What’s in a Name?

Updating Bellevue's Obsolete Pressure Zones

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City of Bellevue, WA

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Background

Approach

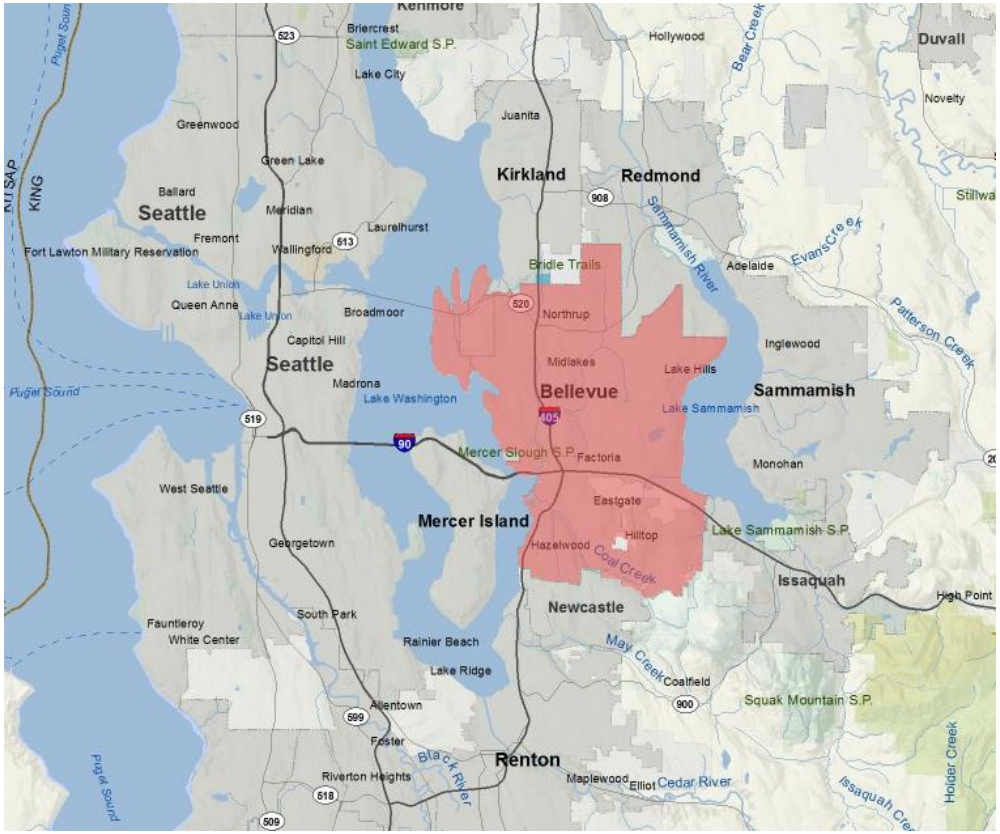
Findings and Recommendations

Next Steps

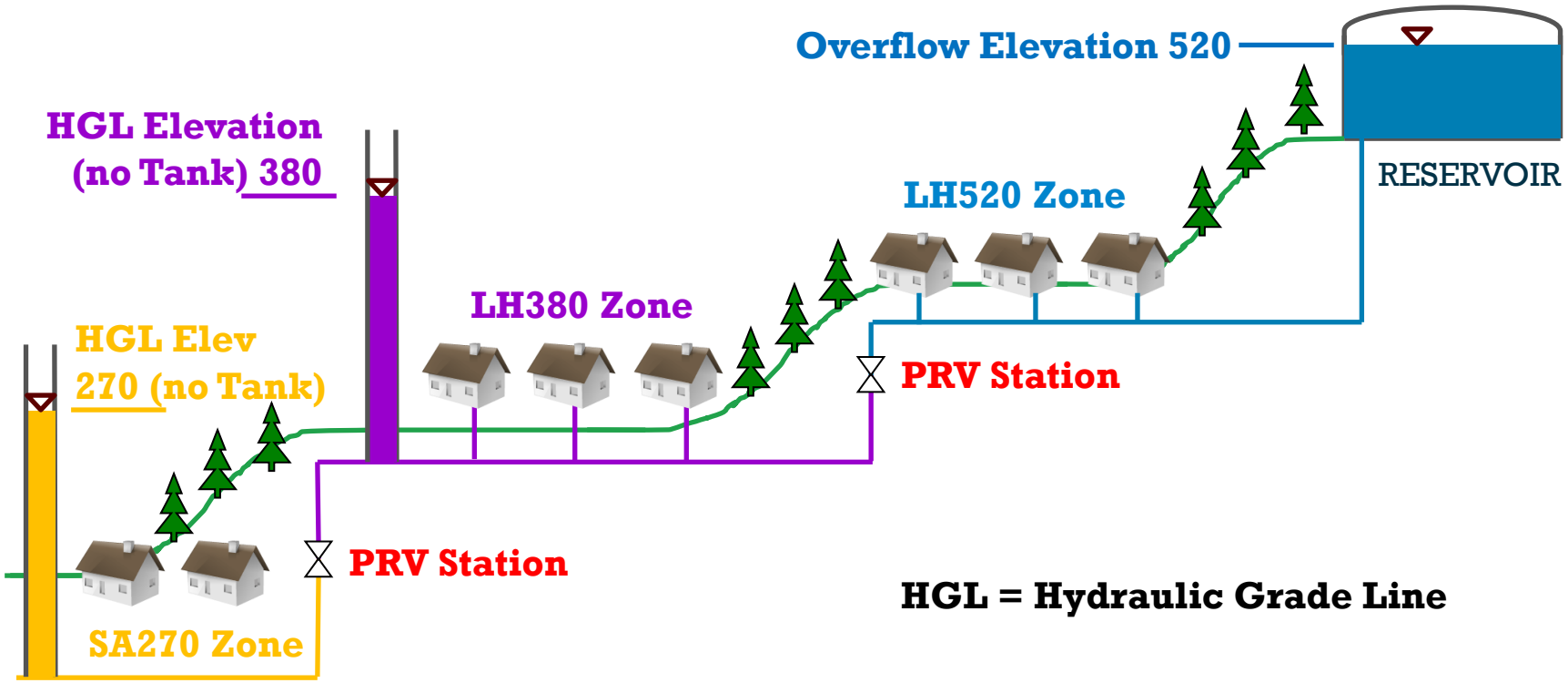
Background

Bellevue's Water Service Area

- 155,000+ Population
- 150,000+ Jobs
- 24 Reservoirs
- 21 Pump Stations
- 610 Miles of Pipe
- Elevation 20' – 1,440'
- 150-ish PRV Stations
- 72 Pressure Zones
  - 15 "Open" w/Reservoir
  - 57 "Closed" (no tank)

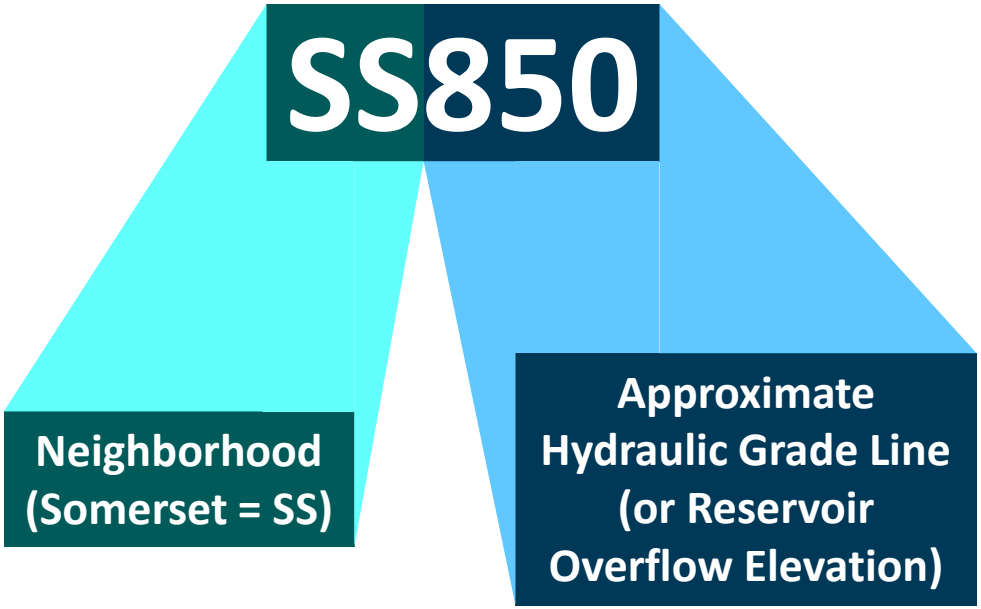


Background: Pressure Zones



What's in a Name?

Pressure Zone	Abbreviation
Bellefield 220	BF220
Bellevue 400	BV400
Clyde Hill 335	CL335
Clyde Hill 500	CL500
Cougar Mountain 1000[1]	CM1000
Cougar Mountain 1150	CM1150
Cougar Mountain 1300[1]	CM1300
Cougar Mountain 1465	CM1465
Cougar Mountain 1575	CM1575
College Hill 380	CO380
College Hill 440	CO440
Eastgate 300	EG300
Eastgate 370[1]	EG370
Eastgate 400	EG400
Eastgate 440[1]	EG440
Eastgate 590[1]	EG590E
Eastgate 630	EG630
Enatai 300	EN300
Factoria 293	FA293
Factoria 460	FA460
Forest Hills 1100	FH1100
Forest Hills 465	FH465
Hunts Point 250	HP250
Horizon View 1080	HV1080
Horizon View 1115	HV1115
Horizon View 1175	HV1175
Horizon View 700	HV700
Horizon View 940	HV940
Kelsey Creek 300	KC300
Kelsey Creek 450	KC450



