City of Quesnel

Presentations to Meeting the Community's Water Quantity Demands

Water Conservation Plan

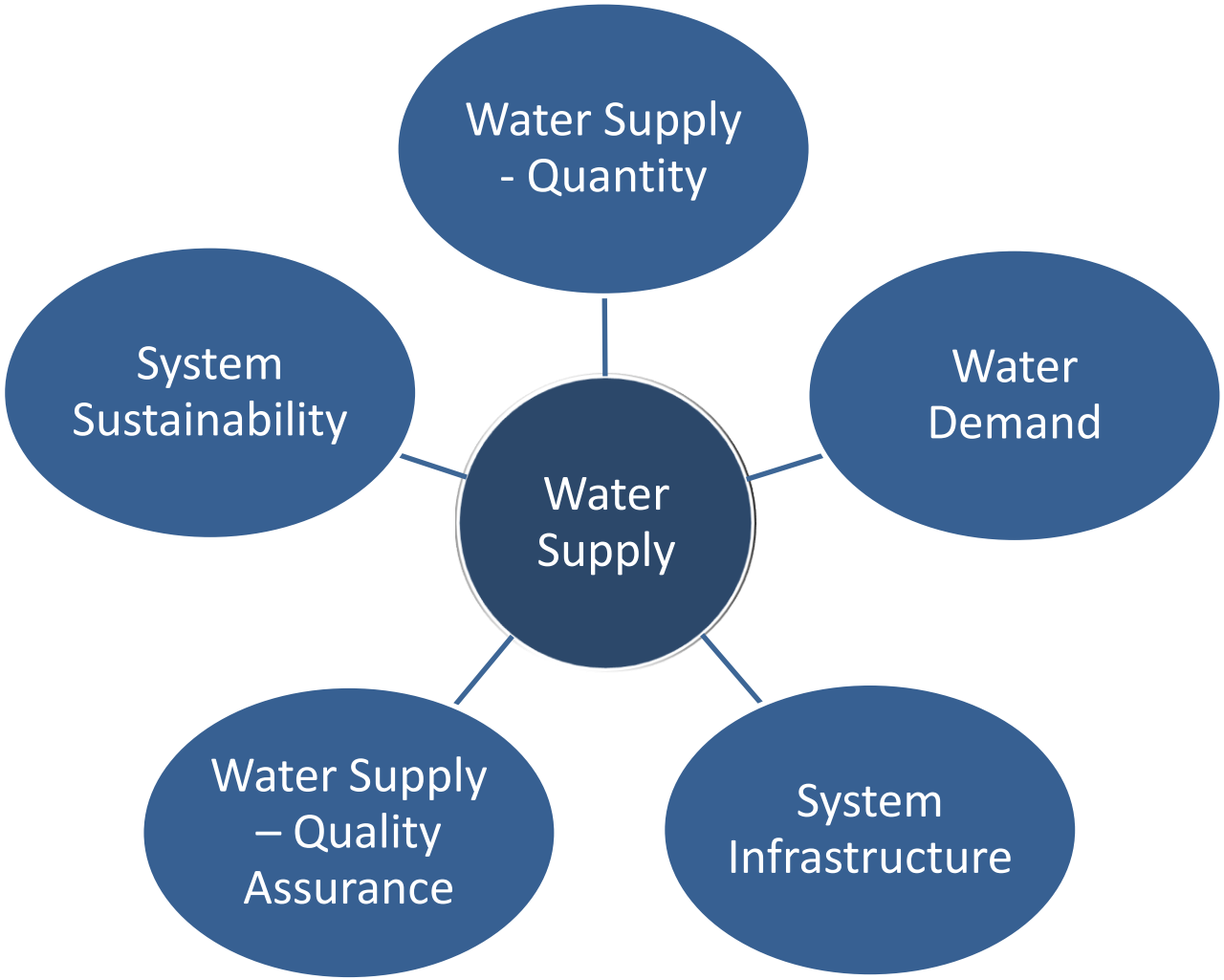
Production Well and Preliminary Surface Water Influence Assessment

September 10, 2012

URBAN systems

BC Groundwater Consulting Services Ltd.
Professional Well Development and Consulting Services

Context


Water Supply - Quantity
System Sustainability
Water Demand
Water Supply
Water Supply – Quality Assurance
System Infrastructure

