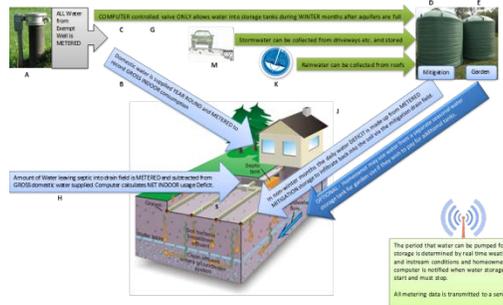


Seasonal storage of surplus water to mitigate fully the net consumptive impact of permit-exempt domestic wells

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Background

A recent Washington State Supreme Court ruling has changed how counties review permit-exempt domestic wells for building permits under the Growth Management Act (GMA).

In the *Whatcom County vs. Hirst, Futurewise, et al.* decision, the Supreme Court ruled that the county failed to comply with the GMA's requirements to protect water resources. The ruling requires the county to make an independent decision about legal water availability. The Court also said the county must ensure that new permit-exempt uses do not impair instream flows and senior water rights when making water availability determinations prior to granting new building permits.¹

Under the new rules a large number of rural parcels have been affected which is creating significant financial hardship for many county residents who had purchased property to live on or for other purposes such as funding their kids' college tuition or their retirement. Contrary to some opinions few if any, of those affected are experienced land speculators that could have been expected to anticipate the risk of loss caused by this situation.

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<http://www.ecy.wa.gov/programs/wr/nwro/hirst.html>
<https://fortress.wa.gov/ecy/publications/documents/1611003.pdf>

In response to the Supreme Court decision Whatcom County has been forced to enact an emergency moratorium prohibiting the filing, acceptance and processing of new applications for uses that rely on permit-exempt groundwater withdrawals for water supply in most of the county. The exception is applications that provide documentation that there is an adequate and legal water supply to serve the proposed use in the form of:

1. A water right from Ecology, or
2. A letter stating the ability to provide water from a municipal or public water purveyor not dependent on a permit-exempt well, with adequate water rights issued by Ecology, or
3. A rainwater catchment system approved by the Whatcom County Health Department.

This document is presented as exploration of a fourth possible option, the seasonal storage of surplus water that is later used to fully mitigate the potential impact of domestic well use in a way that does not affect more senior water rights or instream flows. This water would come from one or more sources including: (a) winter withdrawal of ground water from an aquifer that is expected to be fully recharged before springtime, (b) stormwater runoff from driveways and other impervious surfaces, and (c) rainwater collection from roofs.

Concept

Whatcom County has an abundance of water, unfortunately while we have more than we need in winter we don't have enough in summer. The average gross daily domestic ground water consumption for residents is estimated to be 65 gallons per day or less². The best available science suggests that between 80% and 90% of rural ground water consumed for indoor domestic use is actually returned to the soil through the homes septic system³. The recent ruling requires that any and all consumptive uses must be completely mitigated (drop for drop) and that the mitigation must occur at the time of use.

Exhibit A provides an estimated average Gross consumption for a family of four of 260 gallons per day, Net consumption at 208 gallons per day which calculates that a Deficit of 52 gallons per day needs to be mitigated.

This proposal demonstrates how homeowners could store surplus water during the winter and use it to fully mitigate their net consumptive use at other times of the year in a way that would comply with both the new court ruling and the physical constraints imposed by a physically finite water supply.

² Whatcom County Health Department rainwater storage sizing calculation is 50 and 65 gallons per person per day.
<http://www.co.whatcom.wa.us/DocumentCenter/Home/View/1986>

In Melbourne, Australia (hotter and drier climate) the current average daily use is 44 US gallons (166 Liters) per person the target is 41 gallons
<http://target155.vic.gov.au/>

The WA Department of Ecology estimates permit-exempt domestic wells consumptive indoor water use at 57.1 gallons per day per person
<https://fortress.wa.gov/ecy/publications/SummaryPages/1511006.html>

³ The WA Department of Ecology estimates that 10 percent of indoor water use is consumptive
<https://fortress.wa.gov/ecy/publications/SummaryPages/1511006.html>

The components of the solution (see Exhibit B):

Permit-exempt well

In areas where a public water supply is unavailable a permit-exempt well **(A)** would continue to be used to provide the primary potable water source for the home. Well water can normally be used as potable water source provided it meets bacteria and other containment standards. Whereas State health laws require that rainwater must be treated for bacteria in order to be a potable water source and trucked water may not be used at all as a primary potable water source.

