



RESIDENTIAL DEVELOPMENT AND GROUNDWATER RESOURCES

COMPREHENSIVE PLANNING AND GROUNDWATER FACT SHEET 3

WISCONSIN GROUNDWATER COORDINATING COUNCIL

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New residential development is one of the most common types of growth experienced by Wisconsin communities. In 2000, over 16,000 new one and two-family homes were built in Wisconsin. Wisconsin is expected to have an additional 400,000 households by 2015, so the number of new homes will continue to grow.

To understand how residential development can affect groundwater, it's important to recognize that all land has groundwater beneath it (Figure 1). Groundwater flows through underground soil and rock materials, generally from higher to lower areas on the land surface. Sometimes we plan to directly use that groundwater, as when we drill individual drinking water wells. But even when we do not plan to use it, residential development may affect both the quality and amount of local groundwater.

The choice of water supply and wastewater treatment for residential development is critical. It will affect the size of lots required, and the acceptable number and density of homes. Placement of wells and wastewater systems relative to groundwater flow direction is also important. Educating homeowners on proper lawn care or wastewater management practices later is important, but cannot always overcome poor decisions in the original design. So, good planning of residential development is the first step to protecting groundwater quality in residential areas.

This fact sheet examines the relationship between residential development, particularly development of new subdivisions, and the groundwater resource. It also discusses ways in which impacts can be minimized.

Water Supply Considerations

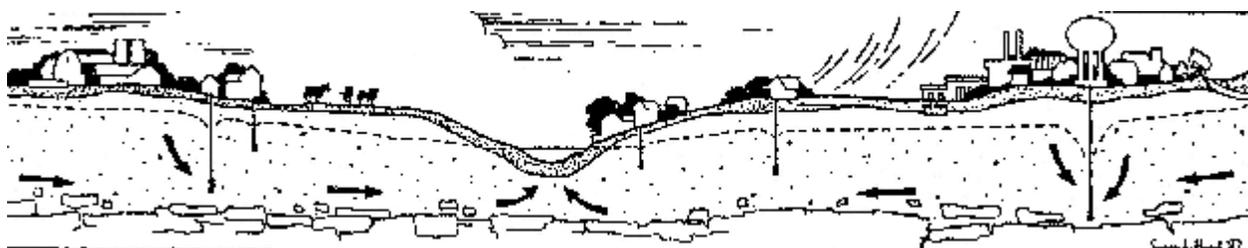
Water to serve residential developments can be provided in three ways: through connection to a community water system, a subdivision water system, or individual home wells.

- *Community water systems* may use surface water or groundwater. When groundwater is used, withdrawal of water from high capacity wells might reduce the amount of water available to local streams and lakes. Careful design and management of these wells can reduce these impacts, but Wisconsin law does not currently

require consideration of surface water effects. Changes to the community infrastructure may be needed to provide services to additional homes. The quality of community water systems is continually monitored.

- *Individual home wells* have smaller impacts on groundwater and surface water flow than high capacity wells, especially when the water is returned to the groundwater through onsite wastewater treatment. Since homeowners generally use well water without treatment, the quality of groundwater available onsite is critical. Homeowners are responsible for monitoring their own water quality.

Figure 1. Groundwater underlies Wisconsin, and supplies water for rural and urban uses.



- *Subdivision water systems* are required to monitor water quality if one well serves 25 or more residents. Typically this is assumed to be the case when 7 or more homes are interconnected to one well. Water systems serving fewer homes are otherwise similar to individual wells in their regulation and impacts on groundwater.

Wastewater Treatment Considerations

Wastewater treatment for a residential development can similarly be provided in three ways: through connection to a municipal system, development of a group onsite wastewater treatment system, or individual onsite wastewater treatment systems. Both public facilities and onsite systems vary in the degree of treatment they are designed to provide.

- Use of *municipal sewers* allows wastewater to be treated off-site, so groundwater contamination potential is minimized. However, in sewered developments with individual home wells, the local groundwater level may be lowered because the public sewer removes wastewater from the area, preventing it from naturally replenishing groundwater.
- In developments with *onsite wastewater treatment systems*, whether individual or group systems, wastewater replenishes local groundwater. However, some contaminants, such as nitrate and chloride, are not removed by conventional systems and may cause local groundwater quality problems even when systems are constructed to applicable state codes. If the development is in the recharge area for the public water source, contaminants could also affect the public water supply. Research shows that developments with individual onsite wastewater treatment systems and private wells require lot sizes of at least an acre to protect drinking water quality.
- Especially sensitive areas for onsite wastewater treatment include those with highly permeable soils, or shallow depths to groundwater or fractured bedrock. In such areas, bacteria, viruses, volatile organic compounds, or other contaminants may also affect groundwater. The community may choose to direct

development away from sensitive groundwater areas, even when onsite wastewater codes allow it, or require additional wastewater treatment, such as sand filtration, disinfection, or nitrate removal.