Kelsey Creek 300	KC300
Kelsey Creek 450	KC450
Lake Hills 380	LH380
Lake Hills 435	LH435
Lake Hills 520	LH520
Meydenbauer 252	MB252
Medina 230	MD230
Newport Hills 320[1]	NH320
Newport Hills 380[1]	NH380
Newport Hills 470	NH470
Newport Hills 580	NH580
Newport Shores 200	NS200
Pikes Peak 550	PP550
Pikes Peak 600	PP600
Pikes Peak 670	PP670
Rose Hill 545	RH545
Redmond 330	RM330
Redmond 400	RM400
Richards Valley 300	RV300
Sammamish 270	SA270
Sunset Hills 450	SH450
Somerset 1000	SS1000
Somerset 550	SS550
Somerset 700	SS700
Somerset 850	SS850
Somerset 940	SS940
Summit 1060	SU1060
Summit 1100	SU1100
Summit 1350	SU1350
Woodridge 340	WD340
Woodridge 400	WD400
Woodridge 450	WD450
Yarrow Bay 300	YB300
Yarrow Point 220	YP220

Most of Bellevue's pressure zones retain the original name assigned decades ago by legacy water districts.

What is the Problem?

Some zone names are obsolete due to various issues:

- Separate, unconnected zones with common names
- Reservoir, zone elevations never adjusted for NAVD88
- HGL differs considerably from zone name elevation
- New zones needed to address deficiencies, or to accommodate new development

It was most efficient to combine pressure zone changes into one project to update all zones.

What is the Problem?

Avoidable risks are created by obsolete naming:

- Main breaks, low/high pressure, or low fire flow
  - Operators may assume zone names accurately reflect the appropriate hydraulic grade, and reset zone pressure to match
- Unexpected service interruption
  - Non-contiguous zones that share names create confusion about connectivity - risk of cutting off service during tie-ins, shutdowns or flushing activities
- Deficient fire sprinkler design by others based on bad assumptions
- General loss of data credibility among staff

Approach

Scope

Zone naming workshop

Field pressure readings (where are we operating?)

Customer elevation analysis (where should we operate?)

Pre-1990 (before NAVD88) reservoir survey

Fire Flow Modeling – existing vs. proposed

Report with recommendations

- New map
- New Hydraulic Profile figure

QA/QC (Engineering, O&M) and vetting (Operations)

DOH Approval, IT updates and field adjustments

Zone Naming Workshop

What does zone name represent?

- Not always obvious!
- HGL can vary
- Reservoir overflows aren’t what (where) they seem

Zone Naming Workshop

Closed Zones (No Reservoir):

Agreement: For “closed” zones (no reservoir), the zone name should reflect the normal/optimal operating HGL. This is clearest and simplifies pressure setting at PRVs.

Other ideas discussed (rejected):

- Relief valve setting (highest max HGL; like overflow)
- Normal high HGL (low flow/ overnight)
- Other variations

Zone Naming Workshop

Zones with reservoirs:

Retain existing zone names and acknowledge they do <u>not</u> match overflow elevation. Rationale:

- Historical names better reflect actual operating HGL.
- Rounded zone names (multiples of “5”) are simple to use and avoid false precision.
- Changing reservoir zone names impacts SCADA programming, may cause confusion.
- Six reservoirs, 3 in BV400 (393.4’, 397’, 404’) and 3 in SS850 (846’, 848.4’, 854’) all have different elevations, could never match zone name under any scenario.

Question #1

Do your engineers and operators have a common understanding of pressure zone operating conditions?

- Always
- Usually
- Typically not
- Almost never
- We don’t talk

Findings

Pressure Readings

At least one per zone

Compare current reading (2020), calibration (2014), and historical records with customer elevation (min/max).

Existing Zone	Min Elev	Max Elev	Min Zone FF (gpm)	Min HGL @ 30 psi	Min HGL w/80+ psi	2014 HGL Observed	2020 HGL Observed
BF220	17	128	1280	197	202	199	199
BV400	32	318	675	387	217	388	384
CL335	27	228	753	297	212	328	---
CL500	210	390	1270	459	395	490	497
CM1000(E)	729	924	1699	993	913	1039	1002
CM1000(W)	700	884	1509	953	885	---	985
CM1150	835	1044	1357	1113	1020	1153	1152
CM1300(N)	994	1170	1029	1239	1178	1253	1283
CM1300(S)	1060	1187	1021	1256	1245	---	1301
CM1465	1191	1365	850	1434	1375	1452	1453
CM1575	1324	1439	1040	1509	1509	1575	1596
CO380	184	280	1431	349	369	370	384
CO440N	192	303	2110	372	376	400	424
CO440S	244	282	1208	351	429	---	440
EG300	88	172	791	241	273	281	286
EG370(W)	146	190	2959	259	331	---	337
EG370(E)	115	267	1813	336	299	364	381
EG400	168	303	1938	373	352	386	403

Pressure Readings

Some zones are never known to have operated at zone name (WD400, SU1350, SH425).