The first difference between this proposal and current practice is that unlike existing unmetered permit-exempt wells previously used to provide water in support of building permits new wells would have meters that measure consumption on a daily basis throughout the year. The second difference is that while normal net daily indoor domestic water consumption is quite small due to the majority of the water being returned to the ground through the septic system, this proposal acknowledges recognizes it is not zero and provide for full mitigation as required by recent court rulings by reducing the net consumptive use to zero.

Distribution from well

Water from the well would travel through two distribution lines:

- The first line would provide potable water to the residence. This line would have a meter **(B)** that would collect data on the Gross amount of water being used for domestic use.
- The second line would provide metered **(C)** water to the mitigation tank **(D)** and the optional outdoor garden tank **(E)**. However water would only be allowed to pass to the storage tanks when the computer **(F)** determines that seasonally surplus water is available and it opens valve #1 **(G)**

Re-infiltration of used water

After water is used in the house most of it would pass into the septic tank as normal and ultimately the septic drain field **(S)**. A third meter **(H)** would be placed on the pipe from the septic tank to the drain field to determine the Net amount of water being returned to the ground. The water "Deficit" amount (Gross – Net) that needs to be mitigated would then be calculated by the computer every 24 hours. (As water from the septic tank may have a small amount of residual solids the meter may need to be different than the other three, alternatively it may be possible to use a positive displacement pump to provide metering data.)

Mitigation

Once the computer **(F)** has calculated the daily water Deficit that needs to be mitigated it will open valve #2 **(I)** on the Mitigation tank **(D)** and will allow mitigation water to enter the ground until the fourth meter **(J)** confirms that the Deficit amount has been sent to infiltrate back into the aquifer as mitigation.

The cheapest option would be to deliver the mitigation water through a dedicated infiltration field such as a french drain located at some suitable place on the property. However if space is a problem and a new septic drain field is being installed the mitigation water could be mixed in with the normal septic drain field water provided the field was upsized approximately 20% to accommodate the additional volume.

This system preserves instream flows and avoids conflict with other senior water rights.

The end result will be a net indoor domestic groundwater consumption of ZERO

Mitigation water supply

Each home would have one or more Mitigation water tanks (**D**) with a collective capacity great enough to store enough water to mitigate their entire years estimated water Deficit (current estimates suggests this would be about 20% of their average daily Deficit for a nine month period however actual usage data from the pilot program may prove this to average 10% or less).

The Mitigation water does not need to meet potable water standards therefore the Mitigation tank can be filled from one or more sources:

1. Stormwater collected from driveways and other impervious surfaces (**M**). An added benefit is that this water and the contaminates would be directed into the septic drainfield during the drier months rather than enter streams during the wetter months as it currently does (this may need to be limited to perhaps 1,000 sq. ft. per occupant to avoid creating a perverse incentive to increase impervious surface areas).
2. Rainwater from roofs (**K**)
3. Surplus winter ground water from the permit-exempt well (**G**)
4. Finally trucked water (in the unlikely event that the other three sources are inadequate)

Garden water tank

At the homeowners option each home could also have one or more Garden water tanks (**L**). The capacity would be determined by the homeowner. This water would normally be used to provide water for garden use. While the Garden tank could be connected via a one way valve to the Mitigation tank to allow the Garden water to be used as a backup Mitigation water supply the Mitigation water would not be allowed to flow into the Garden tank to prevent the Mitigation tank being drained accidentally.