City of Quesnel

Water Conservation Plan

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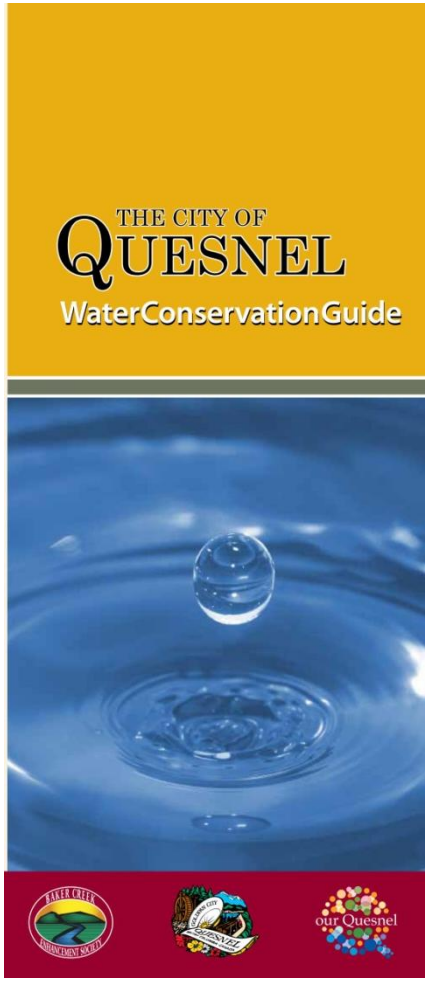
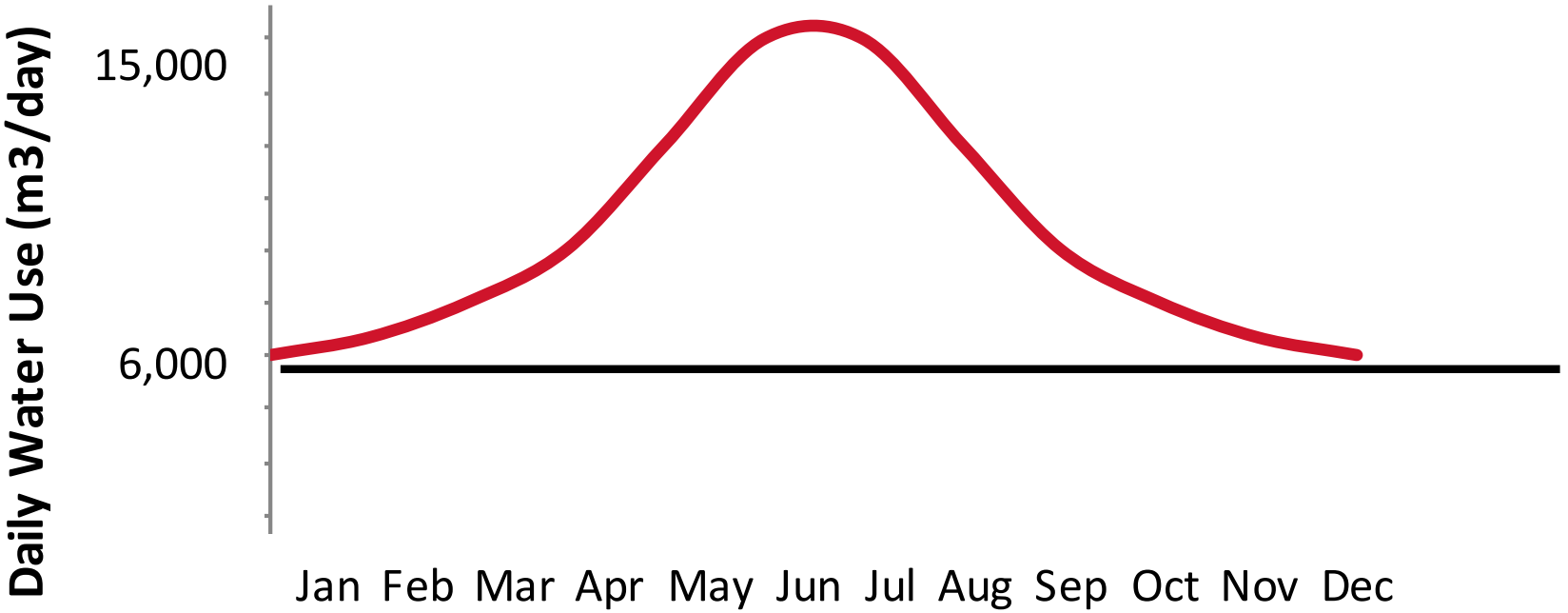
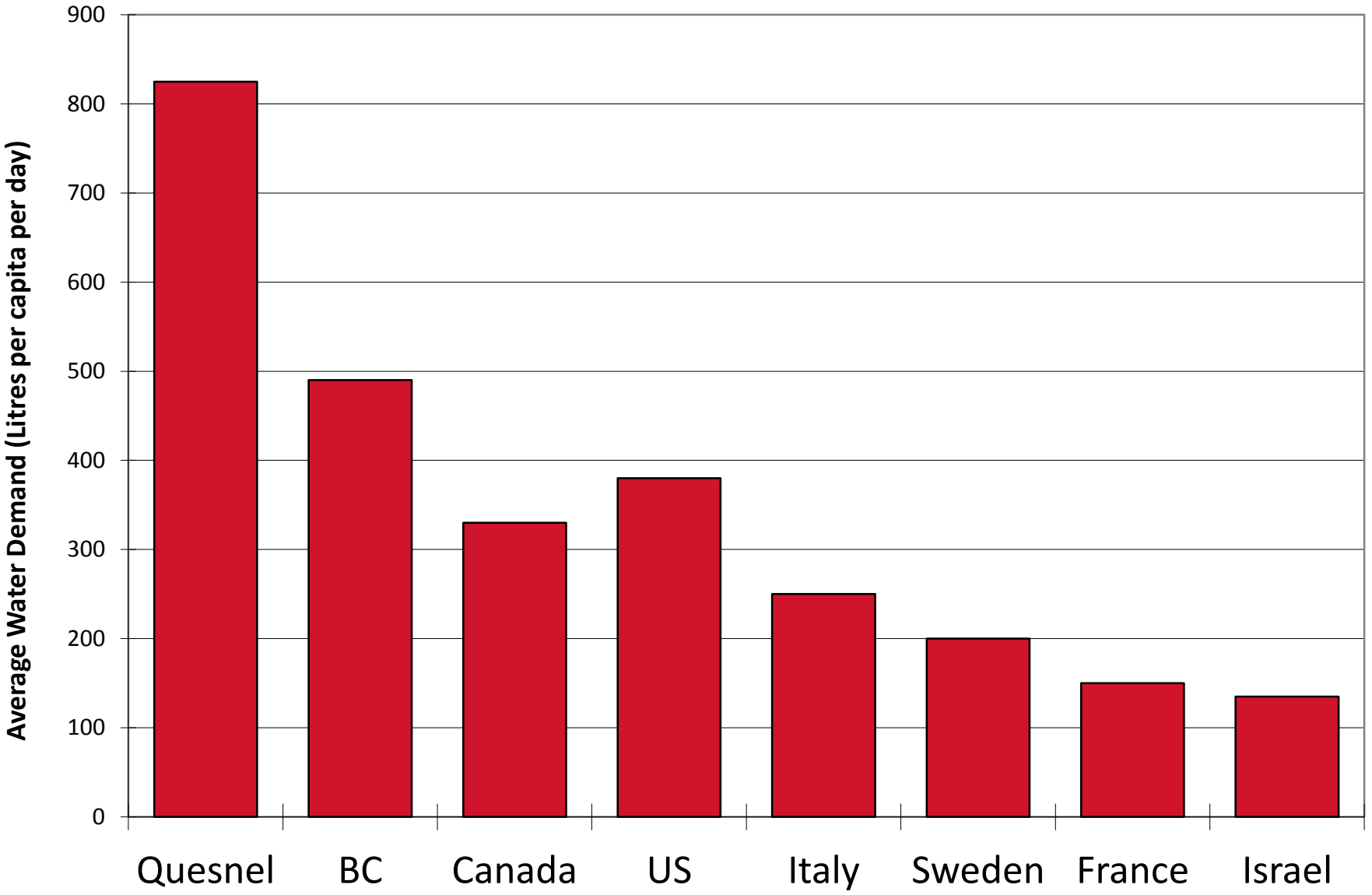
Current Water Conservation Practices in Quesnel