Conservation Subdivisions

Conservation subdivisions (sometimes called cluster development) preserve green space in a community by using less land for individual lots, and maintaining the natural features of the land as much as possible. Such developments can have many environmental benefits, including potential groundwater benefits if less land is developed into fertilized lawns and landscapes.

However, conservation subdivisions, like any development using small lots, must be carefully designed to prevent unwanted “recycling” of wastewater into private wells. This “recycling” occurs when onsite wastewater treatment system drainfields or mounds are located *upgradient* (uphill in the groundwater flow system) from private or group wells. Wastewater containing high levels of nitrate and other contaminants that re-enters the groundwater can be pumped by downgradient wells, even on neighboring properties. To minimize such problems:

- determine groundwater flow direction and avoid constructing wells downgradient from onsite wastewater treatment systems,
- use advanced onsite wastewater treatment systems,
- or connect conservation subdivisions to a community sewer and water supply.

Groundwater Issues Common to All Residential Development

Besides water supply and wastewater treatment, issues common to all residential developments include (Figure 2):

- Land covered with impervious surfaces such as homes, driveways, roads and parking lots may have more runoff and less groundwater recharge than undeveloped land. However, increased groundwater recharge may occur if the runoff water naturally infiltrates onsite or is infiltrated by raingardens or other stormwater management systems.

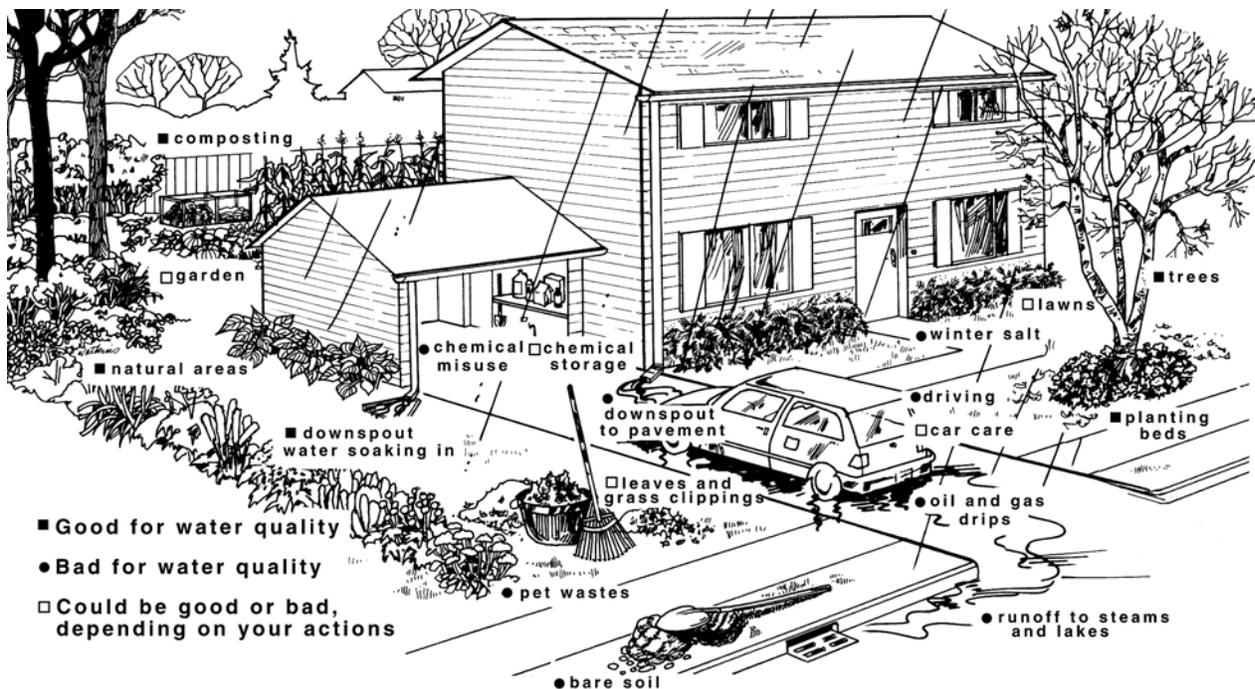
- Where storm sewers are used, they may divert water that otherwise would recharge groundwater.
- Water supplies for new homes may require an increased withdrawal of groundwater.
- Roads and parking lots serving developments mean more use of road salt and more oil, gas and other fluids from vehicles, which can end up in local streams, lakes or groundwater.
- Fertilization and irrigation of lawns increases the risk of contaminating groundwater or surface water.
- Improper waste disposal practices (dumping waste oil or antifreeze on the ground, for example) can also harm groundwater quality.
- past uses of the land. If the land was used for a barnyard, dump, or other waste disposal site, groundwater contamination may already be present. It might be difficult to get good quality water for a private well.
- upgradient land uses. Groundwater flow direction for the subdivision should be determined. Maps are available from the Wisconsin Geological and Natural History Survey for some areas. Contamination sources in the recharge area for private wells in the new development should be identified.
- suitability of property for development of onsite wastewater treatment systems and private wells. An assessment of the local aquifer is needed to ensure that it can supply enough water to the number of private wells planned for the area. The soils on the property also need to be evaluated for their acceptability for the use of onsite wastewater systems (if proposed).