Homeowners Computer

The Computer (**F**) would likely be a modified smart phone running a mobile application. The reasons for this are as follows:

- Smartphones are robust low cost self-contained hardware platforms with inbuilt displays, keyboards, battery backup power and radios (Cellular, Wi-Fi and GPS). Even obsolete models could be used effectively.
- Provides easy connectivity to a central computer via the homeowners Wi-Fi or the Cell carriers data network (low use cellular data connections typically cost \$10 a month or less)
- Intuitive, familiar user interface (everyone knows how to use a phone)
- Application software can be updated easily by downloading it from the phone's "App Store"
- Common, easy to understand programming environment will reduce development costs
- Serial interface can be used to connect to the data bus/ports to read the meters and control the valves

Computer software would be written to:

- Receive information from the central computer as to what dates each season Storage water may be pumped to the Mitigation and Garden tanks
- Send daily information on Gross Water usage, Net Water Usage and Mitigation Water used.
- Provide the above information on the phones display for the phone owner to see
- Email reports to the user as to consumption levels to help them in their personal conservation efforts.

Central computer

A central computer that is managed by either the Department of Ecology or the County would:

- Tell the homeowners computer when water can be pumped for storage
- Collect daily information from each device
- Verify that the consumption and mitigation numbers make sense
- Initiate alerts for improper events such as:
 - Homeowners system has gone offline
 - Out of authorization storage water line usage
 - Actual Mitigation water consumed is below calculated minimum amount (e.g. tank is dry)
- Provide researchers with actual water use data such as:
 - Anonymously by user
 - By named basin
 - By aggregate

System summary

The total system as outlined above would require:

- 1 Cell phone and charger
- Interface box between Cell Phone, meters and valves
- 3 “clean” water meters (B, C & J)
- 1 “dirty” water meter (H)
- 2 valves
- 1 or more water tanks
- Piping
- Software

Costs

Initial rough estimates place the costs, in quantity as follows (these are still a work in progress):

	Qty	Each	Total
Simple smartphone and charger	1	300	300
Interface box between Cell Phone, meters and valves	1	500	500
3 “clean” water meters (B, C & J)	3	110	330
1 “dirty” water meter (H)	1	150	150
2 valves	2	50	100
		Control system Subtotal	1,380
5,000 Gallon Water tanks (installed)	2	7,500	15,000

Mitigation water drain field/French drain (not costed but would be moderate)

Software costs should be moderate and would be amortized across all installed locations

Preliminary estimate for a 4 person household \$16,380

It needs to be acknowledged that this proposal would add extra expense above and beyond the cost of a installing just a well, however the cost of the well and mitigation system would likely still be less than the combined cost (water share, extension of service line to property and connection charges) for a homeowner to hook up to an existing private water system if available.

Legislative requirements

The development and piloting of this proposal will likely take three or more seasons of active data collection in order to prove the concept and refine the computer models necessary to calculate exactly the annual start and end dates that surplus water is available. The best way to generate the data needed to build the models is through the active participation of landowners who are affected by the new rules.

Therefore it is suggested that the Washington State Legislature amend the current statutes to accept that landowners who agree to cooperate and participate in this pilot project will be deemed to have fully mitigated their net consumptive water use and may rely on a permit-exempt well as their primary domestic water source when they apply for their building permit. If the pilot program results in effective solutions being developed the landowner would be expected to adopt them. If for some reason the solutions prove to be ineffective participating landowners would be grandfathered in under the rules in place prior to the moratorium.

Initial Funding

The impact created by the recent Supreme Court rulings is not limited to Whatcom County; it affects most undeveloped rural property across the state. Therefore logically the cost to develop and pilot this concept should be funded from state rather than county funds.

As the residents of Whatcom County are the ones most immediately impacted it would seem reasonable that they should be the ones to be offered the first opportunity to participate in the pilot as a means to achieve compliance with the recent rulings.