- Research found no history or reason to operate at named pressure
- Modeling indicates current operating strategy is more appropriate

Some zones operated by others (NH470, RM335)

- Bellevue does not control HGL
- Adjusted HGL conforms to adjacent utility's naming

EG370 (proposed EG340)

- Constructed 2007
- Undeveloped area was shown inside EG370 polygon to avoid gaps in map;
- New zone not designated when infrastructure built

Pre-1990 Reservoir Survey

Reservoir	Built	Zone	As-Built NGVD29	Surveyed NAVD88	Relative to Zone	Relative to As-Built
Clyde Hill 335 Round	1952	CL335	335.0 ft	338 ft +/-	+ ~3 ft	+ ~3 ft
Clyde Hill 335 Square	1948	CL335	335.0 ft	338.2 ft	+ 3.2 ft	+ 3.2 ft
Clyde Hill 390	1970	BV400	389.6 ft	393.4 ft	- 6.6 ft	+ 3.8 ft
Clyde Hill 465	1958	BV400/CL500	465.0 ft	470.5 ft	N/A	+ 5.5 ft
Crossroads North	1959	LH520	520.0 ft	523.7 ft	+ 3.7 ft	+ 3.7 ft
Crossroads South	1962	LH520	520.0 ft	523.7 ft	+ 3.7 ft	+ 3.7 ft
Factoria	1981	FA293	290.0 ft	295.5 ft	+ 2.5 ft	+ 5.5 ft
Forest Hills	1977	SS850	845.5 ft	848.4 ft	- 1.6 ft	+ 2.9 ft
Horizon View 3	1976	HV1175	1175.0 ft	1178.6 ft	+ 3.6 ft	+ 3.6 ft
Horizon View 3A	1988	HV1175	1175.0 ft	1179 ft +/-	+ ~4 ft	+ ~4 ft
Kirkland South	1971	RH545	545.1 ft	548.8 ft	+ 3.8 ft	+ 3.7 ft
Newport	1976	LH520	519.4 ft	523.1 ft	+ 3.1 ft	+ 3.7 ft
Parksite	1964	LH520	520.0 ft	523.9 ft	+ 3.9 ft	+ 3.9 ft
Somerset 2	1962	SS700	700.0 ft	703.5 ft	+ 3.5 ft	+ 3.5 ft
Woodridge	1956	BV400	397.0 ft	403.9 ft	+ 3.9 ft	+ 6.9 ft

Pre-1990 Reservoir Survey

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Clyde Hill 390	1970	BV400	389.6 ft	393.4 ft	- 6.6 ft	+ 3.8 ft
Clyde Hill 46				ft	N/A	+ 5.5 ft
Crossroads N				ft	+ 3.7 ft	+ 3.7 ft
Crossroads S				ft	+ 3.7 ft	+ 3.7 ft
Factoria				ft	+ 2.5 ft	+ 5.5 ft
Forest Hills				ft	- 1.6 ft	+ 2.9 ft
Horizon View				ft	+ 3.6 ft	+ 3.6 ft
Horizon View				+/-	+ ~4 ft	+ ~4 ft
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Somerset 2	1962	SS700	700.0 ft	703.5 ft	+ 3.5 ft	+ 3.5 ft
Woodridge	1956	BV400	397.0 ft	403.9 ft	+ 3.9 ft	+ 6.9 ft

For reservoirs built before 1990:

- All overflows 3-7 ft higher than as-built (NGVD29) elevation.
- Compared to zone name, they are – 6.6 ft to + 3.9 different.

Fire Flow Modeling

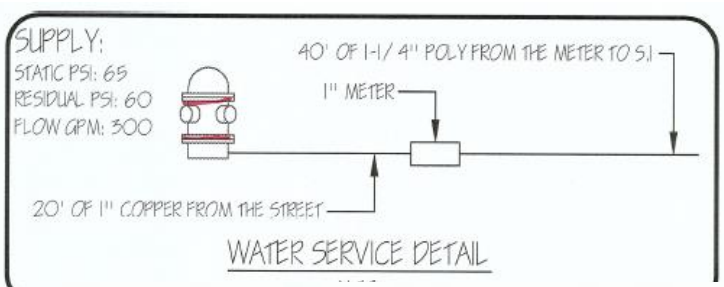
Fire Flow Evaluation

- Due diligence - Verify impacts or benefits from changing settings (don't create a new problem)
- Determine if fire flow deficiencies are due to pressure zone settings or local capacity (how to solve an existing problem)
- <u>Most deficiencies due to pipe size, not HGL.</u>

	gpm @ 20-psi (no velocity limit)			
Hydrant	434 HGL	404 HGL	400 HGL	390 HGL
514230	2,650	2,460	2,420	1,940
514234	2,520	2,280	2,230	1,920
101942	1,880	1,680	1,650	1,590
514232	2,830	2,660	2,630	2,130
514229	3,130	2,970	2,950	2,410
514657	2,520	2,290	2,240	1,920
101116	2,270	1,960	1,820	1,460
100868	2,370	2,110	1,940	1,580
101011	2,490	2,280	2,160	1,720
376929	2,510	2,260	2,210	1,920
376935	2,520	2,270	2,230	1,920
376941	2,520	2,280	2,240	1,920
514228	2,550	2,330	2,280	1,900

