GUIDELINES TO SCREEN FOR

DRINKING WATER USAs IN TEXAS

1) Classification of all wells should be based on the shallowest sourced interval in the well. However, because screen depth data is not currently available for the pilot test in the state of Texas, the classification wells is based on their total depth and the source information provided.

   The maximum depth at which the classification changes to "unknown" is based upon the maximum thickness of each aquifer. The aquifer thicknesses were determined from measurements and figures provided in Ryder (1996). An additional 50 feet was added for shallow aquifers (less than or equal to 400 feet) and 200 feet for deep aquifers (greater than 400 feet) resulting in the estimated maximum thickness. The addition of 50 or 200 feet is to allow for uncertainty in the measurement of well depth, and the situations where wells were drilled a short distance into the underlying unit before drilling was terminated. The objective is to identify the wells that most likely have an error in at least one of the fields of location, depth, or source.

2) Any wells that source the alluvial aquifers of the valleys and terraces associated with the major river systems (e.g., Brazos) at depths less than or equal to 200 ft. are Class Ia, because these aquifers are permeable sands and gravels. Wells sourcing depths greater than 200 ft. become unknown. The 200 ft. cut-off is based on reported maximum thickness of "about 100 ft." and "150 ft. or less" for Brazos river and Rio Grande alluvium respectively (Segment 4 Atlas, USGS, 1996).

3) Any wells that source the Rio Grande (Hueco or Westex) aquifer, located in the western region, and are less than or equal to 1000 feet deep, are Class Ia, because these late Tertiary/Quaternary sediments are permeable sands and gravels. These sediments crop out at the surface in Culberson, El Paso, Hudspeth, Jeff Davis, and Presidio counties and occur within one of the following structural basins - Mesilla, Hueco, Salt, Eagle, Red Light, and Presidio. Wells deeper than 1000 feet are Class III because of confining units and artesian conditions.

4) Any wells that source the Pecos River Basin (Cenozoic) alluvial aquifer in the counties of Andrews, Crane, Ector, Loving, Pecos, Reeves, Ward, and Winker of the upper Pecos River region are Class Ia, because these surficial Cenozoic alluvial deposits are permeable sands and gravels. Wells within this aquifer deriving water from depths greater than 1700 ft. are classified as unknown based on a reported maximum thickness equal to 1500 ft. and the aquifer description of aquifer conditions as "generally unconfined" (Segment 4 Atlas, USGS, 1996).

5) Any wells that source the Seymour aquifer, a surficial Pleistocene erosional remnant that occurs in 22 separate areas in parts of 20 counties in the upper Red and Brazos River Basins, at depths less than or equal to 150 ft. are Class Ia, because these alluvial deposits are permeable sands and gravels. Wells deeper than 150 ft. are unknown. The 150 ft. cut-off was used because the saturated thickness is reported to be locally as much as 100 ft. (Segment 4 Atlas, USGS, 1996). The thickness of the Seymour aquifer ranges from less than 100 ft. to as much as 360 ft. in isolated northern portions of the aquifer (Ashworth and Hopkins, 1995). However, with the data available it is not possible to identify these areas and the 150 ft. cut-off is viewed as a reasonable compromise. The most intensely developed part of this aquifer is located in Haskell and Knox counties, which lie within the central portion of the aquifer.

6) Wells located in the high plains aquifer outcrop belt (Ogallala Formation) that source the Ogallala, or High Plains, aquifer at depths less than or equal to 1000 ft. are Class Ic, because these Tertiary sandstones are semi-consolidated, high-yield aquifers. Wells deriving water from depths greater than 1000 ft. are unknown. The 1000 ft. cut-off is based on a total thickness of 650 ft. for the Ogallala, 150 ft. of wind blown sands and alluvium (Segment 4 Atlas, USGS, 1996), and a 200 ft. overlying buffer because some units below the Ogallala are not hydraulically isolated from the Ogallala.