While further determination needs to be made as to the ideal size and length of the pilot program, given the urgent need to find a solution we should start by offering anyone building a house in Whatcom county over the next three years the opportunity to participate. The state would reimburse reasonably incurred costs for the necessary infrastructure to be incorporated within their building plans in exchange for the landowner agreeing to: (a) providing the data necessary to properly evaluate and refine the concept, and (b) to continue to use the final working system in perpetuity unless the state later determines the solution is unnecessary or ineffective.

Conclusion

While this proposal may be more complex than some others under consideration it respects and responds to the reality that we have finite water resources throughout the state which require that we mitigate seasonal overconsumption of water with actual water from other sources.

Exhibit A

SEASONAL USE OF EXEMPT WELLS

WATER BUDGET - Indoor use only. Outdoor use would be additional

GREEN BOXES ARE VARIABLES

Step 1	Number of users (minimum 2):		4 Persons
	Gallons per day/person:		
	(50g/person/day min, recommend 65)	(range 41 to 103 US Gallons - see notes below)	65 US Gallon
	Gallons per day used: (users x gpd)		260 US Gallon
Step 2	Estimated net percentage of water consumed	(range 10% to 20%)	20%
Step 3	Days per year Exempt wells impacted by Senior Rights or In-Stream Flow rules		
	Start date 1-May	End Date 1-Nov	184 Days
Step 4	Calculate Net impact in Gallons per season		
	Gross water use during restricted period in Gallons (average gallons per day consumed x days impacted)		47,840 US Gallon
	Net water use during restricted period in Gallons (gallons used x net percentage consumed)		9,568 US Gallon
	Size of seasonal storage tank required		9,568 US Gallon
Step 5	Use of Exempt well		
	Allow metered domestic use of exempt well year round an average daily rate not to exceed the storage systems capacity to mitigate		
	In this example as the average daily usage rate would 260 US Gallons therefore the seasonal storage required would be		10,000 US Gallon
	The well, stormwater and rainwater can be used to fill the storage tank in mid winter when there is excess surface water		(Rounded up)
	Approximate price per US Gallon to store water in a tank(s), (includes installation)		\$ 1.50 USD
	Cost of sufficient tank capacity to store water (total storage x cost per Gallon)		\$ 15,000 USD
Step 6	Metering proposal		
	DEDUCT The gross amount of metered water pumped from the well per day to provide Potable water is:		260 US Gallon
	ADD back the amount of metered water leaving septic system for introduction to drain field each day is:		208 US Gallon
	ADD back the net water consumed is automatically calculated and released from storage into the drain field to mitigate:		52 US Gallon
	Total net impact on senior water rights such as seasonal irrigation rights (adjusted daily):	=	0
	Total negative impact on minimum instream flow levels (adjusted daily)	=	0

Notes on sources of water consumption rates

Whatcom County Health Department requires rainwater storage systems be based on between 50 and 65 gallons per person per day
<http://www.co.whatcom.wa.us/DocumentCenter/Home/View/1986>