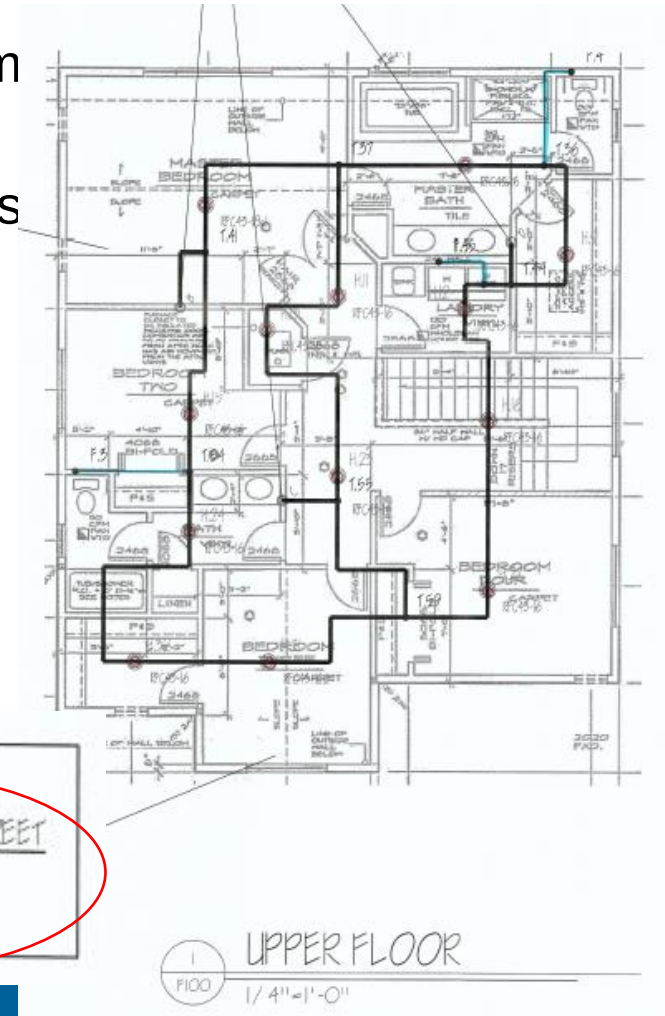
Fire Sprinkler Research

- Confirm design conditions and minimum pressure requirements
- Verify minimum HGL where adjustments might be made.
- <u>Constrains HGL in some zones</u>



MOST HYDRAULICALLY REMOTE HEADS

	HEAD #	GPM	PRESSURE REQ'D AT STREET
1 HEAD	H.3	18	49.39
2 HEAD	H.11 & H.23	26	52.26



Question #2

How much of your system operates at/near the HGL implied by pressure zone names?

- 100%
- 75% to 100%
- 50% to 75%
- Unsure
- We don’t name our zones based on HGL

Recommendations

Name Changes

Existing Map: 62 zones

- + 10 existing unconnected =

Existing System: 72 zones

- + 2 new =

Planned: 74 zones

Also:

Adjust HGL for 12 existing zones

Unconnected Zones

Existing, split zones that are currently mapped as one.

Existing	Clarified
CM1000	CM1000 LM1000
CM1300	CM1290N CM1290S
CO440	CO420 CO400
EG370	EG340 EG370
EG440	EG400 SA400

Existing	Clarified
EG590	EG590 HV590
NH320	NH320 NH340
NH380	CC380 NH380
RM330	RM310 RM335
SS550	FH550 SS550