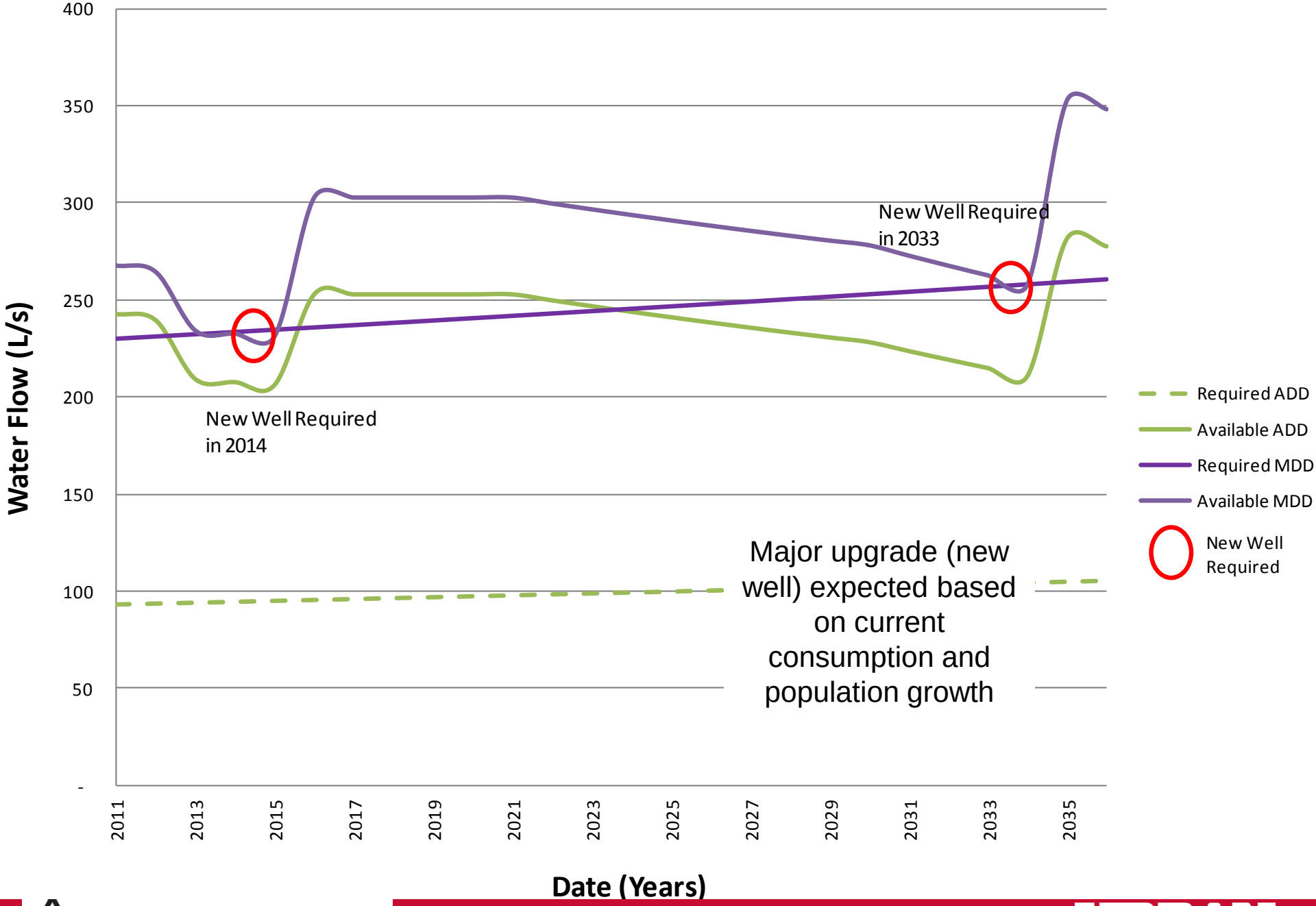
- Sprinkling Regulations
- Water Conservation Guide
- Leak Detection
- Bulk Water Station



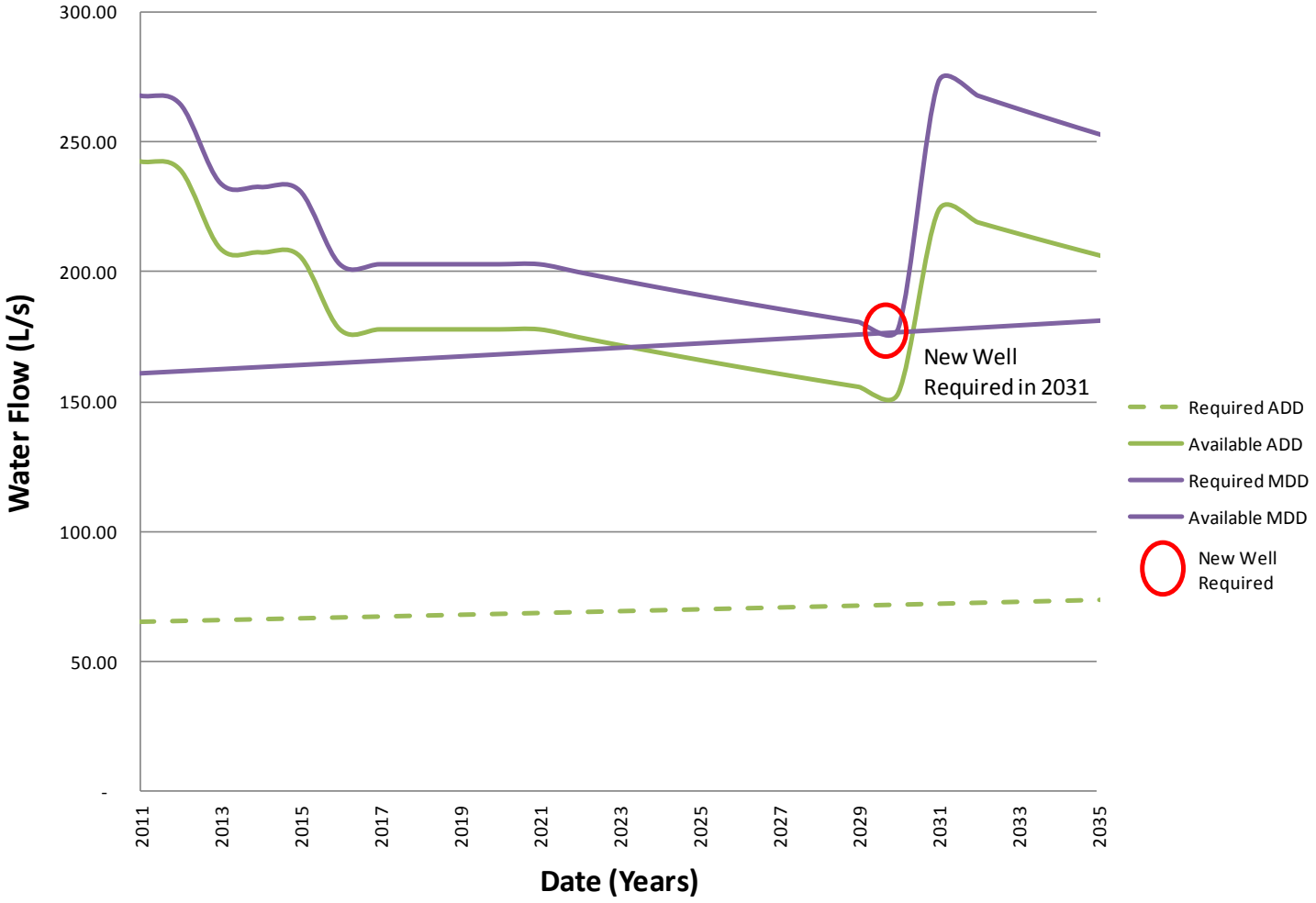
Water Use in Quesnel




Average Water Demand (Litres per capita per day)
900
800
700
600
500
400
300
200
100
0
Quesnel
BC
Canada
US
Italy
Sweden
France
Israel


Water Flow (L/s)
400
350
300
250
200
150
100
50
-
2011
2013
2015
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
Date (Years)
New Well Required in 2014
New Well Required in 2033
Major upgrade (new well) expected based on current consumption and population growth
Required ADD
Available ADD
Required MDD
Available MDD
New Well Required

What does a reduction of 30% look like?



