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Delineation Criteria for the Major and Minor Aquifer Maps of Texas

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An extensive revision of the major and minor aquifer maps of Texas was completed in 1990 by the Ground Water Section of the Texas Water Development Board (TWDB) for inclusion into the 1990 Texas Water Plan. This was prompted by the fact that many of the previous delineations were made in the late nineteen-sixties and early seventies. Since then, statewide geologic atlas coverage was completed by the Bureau of Economic Geology (BEG) of the University of Texas and numerous ground-water studies were completed by the TWDB and other entities. Therefore, it seemed timely as part of the Board's update of the Texas Water Plan, to redelineate the State's major and minor aquifers. The level of detail with which the aquifers were delineated will aid in producing better estimates of recharge and ground-water availability for this and future Water Plan updates.

This report is intended to document the criteria and sources by which each aquifer was delineated. The selected references listed with each aquifer are only those that were specifically used in the delineations and do not necessarily represent the best overview of the aquifer.

The surface extent (geologic outcrop) of each aquifer was digitized onto computer files from geologic atlas sheets published by the BEG and generally represents the recharge zone of each aquifer. Downdip boundaries delineate the extent of the aquifer which contains ground water whose dissolved solids concentrations will meet the aquifer's primary use. The quality limit for most of the aquifers is 3,000 milligrams per liter (mg/l) dissolved solids. However, for a few aquifers the limit is 1,000, 5,000, or 10,000 mg/l dissolved solids. Downdip quality boundaries were determined using a combination of sources including: geophysical logs, driller's logs, water quality sample analyses (some of which were collected from test holes drilled by TWDB staff), results of ground-water studies conducted by TWDB staff and others, and previously published reports.

The aquifers were categorized as major or minor based on the quantity of water supplied by each in 1985, which reflects recent trends; and on their areal extent. The aquifers are defined as follows:

Major aquifer - *supplies large quantities of water in large areas of the State.*

Minor aquifer - *supplies large quantities of water in small areas or relatively small quantities of water in large areas of the State.*

The aquifers were then compiled and delineated on a 1:250,000 scale base map using computer graphics.

Ogallala

The Ogallala aquifer consists primarily of the Ogallala Formation and extends north, west, and east into adjacent states. The boundary of the formation is mapped along the eastern High Plains escarpment and along the Canadian River Valley where the formation outcrop is in contact with underlying formations of Cretaceous, Triassic, or Permian age. The southern extent is placed at the estimated formation pinchout.

The aquifer also includes any water that occurs in overlying younger sediments consisting of windblown sand and silt, alluvium, and playa lake deposits.

In areas where the aquifer is hydrologically connected to the underlying water-bearing formations of Cretaceous and Triassic age it is referred to as the High Plains aquifer.

Selected References: 17, 18, 41

Gulf Coast

The Gulf Coast aquifer occurs in 53 counties and is stratigraphically composed of the Catahoula, Oakville, Fleming, Goliad, Willis, Lissie, Bentley, Montgomery, and Beaumont Formations, and the overlying surficial deposits.

These geologic units consist of complexly interbedded clays, silts, sands, and gravels that are laterally discontinuous both downdip and along strike. In some cases entire formations are discontinuous.

The updip boundary corresponds to the northern and western edge of the Catahoula Formation. The downdip limit of water containing less than 3,000 mg/l dissolved solids is at or near the coastline, however, there are areas where more saline water extends inland. The areas containing less than 3,000 mg/l dissolved solids were delineated using previous regional and county studies.

In the northern coastal area around Houston, Beaumont, Orange, and southwestern Louisiana, the United States Geological Survey has subdivided the aquifer into the Jasper, Evangeline, and Chicot aquifers. In Texas, the boundaries of these aquifers, especially in the subsurface, are somewhat arbitrary.

Selected References: 10, 34, 45, 51, 52, 66, 68, 69, 70, 80

Edwards (Balcones Fault Zone)

The Edwards (BFZ) aquifer consists of all the units, formations, and other members below the Del Rio Formation and above either the Glen Rose Limestone or, when it is present, the Walnut Formation.

The aquifer's outcrop runs uninterrupted from its northern depositional extent in Bell County, to an area in Kinney County where it is broken by faulting and deep river cuts and abuts the Edwards-Trinity (Plateau) aquifer. Catchment areas and stream gaging station data helped determine the northern most recharge areas in Kinney and Uvalde Counties.

The aquifer is subdivided into the San Antonio and Austin Regions by a ground-water flow divide in Hays County.

Downdip, faulting resulted in abrupt changes in water quality and flow direction; and large displacement of the water-bearing units. The downdip limit of the aquifer represents the extent of water containing less than 1,000 mg/l dissolved solids.