7) Wells located within the outcrop belt of the Coastal Lowlands (Gulfcoast) aquifer system [coastal plain seaward of Jackson/Vicksburg (Eocene/early Oligocene) outcrop belt] that source from shallow depths (less than or equal to 400 feet) are: (1) Class Ia if the source is Pliocene or younger in age (Goliad Sand; Willis Sand; Bentley Formation; Montgomery Formation; Beaumont Formation), because these sediments are unconsolidated and highly permeable; or (2) Class Ic if the source is Oligocene/Miocene in age, because these rocks are semi-consolidated,

high-yield aquifers. Deeper wells (greater than 400 feet) producing from either of these systems penetrate confining units and are Class III. Aquifer and rock names include: (1) Jasper aquifer (late Oligocene/Miocene) – Frio Formation, Anahuac Formation, Catahoula Sandstone, Oakville Sandstone, Fleming Sandstone; (2) Evangeline aquifer (Pliocene) – Goliad Sand; and (3) Chicot aquifer (Pleistocene/Holocene) – Willis Sand, Bentley Formation, Montgomery Formation, Beaumont Formation, alluvium. The 400 ft. cut-off is based on the fact that most of the sands sourced are deltaic, barrier island/inlet and coastal plain units, which are typically no thicker than 200 ft. To account for wells that may derive water from only their lower half (per Neftal et al. 1976) this number is doubled, resulting in a 400 ft. cut-off. Additional support for the 400 ft. depth limit is found in Weiss (1992), in which it is shown that the percentage of sand is most commonly less that 60% in the costal lowlands aquifer system. Therefore at a maximum, within 400 feet, approximately 240 feet of the sediments are permeable sand; the remaining 160 feet are low-permeability clays and silts, which may act as confining units.

8) Wells located within the outcrop belts of the Texas Coastal Uplands aquifer system, specifically the (1) Upper Claiborne aquifer (Eocene; Yegua Formation); (2) Middle Claiborne aquifer [Eocene (also called Sparta and Queen City aquifers); Sparta Sand; Weches Formation; Queen City Sand; Reklaw Formation; Bigfoot Formation]; (3) Lower Claiborne-upper Wilcox aquifer (Eocene; Carrizo sand); or (4) Middle Wilcox aquifer (Paleocene), that source these aquifers are Class Ic, because these Tertiary sandstones are semi-consolidated, high-yield aquifers. (Note: Units 3 and 4 are collectively referred to as the Carrizo-Wilcox aquifer.) Wells in any of these outcrop belts that source deeper horizons (greater than 400 feet) are Class III, because these formations are all underlain by confining units. It is not possible to determine which wells are Class III-v since the local thickness of confining units is unknown. Wells located in the subcrop of the aquifer systems defined above are Class III, because each aquifer is surrounded by confining units at depth.

9) Any wells in the Nacatoch aquifer (Upper Cretaceous Navarro Group) outcrop belt of the northeast area that source that unit at depths less than or equal to 700 ft. are Class Ic, because these sedimentary rocks are semi-consolidated, high-yield aquifers. Wells deeper than 700 ft. become unknown. The 700 ft. cutoff is based on a reported maximum thickness of 500 ft (Segment 4 Atlas, USGS, 1996) plus

200 ft. as a conservative buffer. Wells sourcing the subcrop of the aquifer are Class III (or Class III-v if the confining unit thickness is less than 50 ft. or unknown), because younger overlying units create confining conditions. Common rock name: Nacatoch sand.

10) Any wells in the Blossom aquifer (Upper Cretaceous Navarro Group) outcrop belt of the northeast area that source that unit at depths less than or equal to 450 ft. are Class Ic, because these sedimentary rocks are semi-consolidated, high-yield aquifers. Wells with the outcrop belt deeper than 450 ft. are unknown. The 450 ft. cut-off is based on a maximum thickness of 400 ft. (Segment 4 Atlas, USGS, 1996) plus 50 ft. as a conservative buffer. Wells sourcing the subcrop of the aquifer are Class III (or Class III-v if the confining unit thickness is less than 50 ft. or unknown), because of confining units within the Austin Group. Common rock name: Blossom Sand of Austin Group.

