGEND
PROPOSED IMPROVEMENTS
RAW WATER AND CONCENTRATE PIPELINE
NORTHWEST PIPELINE
EXTRACTION AND DISPOSAL PIPELINES (CDM)
WELL NO'S 7, 13, & 16 CONNECTION PIPELINE
DISTRIBUTION IMPROVEMENTS PIPELINE
CITY OF HUTCHINSON, KANSAS
RO STUDY
Professional Engineering Consultants, P.A.

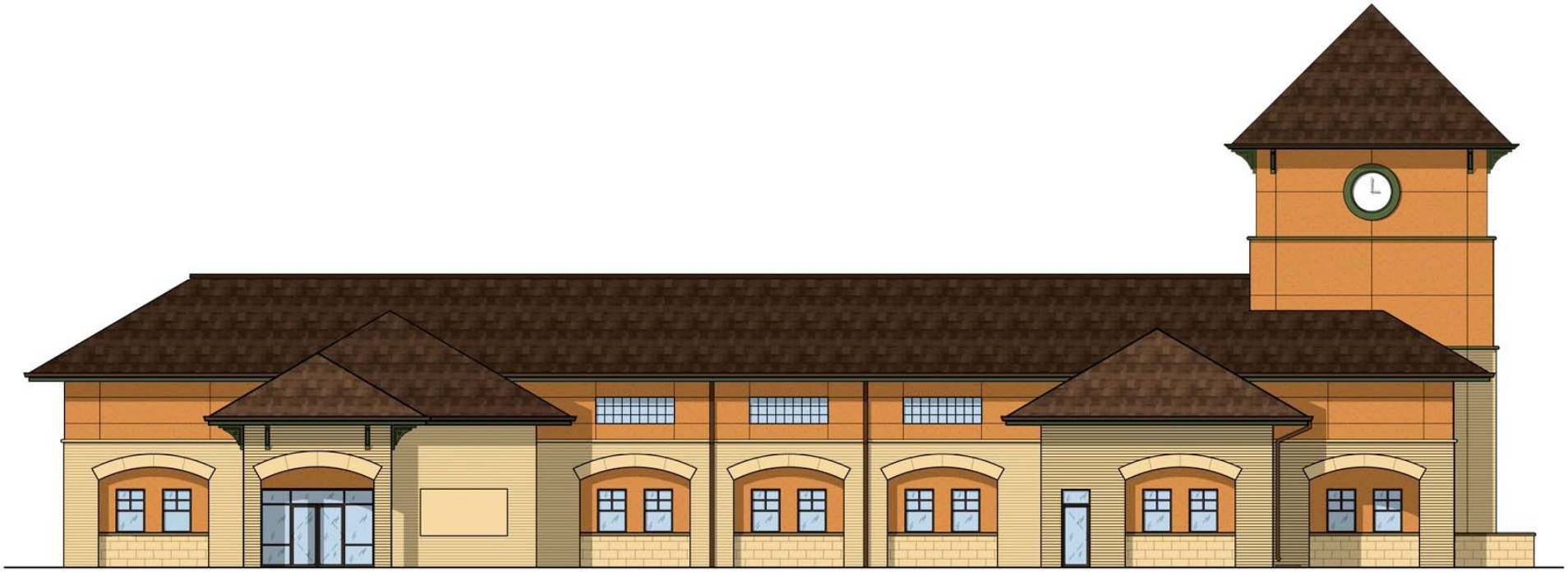
Hutchinson Water Treatment System Schematic




E. 23RD AVENUE
N. SEVERANCE ST.
R-O-W Line
25' Building Setback
11 PARKING SPACES
11 PARKING SPACES
PROCESS BUILDING
EQUIPMENT STORAGE BUILDING
CLEARWELL
PUMP BUILDING
Property Line
SECTION LINE
SCALE: 1" = 20'
0 20 40
LEGEND
CONCRETE PAVEMENT
CONCRETE SIDEWALK, MOW STRIP & FLUME
WROUGHT IRON FENCE
CHAIN LINK FENCE