Evaluating the Quantity and Quality of Groundwater Available for Residential Development with Onsite Water and Wastewater Systems

When evaluating the potential of a piece of land for residential development using individual wells and wastewater treatment systems, the following factors should be considered:

- existing groundwater quality. The developer could be required to install monitoring wells, and sample them for human-made contaminants such as nitrate and pesticides, and natural water quality problems such as

Figure 2. Typical activities around the home can affect groundwater quality.



arsenic, iron and radioactivity. Existing neighboring wells can be sampled if there are other homes in the area. Accurate information about the depth and construction details is needed for existing wells. If groundwater problems exist, local governments can consider requiring treatment systems or a notification of groundwater problems on the home's deed.

Minimizing the Impacts of Residential Development on Groundwater Resources

Fortunately, there are steps that planners, engineers, and developers can take, before, during, and after development, to minimize the effects of residential development on groundwater resources. These include:

- using raingardens to encourage infiltration of stormwater and recharge to groundwater.
- minimizing paved surfaces such as driveways, or installing brick driveways and walks instead of poured concrete or asphalt.
- requiring use of advanced wastewater treatment systems, such as nitrate removal systems, in vulnerable groundwater areas.
- providing centralized water or sewer in areas where natural conditions or housing density make onsite system use unsafe or marginal.
- educating homeowners on the need for proper maintenance of private wells and onsite wastewater treatment systems, periodic testing of private well water, and planning for eventual well, pump or drainfield replacement.
- placing private wells upgradient from onsite wastewater treatment systems on the same or neighboring property to prevent recycling of wastewater into private wells.

- encouraging or requiring water conservation and use of water saving devices, such as low-flow showerheads and toilets, within homes.
- restricting the types and amounts of pesticides and fertilizers used on lawns and gardens.
- encouraging or requiring limits on landscape watering.
- providing education on natural landscaping and other low water demand vegetation.
- providing opportunities, such as Clean Sweep programs, for residents to properly dispose of hazardous household products.
- requiring periodic maintenance of onsite wastewater treatment systems if they are used.

In summary, residential development can have many impacts on both the quality of local groundwater and the amount of water needed by a community. Good planning can balance the need for residential development with protection of both the health and well-being of residents and the quality and quantity of local water resources.

For additional information on residential development options and planning tools, see:

- Ohm, B. W., 1999, Guide to Community Planning, Department of Urban and Regional Planning, Univ. of Madison, Wisconsin /Extension, 275 p. Available from UW Extension.
- WDNR and University of Wisconsin Extension, 2002, Planning for Natural Resources – A Guide to Including Natural Resources in Local Comprehensive Planning, 83 pages. Available from County Extension offices, the Department of Administration's Office of Land Information Services (608-267-2707) and at the WDNR Land Use website.

This is one of a series of groundwater factsheets designed to provide information to assist communities with comprehensive planning. Other factsheets and more detailed information to assist planners can be found at the Groundwater Coordinating Council (GCC) web site, <http://dnr.wi.gov/org/water/dwg/gcc/> or the WDNR Land Use Team website at <http://dnr.wi.gov/org/es/science/landuse/index.htm>.

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