Cost Benefit Analysis of Potential Conservation Measures

CONSERVATION MEASURE	WATER SAVINGS ESTIMATED	COST BENEFIT
Public Education Program	5%	5.0
Retrofit Kits/Targeted Retrofits	5%	2.7
Incentive Rebate Program	5%	2.1
Industry Workshops	2%	1.8
Audits of Large Volume Users	1%	1.2
Cost-of-service Accounting	Depends on outcome of cost of service study	
Sprinkling Regulation	Already in place	

Cost Benefit Analysis of Potential Conservation Measures

CONSERVATION MEASURE	WATER SAVINGS ESTIMATED	COST BENEFIT
Leak Detection and Repair Strategy	Already in place	
Commercial/Industrial Water Metering	6%	0.9
Pressure Reducing Valves	2%	0.6

Cost Benefit Analysis of Potential Conservation Measures

CONSERVATION MEASURE	WATER SAVINGS ESTIMATED	COST BENEFIT
Residential Water Metering	14%	0.4
Large Landscape Audits	0.1%	0.3
Reuse and Recycling	1%	0.1
Xeriscaping/Landscape Management	10%	0.0
System Wide Pressure Management	Impractical with existing system layout	

Cost Benefit Analysis of Potential Conservation Measures

CONSERVATION MEASURE	WATER SAVINGS ESTIMATED	COST BENEFIT
Water Accounting	Requires metering	
Distribution System Audit	Requires metering	
Loss-Prevention Program	Requires metering	
User Rates based on Water Use	Relevant only if users are metered	

Recommendations for Water Conservation Measures

Educational Measures

i. public education campaign
ii. industry workshops
iii. audits of large volume users
iv. incentive rebate program
v. targeted retrofits

Full Cost of Service Recovery

i. cost of service study

Regulatory Measures

i. landscape irrigation enforcement

System Improvement Measures

i. leak detection and repair strategy
ii. install individual pressure reducing valves
iii. undertake a universal metering study to determine if metering is worthwhile at this time, and under which conditions it would be viable if not now

City of Quesnel

Production Well and Preliminary Surface Water Influence Assessment

URBAN systems

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September 10, 2012

BACKGROUND

- City relies completely on wells for water supply
- City currently operates six (6) wells
- City properly maintains wells and monitors aquifers
- Well field is aging
  - Two (2) less than minimum design life (15 years)
  - One (1) approaching maximum design life (25 years)
  - Three (3) beyond maximum recommended design life
- Majority of wells located adjacent to rivers

SCOPE

- Evaluate sanitary seal of each operating well
- Train and assist City staff with testing each well
  - Expands current operator knowledge of well system
  - Significant cost savings (est. $50k - $100k)
- Evaluate available yields of each well
- Recommend pumping rate for each well
- Prepare long-term forecast and replacement strategy
- Evaluate interaction with surface water (preliminary)

WELL CONSTRUCTION

PW8 (1992)

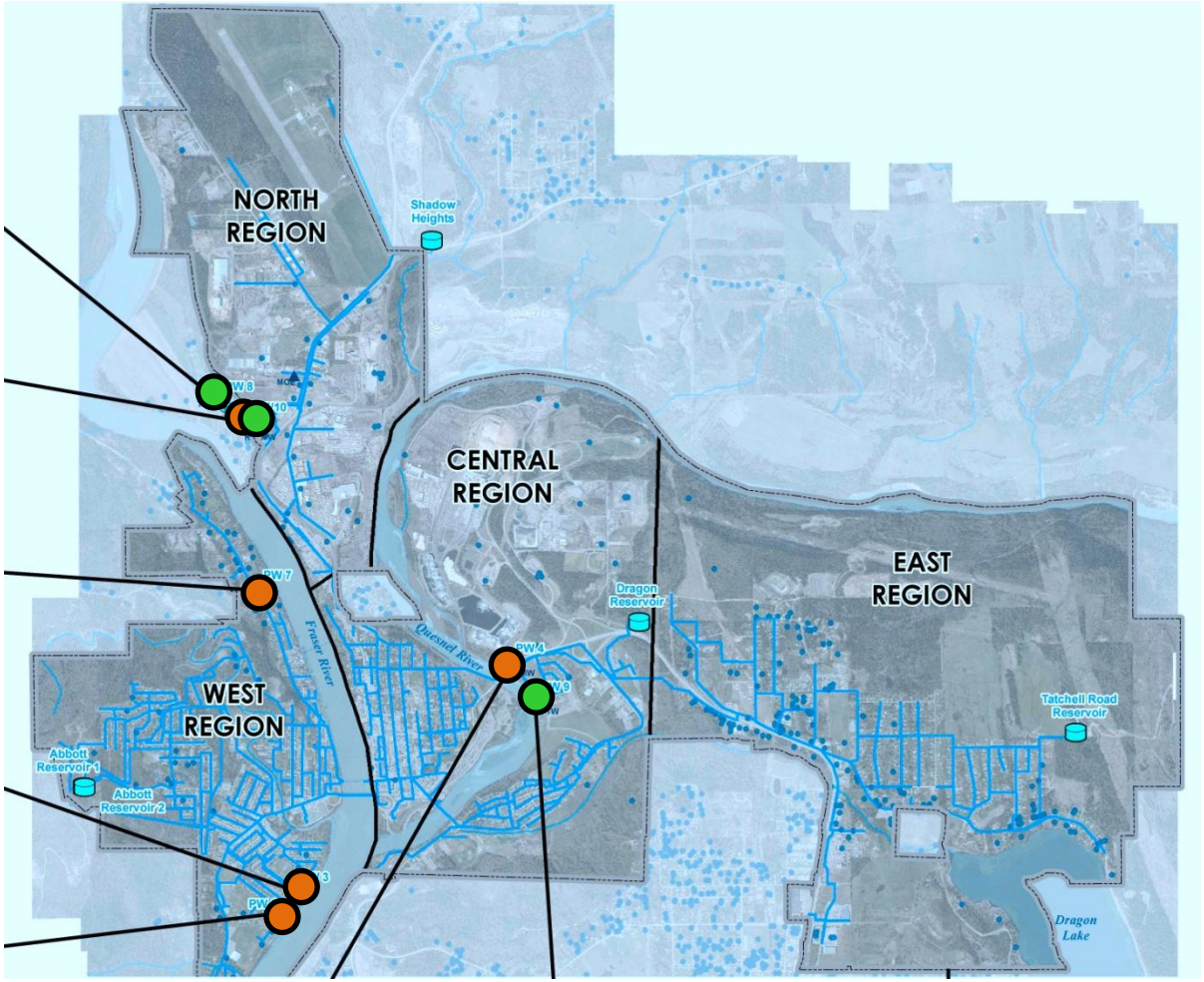
PW5 (1971)