11) Any wells in the Woodbine aquifer (Upper Cretaceous) outcrop belt of the north-central area that source that unit at depths less than or equal to 900 ft. are Class IIa, because the sedimentary rocks in this aquifer typically yield well over 50 gpm. Wells deeper than 900 ft. are unknown. This 900 ft. cut-off is based on a reported thickness of the aquifer of 700 ft. "near the downdip limit of slightly saline water" and 200 ft as a conservative buffer. Wells sourcing the subcrop of the aquifer are Class III (or Class III-v if the confining unit thickness is less than 50 ft. or unknown), because of confining units above and below the aquifer at depth. Common rock names include: Templeton, Lewisville, Red Branch, and Dexter members.

12) Any wells in the Edwards (Cretaceous) aquifer outcrop belt in the Balcones fault region of the south-central area that source that aquifer are Class Ib, because this limestone aquifer is highly faulted and fractured. Wells sourcing the subcrop of the aquifer are Class III (or Class III-v if the confining unit thickness is less than 50 ft. or unknown), because younger overlying units create confining conditions. Wells deriving water from the aquifer with depths greater than 1000 ft. are unknown. This 1000 ft. cut-off is the result of a reported maximum thickness of 800 ft. (Segment 4 Atlas, USGS, 1996) plus a 200 ft. conservative buffer. The outcrop belt of the Edwards is located in the following counties (north to south): Bell, Williamson, Travis, Hays, Comal, Bexar, Medina, Uvalde, and Kinney. Common rock names for the aquifer are: Georgetown Formation, and Person and Kainer Formations of the Edwards Group.

13) Any wells in the Edwards-Trinity (Cretaceous) aquifer outcrop belt in the Trans-Pecos or Edwards Plateau geographic regions that source that aquifer at depths less than or equal to 1200 ft. are Class Ib, because the upper portion of the aquifer is composed of limestones that contain secondary porosity (jointing and caverns). Wells sourcing deeper horizons are Class III. The 1200 ft. cut-off is derived from a published cross section (Fig. 87, Segment 4 Atlas, USGS, 1996) and a general description of the aquifer thickness in the same publication which states "thickness ranges from a few tens of feet to more than 1000 ft." Wells sourcing the subcrop of the aquifer are Class III (or Class III-v if the confining unit thickness is less than 50 ft. or unknown), because younger overlying units create confining conditions. Common rock names: Boracho, Fort Lancaster, Finlay, Fort Terrett, and Segovia Formations; also possibly referred to as Edwards Group.

14) Any wells in the Trinity (Cretaceous) aquifer outcrop belt that source the Trinity at depths less than or equal to 1200 ft. are Class IIa, because the Trinity aquifer consists of sandstones and limestones that typically yield well over 50 gpm. Wells within the outcrop belt and deeper than 1200 ft. are unknown. Any wells outside the Trinity aquifer outcrop belt that source the Trinity at a depth less than or equal to 2000 ft. are Class III (or Class III-v if confining unit thickness is less than 50 ft. or is unknown), because the Trinity aquifer is confined by an overlying unit. An exception is where wells in the Edwards outcrop source the Trinity subcrop (in the Balcones Fault Zone). These wells, if shallower than 2000 ft., are Class IIa. Wells with a depth greater than 2000 ft are unknown. The 2000 ft. cut-off is based on published cross sections (Figs. 110, 111, 112, Segment 4 Atlas, USGS, 1996). Common rock names: Travis Peak, Glen Rose, Paluxy, and Twin Mountains Formations

15) Any wells that source the Dockum aquifer (Triassic) of the west-central and panhandle areas, at depths less than or equal to 900 ft., are Class IIa, because these rocks contain sandstones and conglomerates that typically yield well over 50 gpm. Wells deeper than 900 ft. are unknown. The 900 ft. cut-off is based on a reported saturated thickness of as much as 700 ft. (Segment 4 Atlas, USGS, 1996). Wells sourcing the subcrop of the aquifer are also considered Class IIa because the aquifer is not hydraulically isolated from the surface.

16) Any wells in the outcrop belt of the Capitan Reef Complex aquifer (Permian) that source that aquifer at depths up to 1200 ft are Class Ib, because it is a highly porous limestone. Wells deeper than 1200 ft. are unknown. The 1200 ft. cut –off is based on a statement in the Segment 4 Atlas, USGS, (1996) that the aquifer has been "penetrated by wells to depths > 1000 ft" and reports of water levels that "range between 280 to 1000 ft below the surface" in the same publication. Common rock names: Capitan Limestone, Goat Seep Limestone, and the Tansil, Yates, Seven Rivers, Queen, and Grayburg Formations.