Selected References: 12, 26, 42, 48, 71

Carrizo-Wilcox

The Carrizo-Wilcox aquifer includes the Carrizo Formation and the entire Wilcox Group. It extends across the State from Mexico to Louisiana.

In the Central Texas Region the Wilcox Group is subdivided into the Calvert Bluff, Simsboro, and Hooper Formations.

The downdip limit, representing the extent of fresh to slightly saline water (less than 3,000 mg/l dissolved solids) in the aquifer, was delineated using previous regional and county studies.

Selected References: 4, 14, 15, 22, 32, 39, 75

Trinity

The Trinity aquifer consists of all water-bearing basal Cretaceous units including the Paluxy Formation throughout the northern extent, and the Glen Rose Limestone throughout the southern extent. The outcrop of the basal Cretaceous units in the southern area is included for the first time and results in a continuous area of outcrop from the Oklahoma border south to the Sabinal River in Uvalde County; beyond which the aquifer abuts with the Edwards-Trinity (Plateau) aquifer.

An outlier in northwest Coleman County previously included as part of the Trinity aquifer was eliminated because it contained only minor amounts of water; and a larger outlier in Nolan and Taylor Counties was redesignated Edwards-Trinity (Plateau) because the ground water in this area occurs primarily in the Edwards and is more characteristic of the Plateau aquifer.

In its southern part, the downdip portion of the aquifer underlies the Edwards (BFZ) aquifer. The downdip limit of water containing less than 3,000 mg/l dissolved solids was delineated using chemical quality analyses and geophysical log data.

Selected References: 6, 9, 23, 40, 54, 55

Edwards Trinity (Plateau)

The Edwards-Trinity (Plateau) aquifer consists of basal Cretaceous units of the Fredericksburg and Trinity Groups. West and northwest areas of the aquifer are overlain by large extents of alluvial cover.

A large outlier in Nolan and Taylor Counties, formerly included in the Trinity Group aquifer, was included here because the ground water in this area occurs primarily in the Edwards and is more characteristic of the Plateau aquifer.

Where the Fredericksburg has been eroded away along the southeastern edge of the plateau the exposed units are designated as the Trinity aquifer.

To be consistent with the Edwards (BFZ) aquifer, the downdip limit, occurring only in Val Verde and Kinney Counties, is defined by a 1,000 mg/l dissolved solids line based on chemical analyses.

Selected References: 25, 72, 79

Seymour

The Seymour aquifer occurs in isolated, eroded, alluvial remnants in north-central Texas. The areas delineated are based on surface extent, well development, and usage. Consequently, many smaller remnants that provide little water or are not developed, are not represented.

Previous major aquifer maps included these remnants as part of the Alluvium of North-Central Texas or part of the Alluvium and Bolson Deposits. However, because of its extensive areal extent and importance as a source of water for irrigation use, it has been redesignated as an individual major aquifer.

Selected References: 35, 60, 61, 62, 73

Hueco-Mesilla Bolson

The Hueco-Mesilla Bolson aquifer consists of Cenozoic alluvial and bolson deposits that occur within the valleys which flank the Franklin Mountains; and extend north and west into New Mexico, and south into Mexico. The areal extent includes the outcrop of the bolson deposits; however, a vertical boundary occurs at depths where water quality exceeds 1,000 mg/l dissolved solids.

Although hydrologically connected, the aquifer does not include the overlying Rio Grande alluvium.

The previous major aquifer map included the aquifer as a part of the Alluvium and Bolson Deposits. However, since it is the primary source of municipal and industrial water supply for the City of El Paso, other nearby communities, and Ciudad Juarez, Mexico; and provides a portion of the irrigation water supply on either side of the river, it was redesignated as an individual major aquifer.

Selected References: 2, 82

The Cenozoic Pecos Alluvium aquifer occurs in deposits that fill the Pecos and Monument Draw Troughs.

The outer boundaries are drawn at the pinchout contacts with older units of Permian, Triassic, and Cretaceous age; and in places along the southern boundary with Tertiary igneous units. Inner boundaries are less distinct and are based on basin fill pinchout as determined by geophysical and drillers' log interpretations. A small part of the aquifer extends northward into New Mexico. The entire aquifer is included regardless of chemical quality because of the extensive use of its water.

The Cenozoic Pecos Alluvium aquifer is hydrologically connected in various areas to underlying formations. However, these were not included as part of the aquifer during this assessment. In Pecos County, the combination of Cenozoic Pecos Alluvium and Cretaceous has been previously designated the Pecos aquifer; while in Ward County, its combination with the Dockum has been previously designated the Allarosa aquifer.