PW10 (2010)

PW7 (1986)

PW3 (1959)

PW6 (1978)



PW4 (1963) PW9 (2004)

GRAVEL-PACK SCREEN

Stabilization but Low-efficiency

TELESCOPIC SCREEN

No Stabilization High-efficiency

WELLHEAD COMPLETIONS

VERTICAL TURBINE LINE-SHAFT

PITLESS ADAPTOR

INITIAL WELL YIELD ESTIMATES (WHEN DRILLED)

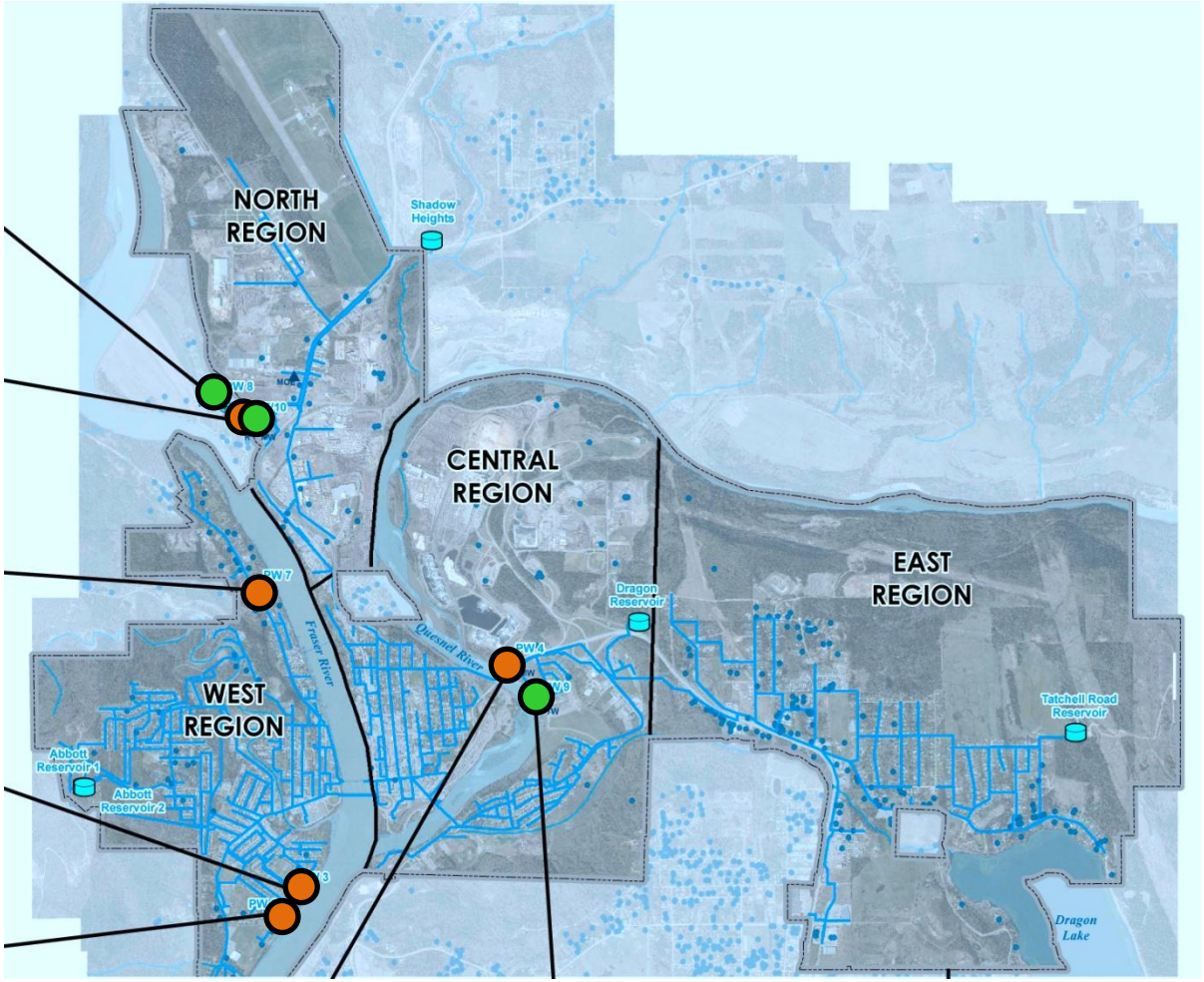
PW8 (1992)
80 L/s Yield

PW5 (1971)
70 L/s Yield
PW10 (2010)
80 - 150 L/s Yield

PW7 (1986)
70 L/s Yield

PW3 (1959)
50 L/s Yield

PW6 (1978)
70 L/s Yield



PW4 (1963)
50 L/s Yield

PW9 (2004)
100 - 130 L/s Yield

GRAVEL-PACK SCREEN