HGL Adjustments

Many zones increased ~40 feet in 1980s/1990s due to low capacity

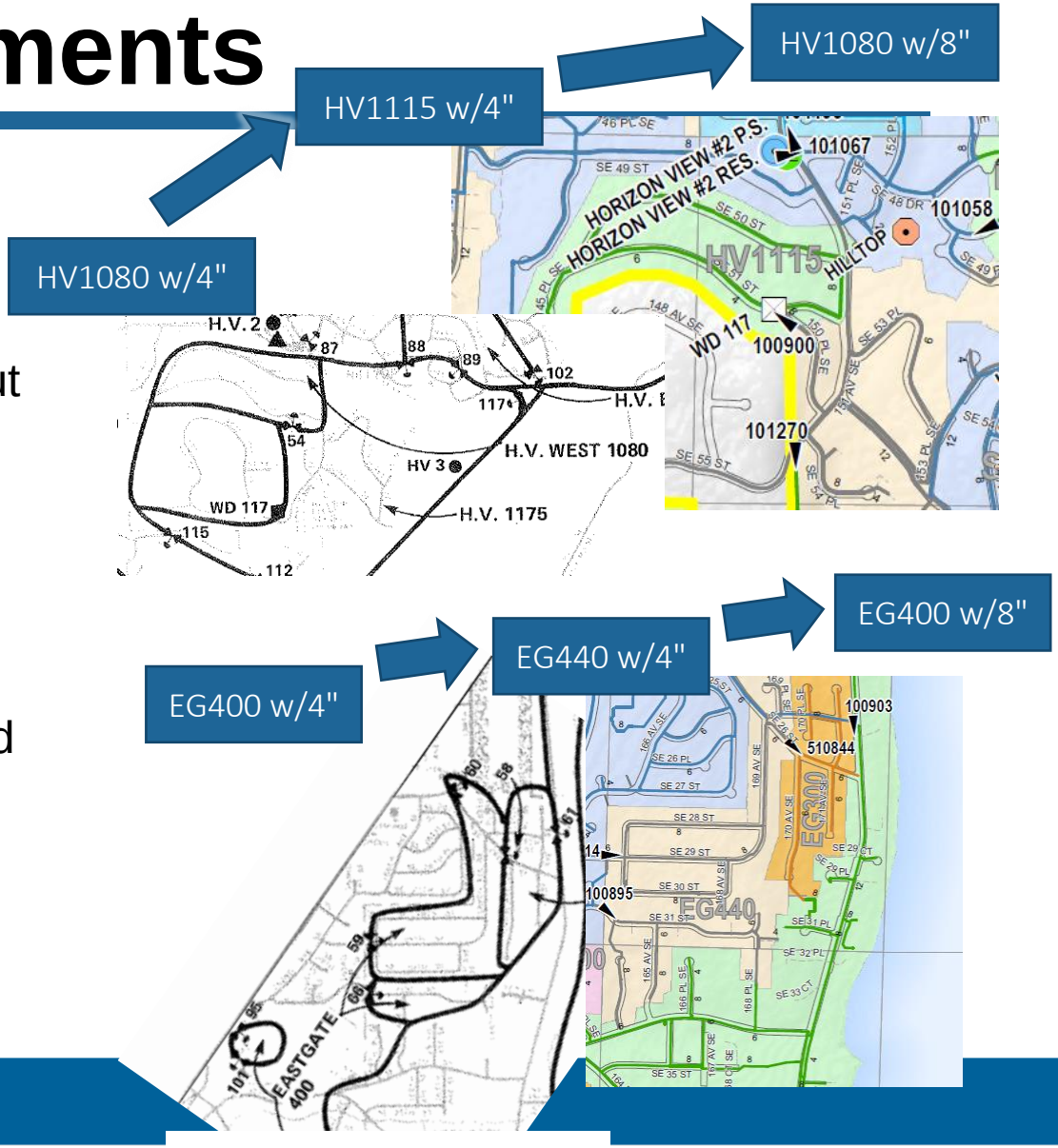
- Slightly improved fire flow, but still deficient
- Very high static pressure

4" mains replaced in 2000s

- Fire flow and capacity issues completely resolved
- Excessive pressure remained