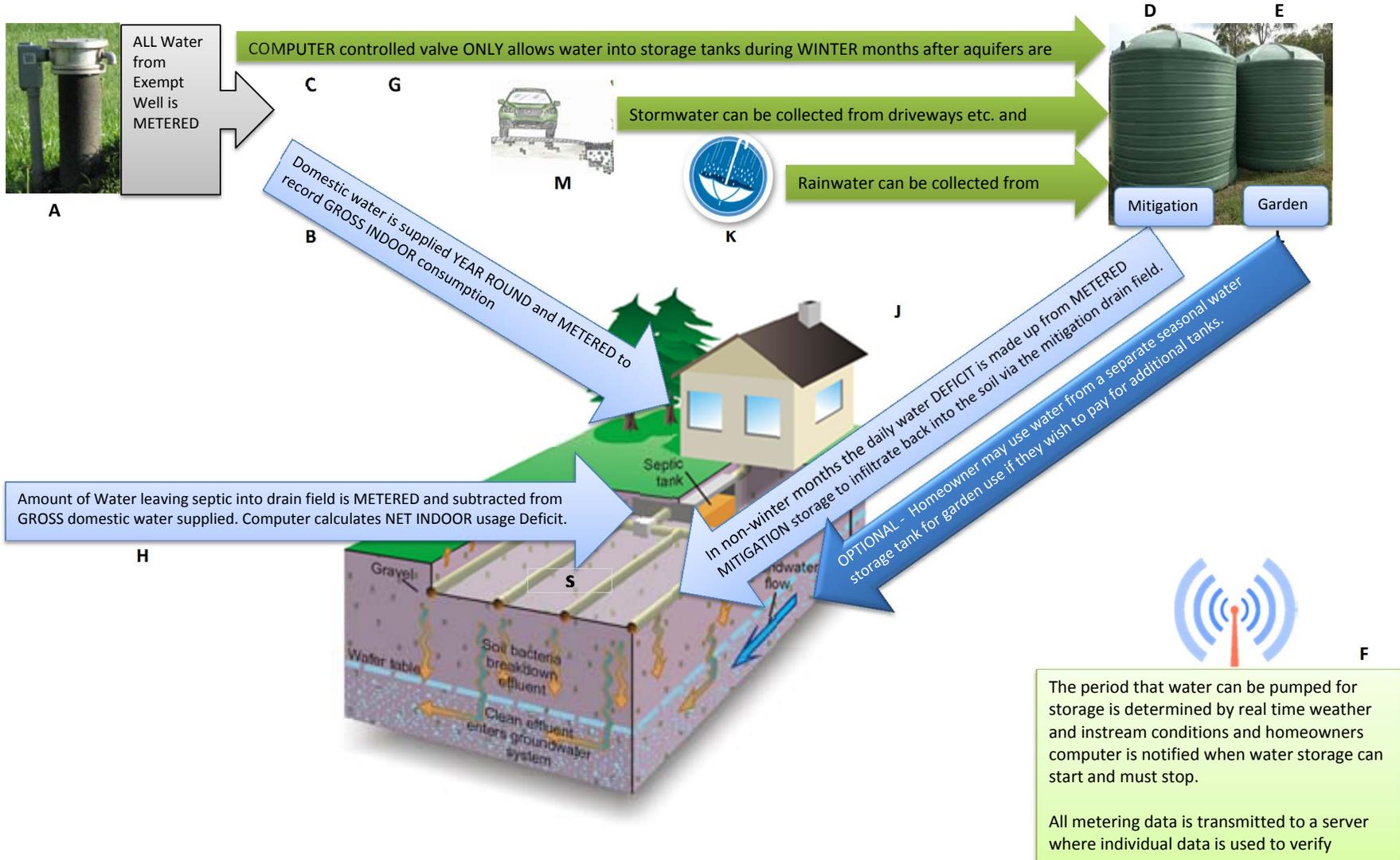
In Melbourne, Australia the average daily use is 44 US gallons (166 Liters) per person and the target is to reduce it to 41 gallons (155 liters). Melbourne is much drier and hotter than Whatcom County, and most of the population lives in low density single family housing
<http://target155.vic.gov.au/>

The WA Department of Ecology estimates permit-exempt domestic wells consumptive indoor water use at 57.1 gallons per day per person Based on 2005 USGS total water use estimates (Lane, 2009)
<https://fortress.wa.gov/ecy/publications/SummaryPages/1511006.html>

The "Water Usage in the West" report calculates that Domestic Water Use Per Capita per day across Washington state is 103 gallons
<http://www.csgwest.org/policy/WesternWaterUsage.aspx>

FLOW CHART OF SEASONAL USE OF EXEMPT WELLS CONCEPT

Exhibit B



Domestic water returned through septic drain field AND mitigation water field should result in NET ZERO impact on instream flows or other senior water rights
 Use of stored winter water for garden use should result in a small but net increase summer ground water levels
 As the mitigation water does not need to be potable it can be storwater, rainwater or trucked water.