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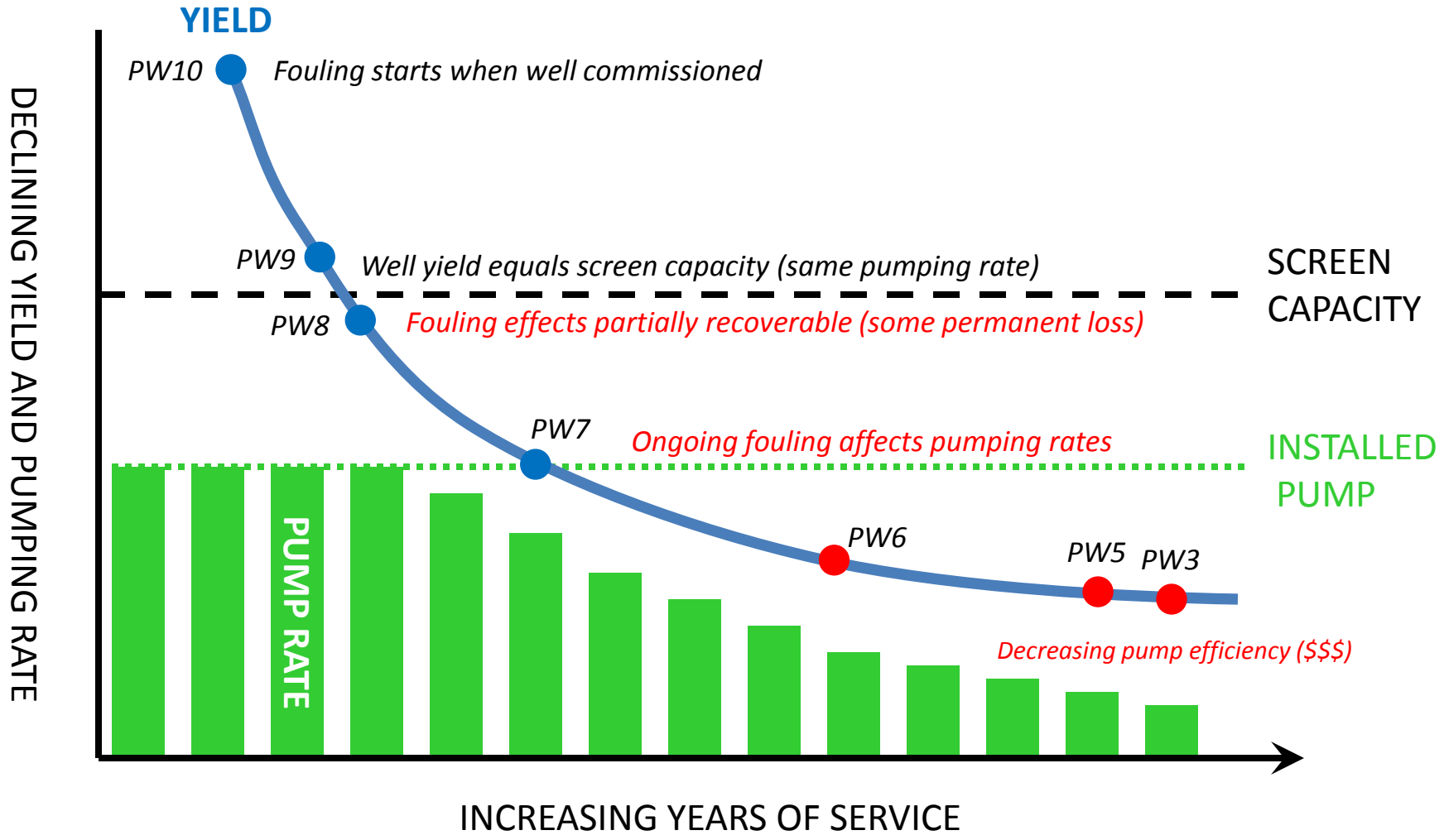
TELESCOPIC SCREEN

No Stabilization High-efficiency

AVAILABLE YIELD AND PUMPING RATES (CURRENT BY WELL)



WHY DO WELL YIELDS AND PUMPING RATES DECLINE OVER TIME

- Migration of sediment from aquifer(screen blinding)
- Encrustation due to water composition (hardness)
- Groundwater biology (organisms and bacteria)

Inadequate flushing of the well screen during construction is one of the main sources of excessive long-term fouling.

- It is difficult (if not impossible) to adequately flush a gravel-packed well screen...

CURRENT RECOMMENDED PUMPING RATES (2012)