The previous major aquifer map included the aquifer as a part of the Alluvium and Bolson Deposits. However, since the aquifer supplies the area's water needs for irrigation, industrial, and municipal purposes, it was redesignated as an individual major aquifer.

Selected References: 5, 8, 28, 31, 57, 58, 81

Bone Spring-Victorio Peak

The delineated extent of the Bone Spring-Victorio Peak aquifer is based on the occurrence of irrigable land that is underlain by the Bone Spring and Victorio Peak Limestones; and extends northward into the Crow Flats area of New Mexico.

The southern boundary is drawn along the trace of a dominant fault and the eastern boundary occurs along the edge of the Salt Basin.

Selected Reference: 13

Dockum

The Dockum aquifer includes the outcrop of the Dockum Formation along its eastern extent and in the Canadian River Valley and the extent of its subcrop that contains water with less than 5,000 mg/l dissolved solids.

The aquifer extends north and westward into adjoining states and includes all water bearing units within the Dockum.

The eastern subcrop pinchout, north of the Canadian River and southward through Carson and Armstrong Counties, was determined from driller's and geophysical logs.

The southern subcrop boundary is delineated along the pinchout of the dominant sand unit (Santa Rosa) as determined by geophysical log evaluations and as reported in various agency and Bureau of Economic Geology reports.

The downdip boundary was delineated based on chemical quality analyses and includes water with less than 5,000 mg/l dissolved solids because of its extensive industrial use.

The previous major aquifer map referred to the aquifer as the Santa Rosa. However, it was redesignated Dockum in this assessment to include all water-bearing units within the formation.

Selected References: 24, 30, 46

Brazos River Alluvium

The Brazos River Alluvium aquifer consists of recent alluvial deposits which generally coincide with the Brazos River flood plain and includes older terrace deposits with which it is in direct contact.

The aquifer boundary is based on its areal extent and use and extends from Lake Whitney, on the Brazos River in Hill and Bosque Counties; southeastward to the vicinity of the Gulf Colorado and Sante Fe Railroad in Fort Bend County, near the Brazos County line.

Alluvial deposits associated with the Brazos River beyond this point are excluded from the aquifer because all major wells in these areas are completed in older Eocene deposits underlying the Alluvium.

The previous major aquifer map included this aquifer as a part of the Alluvium and Bolson Deposits. However, because of its importance as a water supply for irrigation use, it has been redesignated as an individual minor aquifer.

Selected Reference: 19

Hickory

The Hickory aquifer is composed of the sand and sandstone of the Hickory Sandstone Member of the Riley Formation of Cambrian age and is the oldest aquifer in Texas. The aquifer crops out and dips into the subsurface in a circular pattern around the Llano Uplift. It is underlain by Precambrian rock and overlain by the Cap Mountain and Lion Mountain Members of the Riley Formation.

The downdip limit of water containing less than 3,000 mg/l dissolved solids is based on data interpretations from field investigations that are currently underway. Faulting influences the downdip boundary.

Selected Reference: 77

West Texas Bolsons

The West Texas Bolsons aquifer includes the alluvium and bolson deposits that occur within the Red Light Draw, Eagle Flat, Green River Valley, Presidio-Redford Bolsons, and Salt Basin.

The Salt Basin can be subdivided into the Wild Horse Flat, Michigan Flat, Lobo Flat, and Ryan Flat. The extent includes the outcrop area within each basin except for the northern part, above Wild Horse Flat, where dissolved-solids content are in excess of 3,000 mg/l as determined from chemical analyses.A vertical boundary occurs at varying depths in some areas where water quality exceeds 3,000 mg/l dissolved solids.

The previous major aquifer map included these bolsons with the Alluvium and Bolson Deposits. However, because of their importance as a water supply for irrigation use and as a municipal supply for several small communities, they were redesignated as an individual minor aquifer.

Selected References: 29, 83

Queen City

The Queen City aquifer is part of the Claiborne Group and consists of sand and clay units . It is overlain by the Weches Formation and is underlain by the Reklaw Formation.

In Texas the aquifer extends from the Frio River in Frio County, to the Louisiana border in Cass County.

Because a facies change occurs near the Frio River which results in a deterioration of water quality, it is not mapped west of the river.

The downdip limit represents the extent of fresh to slightly saline water (less than 3,000 mg/l dissolved solids) in the aquifer as delineated in previous regional and county studies.

Selected References: 1, 3, 11, 27, 36, 39, 65, 67, 78

Woodbine

The Templeton, Lewisville, Red Branch, and Dexter Members of the Woodbine Formation combine to form the Woodbine aquifer. Where they are not subdivided on geologic maps, generalized terms such as Upper or Lower Woodbine or simply Woodbine are incorporated.