City of Hutchinson

Reverse Osmosis Water Treatment Facility



North Process Building Elevation

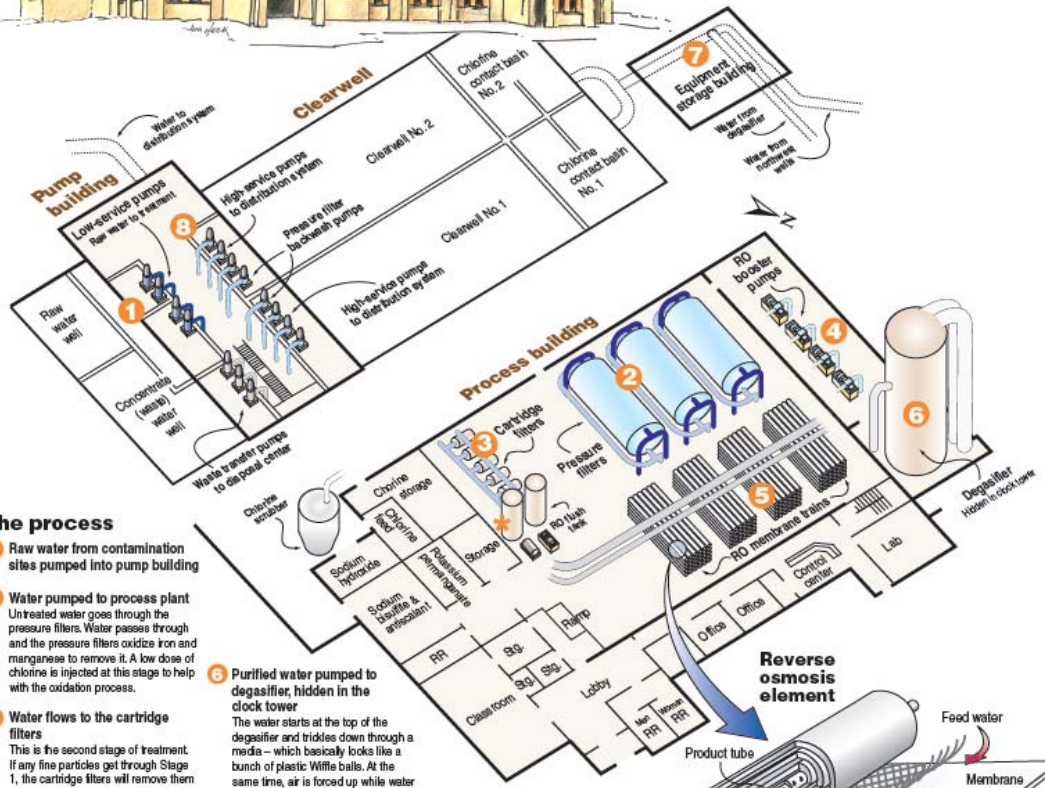
City of Hutchinson

Reverse Osmosis Water Treatment Center

HUTCHINSON

Water Treatment System

- 3 Dual Chamber Pressure Sand Filters (2 filters per vessel – 1.61 MGD treatment capacity per filter)
- 6 Cartridge Filter Units (5 micron) (1.68 MGD per filter unit)
- 4 RO Feed Pumps (1400 gpm, 250 HP each)
- 4 RO Treatment Module Skids (2 MGD input/1.5 MGD output treatment capacity each)
- 1 Air Stripper/Degasifier Tower (7.56 MGD treatment capacity)



The process

1. **Raw water from contamination sites pumped into pump building**

2. **Water pumped to process plant**
   Untreated water goes through the pressure filters. Water passes through and the pressure filters oxidize iron and manganese to remove it. A low dose of chlorine is injected at this stage to help with the oxidation process.

3. **Water flows to the cartridge filters**
   This is the second stage of treatment. If any fine particles get through Stage 1, the cartridge filters will remove them prior to the water going to the RO membranes. This is important because particles 5 microns or larger will not go through the RO membranes.
   In this stage, sodium metabisulfite is injected into the water to neutralize the chlorine added in Stage 1. (Chlorine is not compatible with RO membranes.)

4. **Water flows to RO booster pumps**
   Pumps boost pressure from about 10 PSI to between150 and 200 PSI needed to push the water through the RO membranes. Each of the four trains of white RO tubes has its own booster pump.

5. **Water flows to RO membranes**
   Impurities not already removed are taken out. Water pressure forces the water through the membranes. Each white tube works independently.

6. **Purified water pumped to degasifier, hidden in the clock tower**
   The water starts at the top of the degasifier and trickles down through a media – which basically looks like a bunch of plastic Wiffle balls. At the same time, air is forced up while water trickles down. This strips out carbon dioxide gas and also will strip out any remaining VOC contaminants.