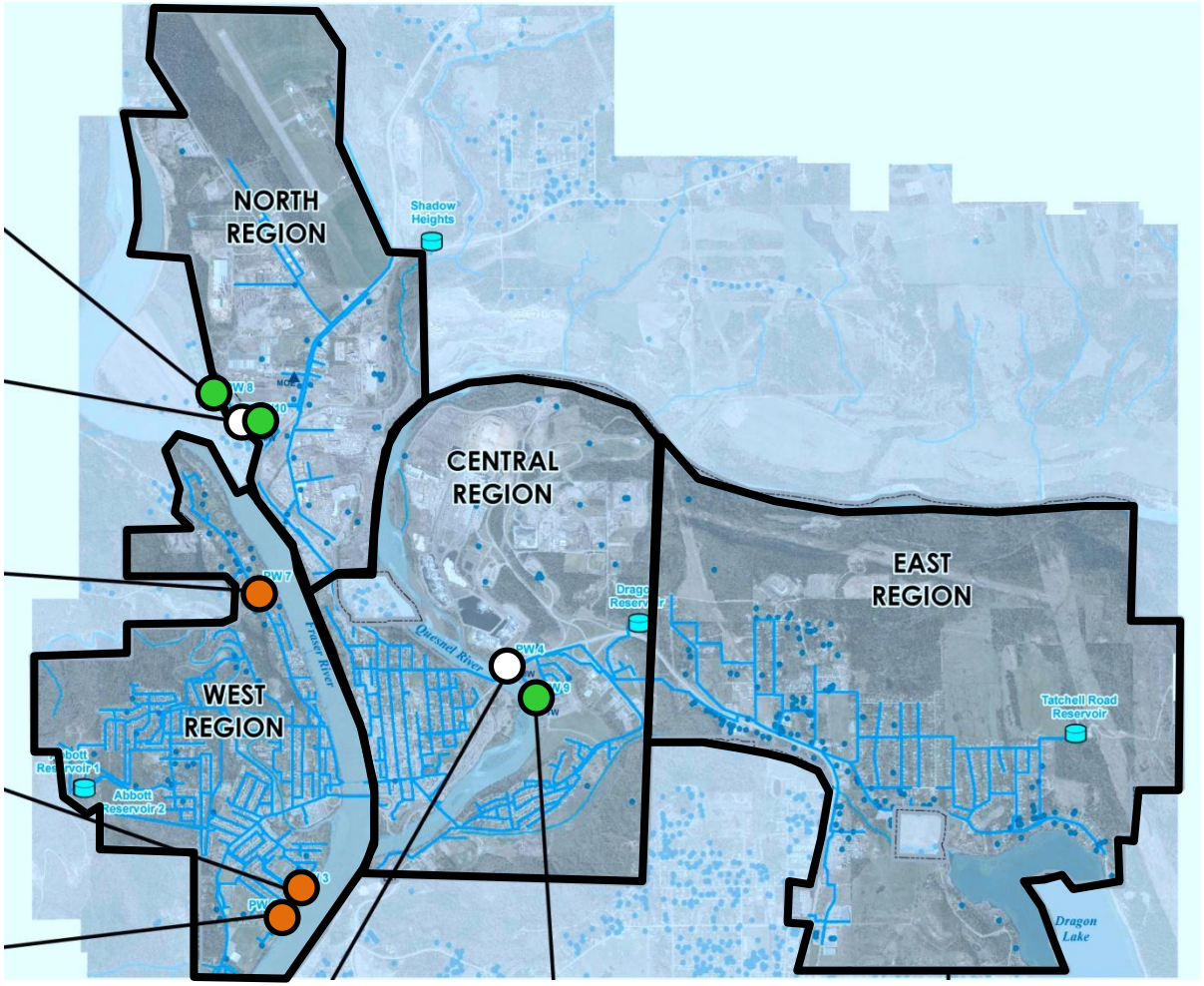
PW8 (1992)
70 - 140 L/s

~~PW5 (1971)~~
Closed
PW10 (2010)
85 - 150 L/s

PW7 (1986)
13 - 21 L/s

PW3 (1959)
6 - 8 L/s

PW6 (1978)
9 - 12 L/s



~~PW4 (1963)~~
Closed

PW9 (2004)
45 - 89 L/s Yield

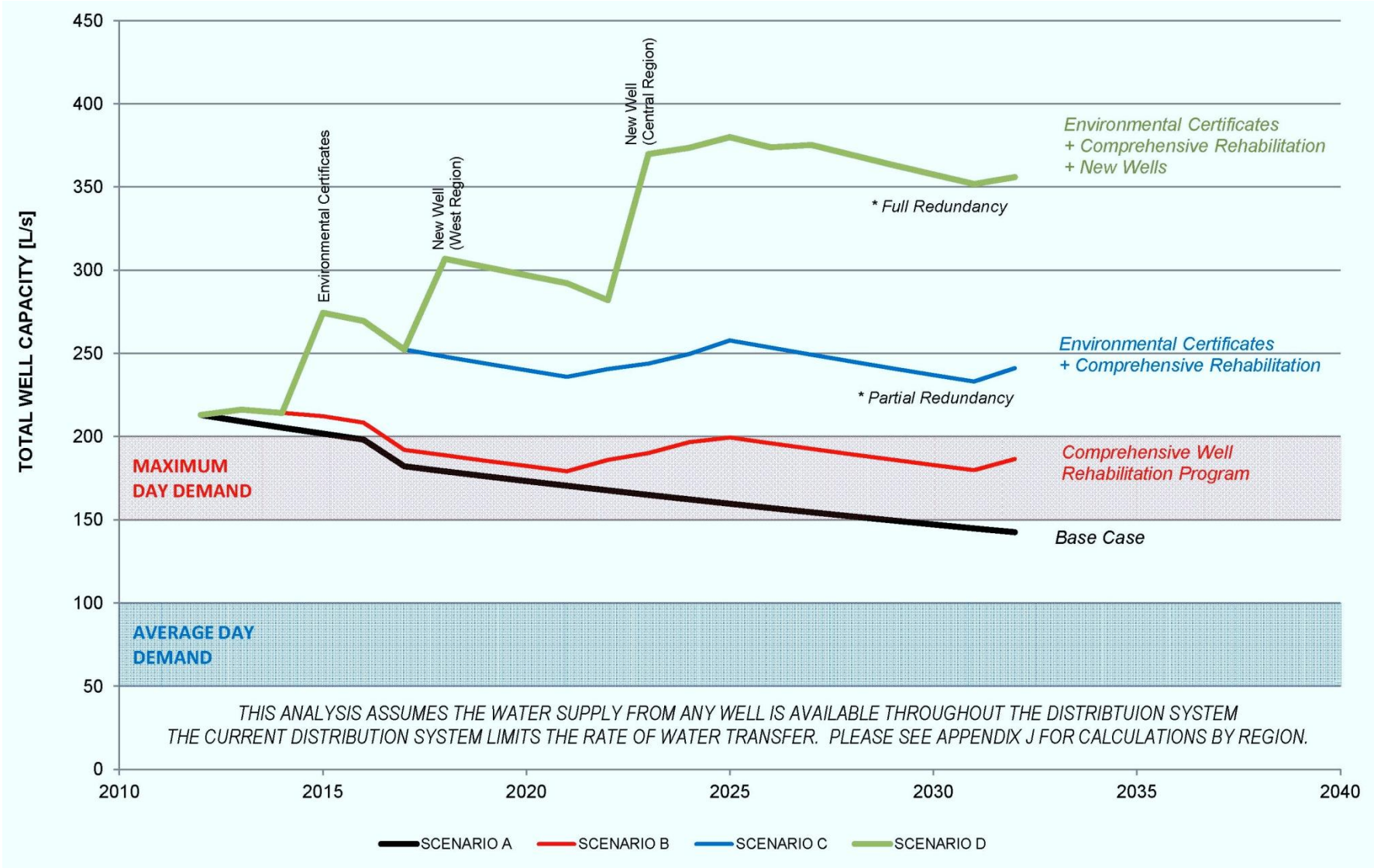
GRAVEL-PACK SCREEN

Stabilization but Low-efficiency

TELESCOPIC SCREEN

No Stabilization High-efficiency

LONG-TERM FORECAST (20 YEARS)



