To: Erinn Zindt, Technical Assistance Provider, Midwest Assistance Program

From: James Rose, Associate Hydrogeologist, Montana Bureau of Mines and Geology- Ground Water Investigation Program

January 5, 2016

Re: The Meadowlands Subdivision elevated nitrate in groundwater from wells completed in the Deep Aquifer.

We have not specifically studied the elevated nitrate concentrations issue in Meadowlands Subdivision, but we have gathered information about the area, and we are aware of the elevated nitrates and the associated groundwater setting. I will give you a summary of what we do know about this particular area and the nitrate issue.

The Meadowlands nitrate issue is certainly an unusual problem in the Deep Aquifer of the Flathead River Valley in the Kalispell area. During our 2010-2012 Deep Aquifer groundwater study for the MBMG-Ground Water Investigation Program, one of our tasks was to identify Deep Aquifer contamination or potential pathways for contamination from surface water into the deep ground water. With exception of this particular area, we have not found any other indications of Deep Aquifer contamination by surface water.

Both of the Meadowlands wells (GWIC ID: 1713788 and 271549) located in Township 28N Range 22W Section 1,are completed in the upper 30 feet to 40 feet of the Deep Aquifer. The well logs indicate a 120 foot to 180 foot thick layer of silt and clay-bearing material above the aquifer at the subdivision site. Because of the overlying clay-silt material the Deep Aquifer is confined, or separated, from shallow groundwater and surface water.

The Deep Aquifer is the preferred and most used by wells in the Kalispell area. The Deep Aquifer in the Flathead River Valley is a thick, coarse sand and gravel valley-fill deposit that begins approximately 200 feet below the land surface and extends 1,500 feet to 3,000 feet deep. Throughout the valley most all of the Deep Aquifer is covered by a thick, series of clay and silt layers that restricts groundwater flow to or from the shallow groundwater system and surface water. The sealing qualities of the silt-clay layer allow the Deep Aquifer groundwater to be stored, in most of the valley, under pressure. Because the groundwater is under pressure, wells drilled into the aquifer have water levels that rise to levels much higher than the top of the aquifer. This pressure also attempts to push water from the Deep Aquifer upward, toward the surface, applying upward pressure against the silt-clay layers.

As I stated, the presence of nitrate in the Deep Aquifer is rare. There are only a few sampled wells in this northwestern part of the valley that have nitrate present above normal background values. We have not clearly identified the specific source of this nitrate, but some hydrogeologic information about the area may help to explain possible causes for nitrate to be present in the deep ground water.

Measurement of water-level elevations in wells indicates that the Deep Aquifer groundwater in the Meadowlands Subdivision area flows from the northwest to the southeast, similar to the pattern of surface-water flow visible in local drainages. The most likely source of the nitrate in the wells is therefore, upgradient to the northwest of the subdivision.

For our report, we have mapped the elevation of the top of the Deep Aquifer and the thickness of the overlying, confining clay-silt layers using data from over 1,100 wells in the Flathead River Valley. This mapping, along with earlier thickness mapping by GWAP, 2004, suggests that the silt-clay confining layer over the Deep Aquifer is present in the Meadowlands Subdivision area, but in the Lost Creek area, northwest of the Meadowlands Subdivision, could be less than 100 feet thick and may be absent in some areas.

The surface geology in this part of the Flathead Valley may contribute to infiltration of surface water into the deep groundwater. This part of the valley lies at the mouth of the Stillwater River Valley where it joins with the Flathead River Valley. Large Continental Glaciers flowed down the Stillwater Valley and deposited coarse outwash gravel and cobbles across the valley as they melted and retreated. The pore spaces between the gravels and cobbles were infilled with clay. The clay material between the gravels and cobbles can form a barrier to water flow, but local ranchers report that when the clay and gravels are disturbed, in the base of a stream or ditch for example, the water from the channel will quickly drain into the ground. This was also observed by us where streams flow into the valley from the hills to the west. As the stream reaches the valley floor the water quickly drains into the ground, and the creek bed downstream is left dry. The coarse gravel and cobble deposits also have potholes on the surface where large blocks of ice sat in the gravels and melted. Many of the low-lying pothole areas have shallow surface water in the bottom. In these areas, at least the shallow groundwater is exposed to the land surface. Whether that connection continues into the Deep Aquifer is dependent upon the presence of the clay layer over the aquifer and requires a downward vertical hydrologic gradient.

Historically the area northwest of the subdivision and areas to the south west were once extensive dairy farms with milk cows grazing on the pasture land. Concentrated locations of animal waste on the land surface may be one possible source of the nitrate. Much of the land is presently irrigated fields that may have had nitrate rich fertilizers applied along with irrigation water. A 2003 DEQ Report by Thamke, reported elevated concentrations of nitrate in groundwater in the Lost Creek Alluvial Fan area. Follow-up studies by DEQ found no pattern to elevated levels of nitrate in water wells in the Lost Creek area, and no concentration plume was located. A one-time event, also reported by DEQ, indicated that some quantity of nitrate-rich fertilizer may have been back-suctioned into a water well in the Lost Creek area in the early-2000's. None of these suggested sources have been proven to be the cause of nitrate in the Deep Aquifer groundwater, but the information has been provided for consideration of the situation.

The present wells are located in the upper few feet of the Deep Aquifer where most surface infiltration water would contact the Deep Aquifer groundwater. In addition, pumping from the wells draws water movement towards the well. If nitrate in the groundwater was derived from past farming or fertilizer spillage, the nitrate plume and concentration would be expected to dissipate and decline over time. However, the particular conditions in the groundwater that

control the concentration of nitrate are not fully known, and the decline in nitrate levels could take a very long time.

Drilling deeper water-supply wells at the subdivision might be one possible solution to the nitrate problem. This is risky however, since no data are available on the presence or absence of nitrate deeper in the same aquifer. And it is uncertain how pumping these new wells might affect nitrate-bearing water movement in the vicinity.

I if can provide any more assistance please contact me.