7. **Purified water is piped to the basement of the equipment storage building**
   Purified water is blended with water coming in from the existing water supply wells. It is here that the 60/40 blend is achieved. Chlorine also is added at this stage for disinfection. Water is then stored in a 750,000-gallon clearwell.

8. **Blended water is pumped back into the pump house and then out into the distribution system**

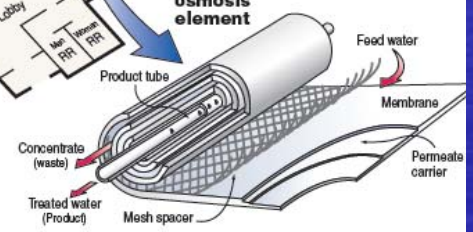
★ *The plant has a "clean in place" system, which uses RO pure water for the cleaning of the RO system to remove any buildup that might occur.*

20 to 25 percent of the original, untreated water pumped into the plant comes out as concentrate (waste). It is pumped out of the plant and goes into deep disposal wells in southeast Hutchinson.

By Edie Ross and Jim Heck

Sources
The City of Hutchinson
Reg Jones and Don Koci

Reverse osmosis element



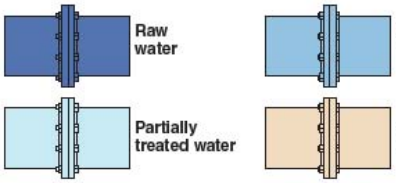
Each reverse osmosis train has the capability of treating 1.5 million gallons of water each day. (It takes about 2 million gallons coming in to get 1.5 million gallons of essentially pure water going out.)

The plant can produce 10 million gallons of 60/40 blended water a day.

Hutchinson uses about 6 million gallons of water a day on average. The low side is 3.5 to 4 million gallons a day in the winter and the high side is 14 to 15 million gallons a day during the summer.

The color code

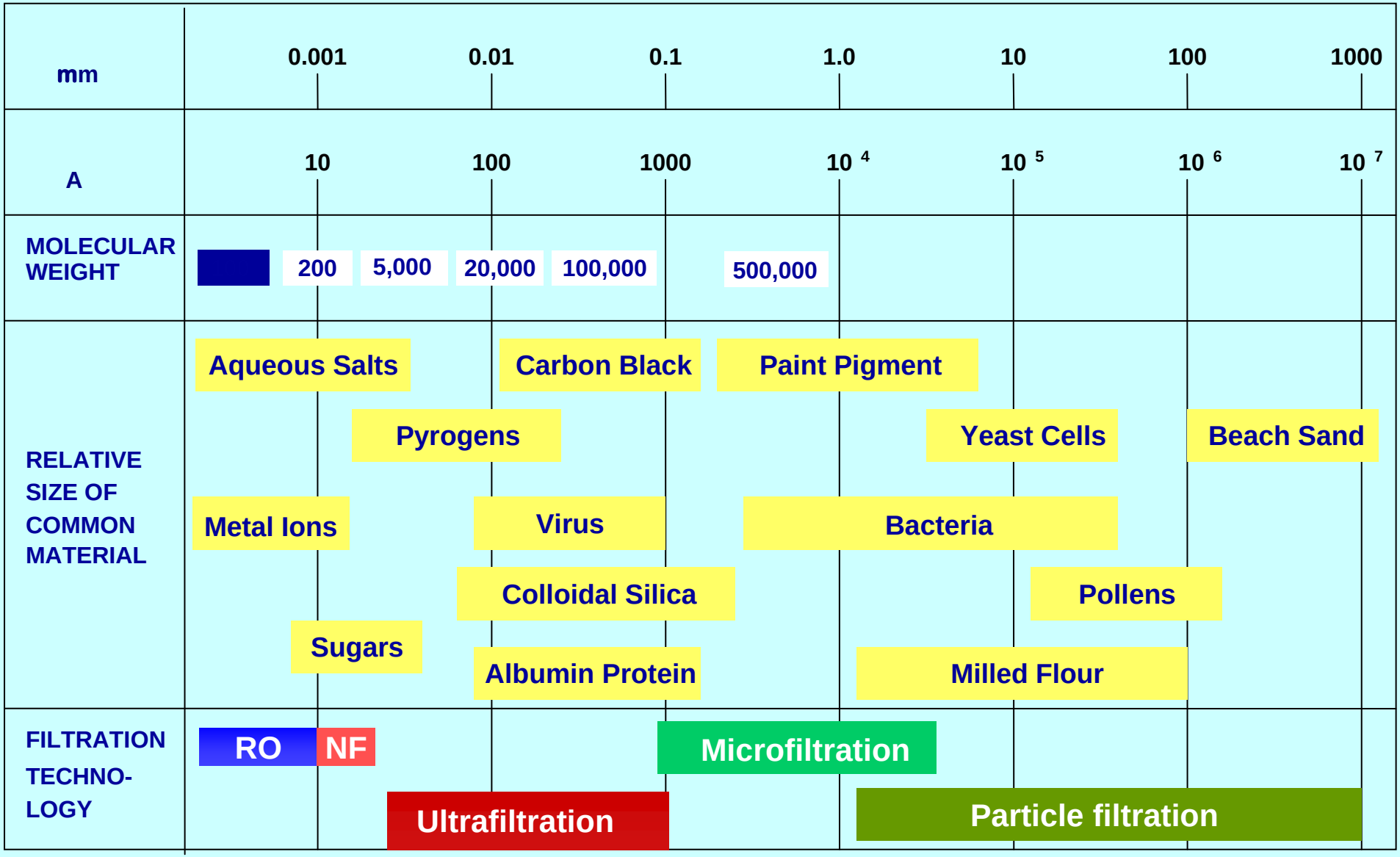
To help follow the flow of water through the different stages of treatment, the pipes are assigned specific colors