CONCLUSIONS

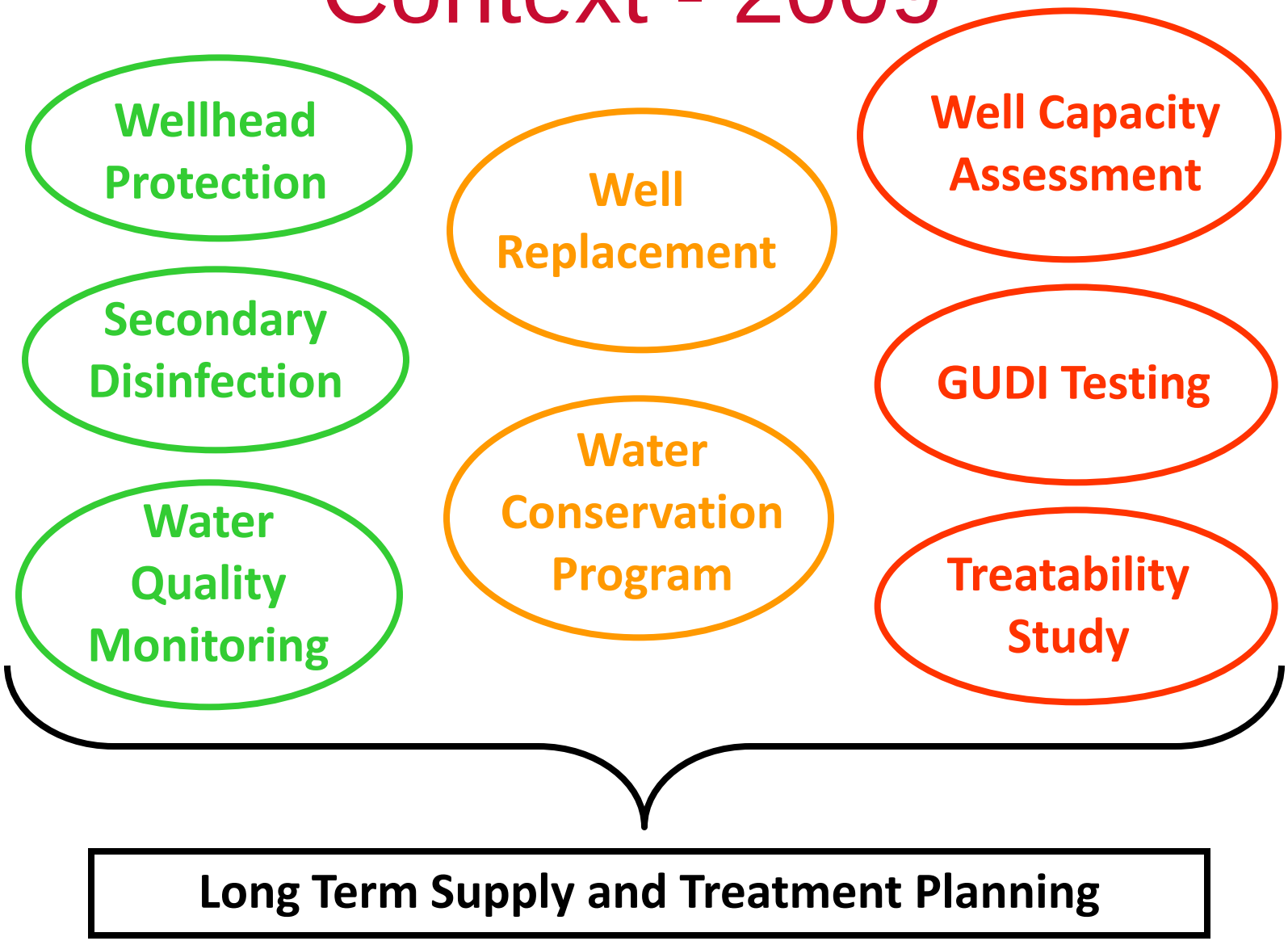
- Base case (do nothing) will result in a shortfall within the next few years
  - There is currently inadequate redundancy to offset the loss of one high-capacity well during the summer months
- Implementation of comprehensive well rehabilitation is necessary
  - Reduces the potential for catastrophic loss of a well
  - Provides time to implement other options

RECOMMENDATIONS

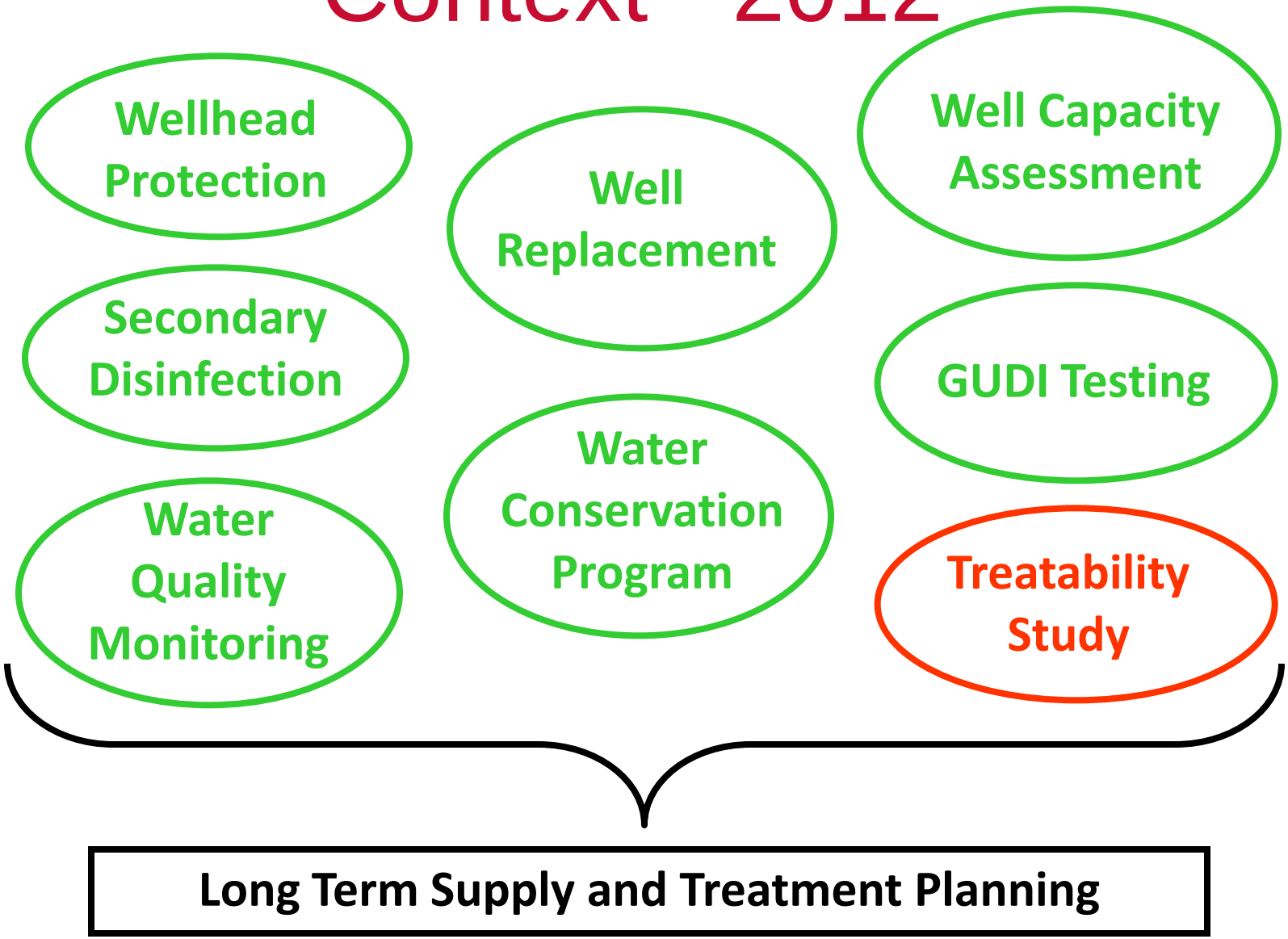
- Continue to monitor aquifers
  - Datalogger upgrade currently underway (2012)
- Implement comprehensive well rehabilitation (2013)
- Develop program to acquire Environmental Certificates
  - Liaison with regulatory agencies (2012)
  - High-capacity pumping tests of select wells (2013 - 2014)
- Exploration to confirm future production well options
  - West Region (2013) and Central / East Region (2014)

Fitting Everything Together

Context - 2009



Context - 2012



Long Term Supply and Treatment Plan

Future Well Locations ⟷ Future Treatment

(Few Well Sites or Multiple Sites)

- When new wells are required
- Where to develop wells
- What treatment may be required depending on well location
- Well head protection
- Well monitoring and maintenance
- Forecast major capital expenditures

QUESTIONS