17) Any wells in the Blaine aquifer outcrop belt (Permian Pease River Group; Dog Creek Shale, Blaine Gypsum; Blaine Formation) that source that aquifer at depths less than or equal to 450 ft. are Class Ib, because the anhydrite and gypsum in that unit are commonly cavernous. Wells within the Blaine deeper than 450 ft. are unknown. This is based on a maximum thickness of 400 ft. (Segment 4 Atlas, USGS, 1996) plus a conservative buffer of 50 ft. Wells sourcing the subcrop of the aquifer are Class III (or Class III-v if the confining unit thickness is less than 50 ft. or unknown), because younger overlying units create confining conditions.

18) Any wells in the Marble Falls aquifer (Pennsylvanian: Marble Falls Limestone) outcrop belt located in a circular pattern around the Llano Uplift in center of the state that source that aquifer at depths less than or equal to 800 ft. are Class Ib, because this limestone unit contains numerous fractures, cavities, and solution channels. Wells deeper than 800 ft. are classed as unknown. The 800 ft. cut-off is based on a 600 ft. maximum thickness (Segment 4 Atlas, USGS, 1996) and 200 ft buffer in order to be conservative.

19) Any wells in the Ellenburger-San Saba aquifer outcrop belt (San Saba Limestone Member of the Wilberns Formation of Cambrian/Ordovician age: Tanyard, Gorman, and Honeycut Formations of the Ellenburger Group of Ordovician age) located in a circular pattern around the Llano Uplift in center of the state that source that aquifer at depths less than or equal to 2200 ft. are Class Ib, because these limestones contain numerous fractures, cavities, and solution channels. Wells deeper than 2200 ft. are classed as unknown. Wells sourcing the subcrop of the aquifer are Class III (or Class III-v if the confining unit thickness is less than 50 ft. or unknown), because younger overlying units create confining conditions. An exception to this occurs when the subcrop of the Ellenburger-San

Saba aquifer lies below the Marble falls outcrop. In this case aquifer conditions are still unconfined and wells are Class Ib.

20) Any wells in the Hickory aquifer outcrop that source the Hickory at depths less than or equal to 700 ft. are Class IIa, because these rocks contain sandstones and conglomerates that typically yield over 50 gpm. Wells deeper than 700 ft. are classed as unknown. The 700 ft. cut-off is derived from a maximum thickness of 500 ft. (Segment 4 Atlas, USGS, 1996) and a 200 ft. conservative buffer.

21) Any wells located in the Igneous aquifer outcrop belt that source that aquifer are Class Ib, because of the high yield of wells in this aquifer. A depth at which it becomes unreasonable for a well to be sourcing this aquifer is unknown. The vertical extent of igneous intrusive rocks can be quite great and in this case is poorly constrained.

22) Any wells in the Bonespring - Victorio Falls aquifer outcrop belt that source that aquifer are Class Ib, because this limestone unit contains numerous fractures, cavities, and solution channels. Wells within the Bonespring - Victorio Falls aquifer may not exceed a depth of 2200 ft. Wells deeper than this are classed as unknown. The 200 ft cut-off is based on an estimation of aquifer thickness of "as much as 2000 ft." (Segment 4 Atlas, USGS, 1996).

23) Any wells in the Lipan aquifer outcrop belt that source that aquifer are Class Ia, because this limestone unit contains numerous fractures, cavities, and solution channels. Wells within the Lipan aquifer may not exceed 175 ft. Any wells deeper than this cut–off are classed as unknown. This is based on a reported aquifer thickness of 125 ft. (Segment 4 Atlas, USGS, 1996) plus 50 ft. as a conservative buffer.

24) Any wells in the Marathon aquifer outcrop belt that source that aquifer are Class Ib, because this limestone unit contains numerous fractures, cavities, and solution channels. Wells within the Marathon aquifer may not exceed 1100 ft. Any wells deeper than this cut–off are classed as unknown. This is based on a reported aquifer thickness of 900 ft. (Segment 4 Atlas, USGS, 1996) plus 200 ft. as a conservative buffer.