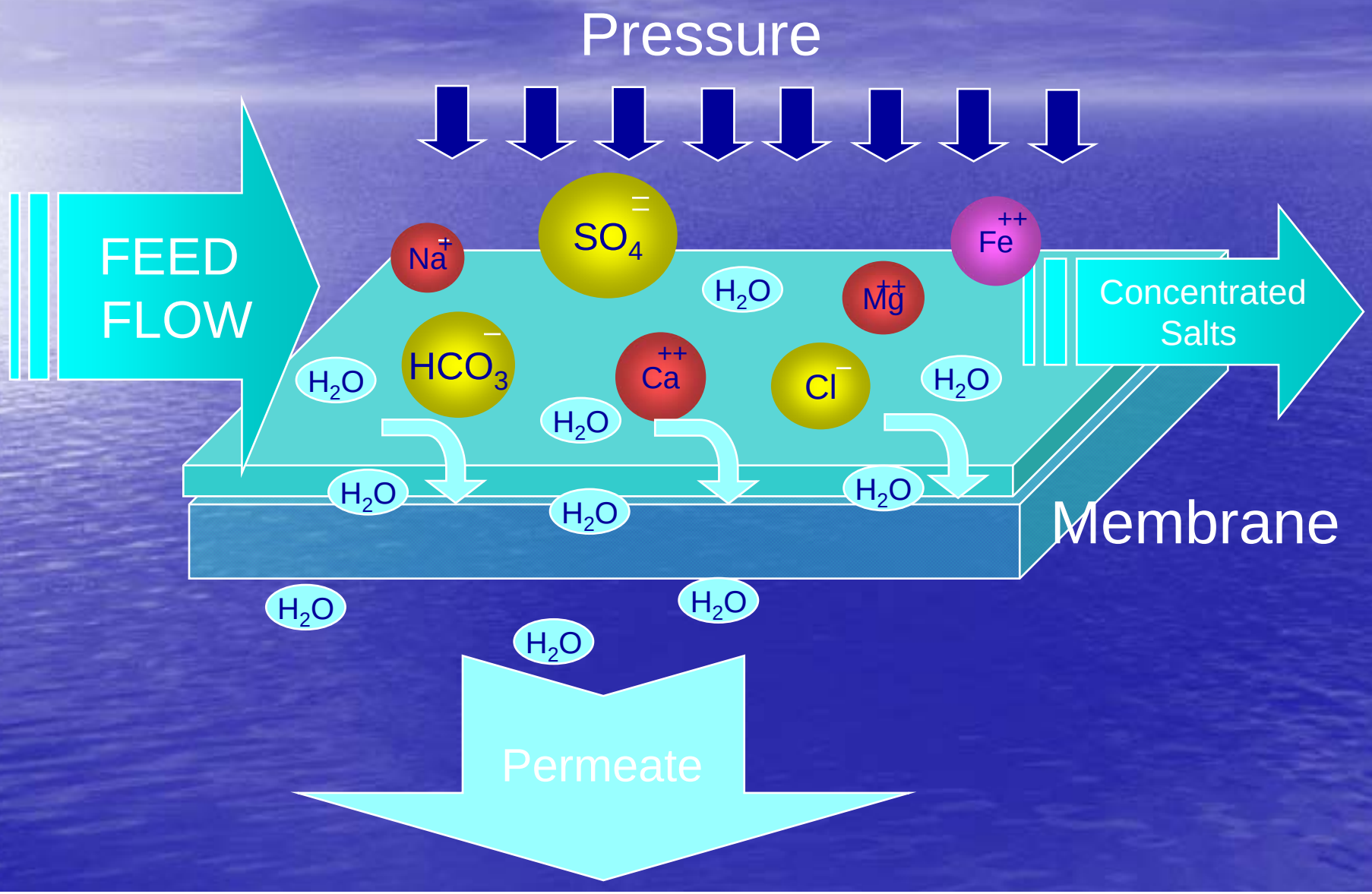
FILTERED WATER
FILTERED WATER
FILTERED WATER
CF-1
CF-2
CF-3
CF-4
EXIT

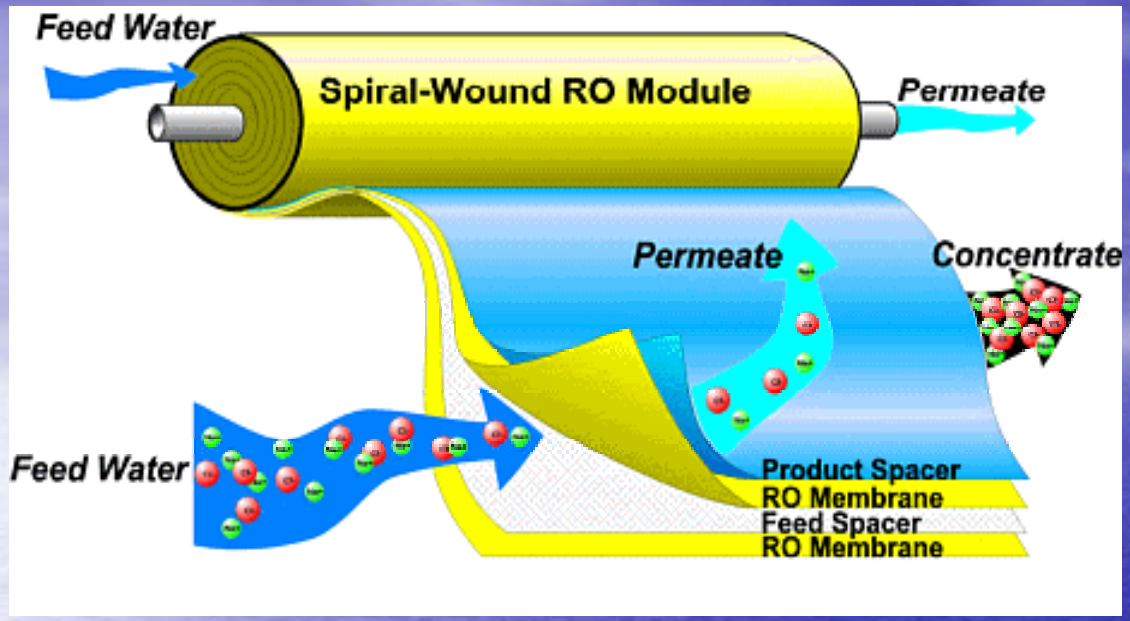
OVERHEAD DOOR
P8
FILTERED WATER

THE FILTRATION SPECTRUM



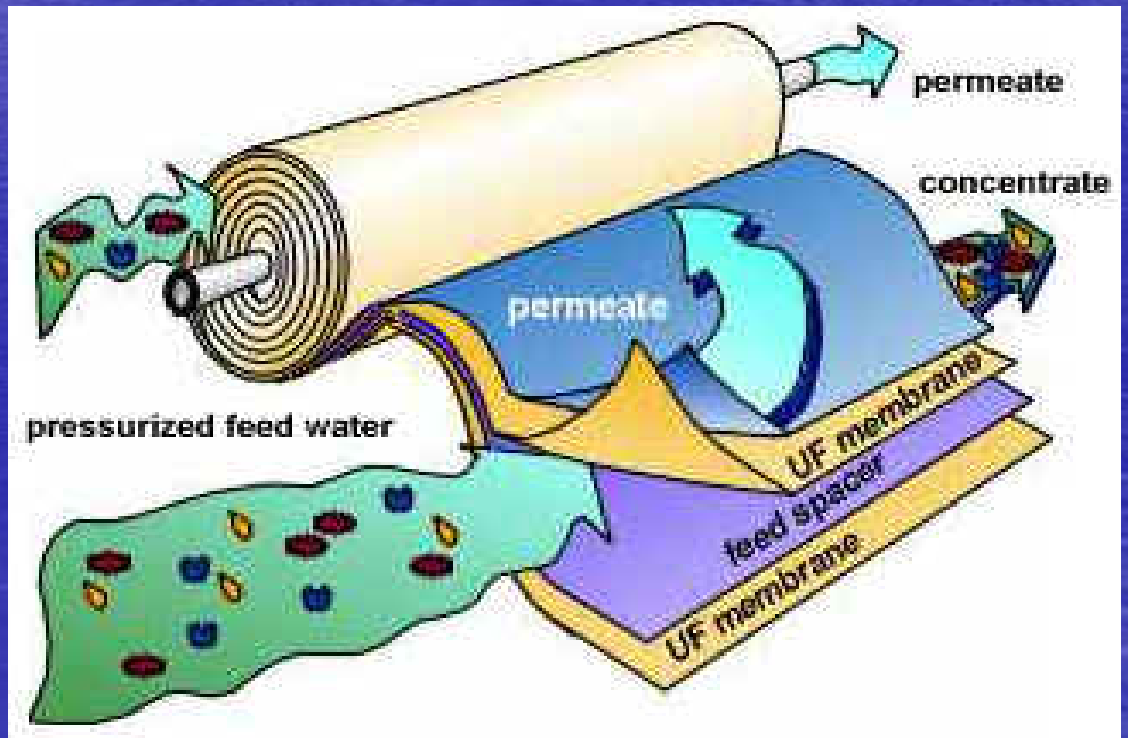
RO Membrane Separation Mechanism





RO Spiral Module

UF Spiral Module



Water Treatment Pumping Systems

- 4 Low Service Raw Water Pumps to Treatment (1900 gpm, 75 HP each)
- 3 Waste Transfer Pumps to Disposal Wells (1050 gpm, 30 HP each)
- 2 Pressure Filter Backwash Pumps (3500 gpm, 75 HP each)
- 6 High Service Pumps to Distribution System (3300 gpm, 250 HP each)

Water Quality Results

	Total Hardness (mg/L)	Chloride (mg/L)
Pre RO Treatment	300	138
Current	120	55
Drinking Water Standard	400	250

Projected Water Demand

		Average Daily Flow (MGD)	Peak Daily Flow (MGD)