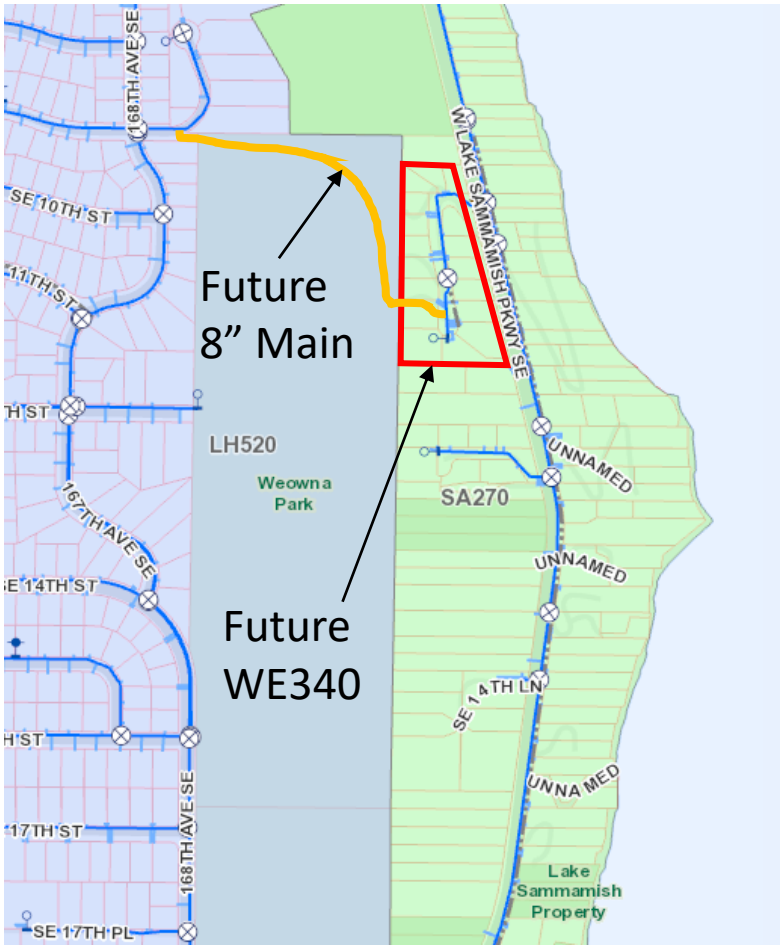
<u>Reduce to original pressure</u>

- Confirmed fire sprinklers OK
- Reduces main break and customer plumbing risks



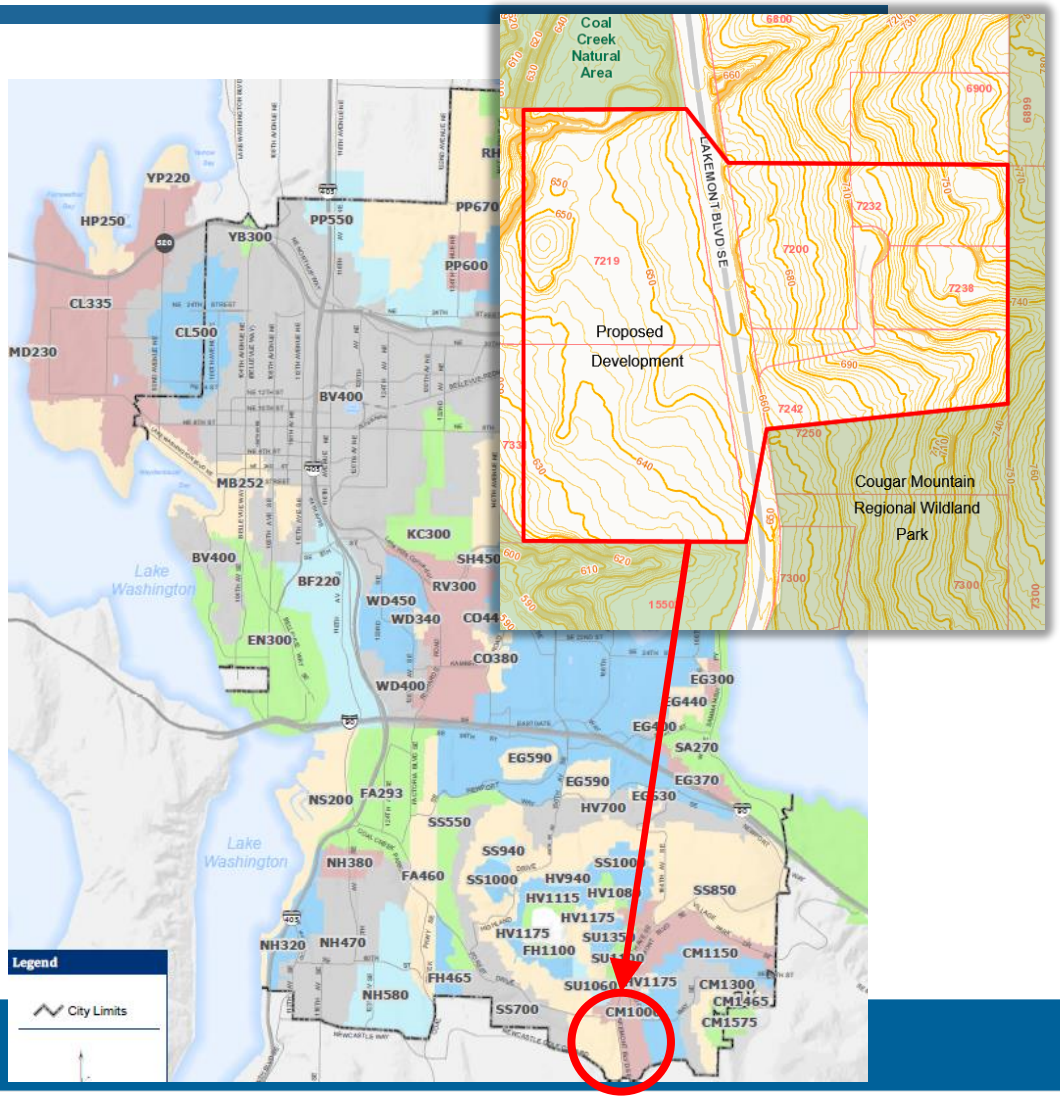
New Zone (Weowna 340)

- Existing low-pressure deficiency in SA270 zone
- Route supply from LH520 zone across park
- <u>New Weowna 340</u>



New Zone (Lakemont 820)

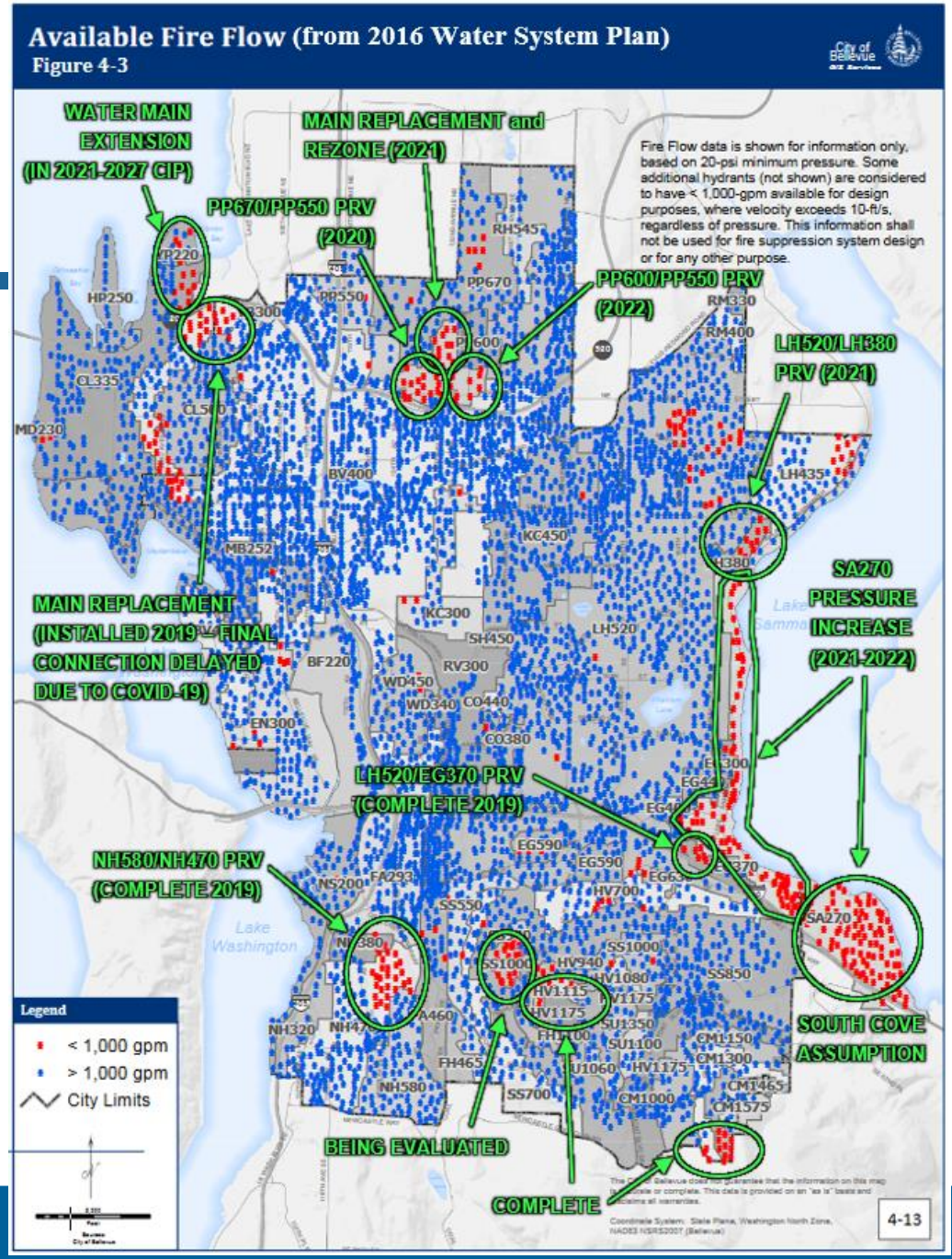
- No infrastructure (yet)
- Currently mapped in Somerset 850 zone to avoid gap in map
- 41 houses proposed
- Requires PRV and new zone
- <u>New Lakemont 820</u>



CIP Projects

Prioritize 6” water main replacement at 9 sites.

Fire flow evaluation identified specific locations where deficiencies are solely due to pipe capacity (not HGL).



Other Recommendations

- Establish standard operating procedures and training for setting PRVs.
- Verify level and pressure sensor calibration at reservoirs.
- Re-evaluate the need, locations, and settings for altitude valves.

Next Steps

- IT systems updates
  - GIS
  - CMMS
- Accelerate 9 sites for AC main replacement
- PRV and pump settings adjustments

Thank You!

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