EXISTING	(2000)	**6.5**	**15.0**
PROJECTED	(2010)	**8.1**	**19.1**
PROJECTED	**(2030)**	**10.0**	**23.4**

Benefits for the City of Hutchinson

- Higher quality of water for the community
- Extends life of household plumbing and appliances
- Provides comprehensive solution to industrial community
- Modular and easily expandable water treatment center to accommodate future capacity needs
- Meets existing and future water supply regulations (insurance policy for future generations)

Benefits for the Environment

- Cleans up the Equus Beds Aquifer
- Prevents migration of contamination to protect the groundwater
- Eliminates discharge of high chloride water into surface waterways
- Beneficial use of remediated water
- Reduces use of current groundwater supply, by replacing it with remediated water

PROJECT COST:

Groundwater Contamination Source Remediation		$ 740,000
RO Concentrate and Wastewater Deep Disposal Wells (DDW's)		$ 4,095,000
Groundwater Remediation Wells and Pipelines		$ 2,610,000
RO Water Treatment Plant		$17,660,000
RO Raw Water, Concentrate and Distribution System Pipelines		$ 9,340,000
	Total	$34,445,000

PROJECT FUNDING:

Payments from Companies Responsible for Contamination		$12,222,000
TIF District Tax Proceeds and Interest Earned		$ 1,086,000
Federal Grants ($3.5 million less grant admin. costs)		$ 3,372,000
KDHE Low Interest Loans – City Funds		$16,650,000
Water Utility Capital Improvement (CIP) Funds – City Funds		$ 1,350,000
	Total	$34,680,000

Cooperative Effort

- City of Hutchinson
- Potential Responsible Parties (PRPs)
- State Agencies
- Federal Assistance

Questions?