The aquifer also includes the overlying alluvium adjacent to the Red River where it is in hydraulic contact with the Woodbine.

The aquifers downdip boundary of 3,000 mg/l dissolved solids was defined from water quality analyses and geophysical log interpretation.

Selected References: 37,40,50,54,59,74

Edwards-Trinity (High Plains)

The Edwards-Trinity (High Plains) aquifer includes the extent of water bearing units of Cretaceous age underlyingthe south-central part of the Texas High Plains regardless of quality and extends westward into New Mexico.

Outliers in Hale and Floyd Counties were included in the current delineation due to significant use of its water in these areas.

The aquifer underlies, and in many places is hydraulically connected to, the Ogallala Formation except for a narrow zone of outcrop along the eastern edge of the High Plains escarpment.

Selected References: 25,41,53

Blaine

The Blaine aquifer crops out in a narrow band from Wheeler to King Counties, beyond which the limited use of the aquifer does not justify its delineation on the present minor aquifer map.

The aquifer consists of a sequence of anhydrite or gypsum, shale, and dolomitic beds found between the overlying Dog Creek Formation and the underlying Flowerpot Member of the San Andres Formation.

The chemical quality of water within the aquifer varies drastically due to the natural contamination of ground water from salt springs and seeps located on the aquifer's outcrop.

The extent of the aquifer, based on use, includes water containing less than 10,000 mg/l dissolved solids and excludes those portions of the outcrop containing water in excess of this limit.

Selected References: 56, 63, 74

Sparta

The Sparta aquifer is composed of sands and clays situated between the overlying Cook Mountain and the underlying Weches Formations of the Claiborne Group.

In Texas, it extends from the Frio River in Frio County, to the Louisiana border in Sabine County.

The downdip limit represents the extent of fresh to slightly saline water (less than 3,000 mg/l dissolved solids) in the aquifer based on delineations from previous regional and county studies.

A facies change and a corresponding deterioration in water quality occurs at the Frio River in Frio County resulting in the unit not being mapped west of the river.

Selected References: 1, 3, 11, 36, 39, 65, 67, 78

Nacatoch

The Nacatoch aquifer occurs in sequences of sand and mudstone between the overlying Corsicana Marl and the underlying Neylandville Marl, all of which are a part of the Navarro Group.

Overlying alluvium, in hydraulic contact with the Nacatoch Formation, is included in the aquifer.

Although the formation continues to the south, the southern aquifer boundary occurs at the Navarro-Limestone County line where the water-bearing sand facies pinches out.

The Mexia-Talco fault system has a significant impact on the occurrence of ground water, controlling the depth to the sand, water movement, and quality. The aquifer's downdip limit of water containing less than 3,000 mg/l dissolved solids, which is based on sampling and geophysical logs, reflects the fault system's influence.

Selected Reference: 7

Lipan

The areal extent of the Lipan aquifer includes the outcrop of caliche and gravel deposits (Qc on the San Angelo and Brownwood geologic atlas sheets) in the area known as Lipan Flat. However, it does not include the Qc area southwest of San Angelo due to less usage.

The aquifer includes the Leona Formation and underlying Choza Formation and Bullwagon Dolomite. This aquifer was previously named the Leona but was changed in order to avoid conflict with the presence of the Leona Formation elsewhere in the state.

The previous major aquifer map included this aquifer as a part of the Alluvium and Bolson Deposits. However, because of its importance as a water supply for irrigation use it was redesignated as an individual minor aquifer.

Selected Reference: 43

Igneous

Igneous rocks, both intrusive and extrusive, are abundant in West Texas; and the three following represent areas of substantial ground-water use.

Marfa -includes those parts of the Petan Basalt and Tascotal Formation in which substantial pumpage has occurred.

Selected Reference: 20

Davis Mountains - includes Barrel Springs Formation and some associated alluvium along the southern and eastern boundary.

Selected References: none

Alpine -includes Cottonwood Spring Basalt, Sheep Canyon Basalt, Crossen Trachyte, and associated alluvium. The southern boundary occurs at the first major fault.

Selected Reference: 44

Rita Blanca

The Rita Blanca aquifer includes all fresh to slightly saline water bearing-formations below the Ogallala Formation and above the Triassic Dockum in Dallam and Hartley Counties..

Primary water bearing units include the Romeroville Sandstone, Mesa Rica Sandstone, and Lytle Sandstone of Cretaceous age; and the Morrison Formation and Exeter Sandstone of Jurassic age.

The aquifer occurs throughout the extent of these units in Texas and ends at the southeast pinchout of the formations. Mapping of these units was accomplished from interpretations of driller's logs and geophysical logs.

The aquifer was previously referred to as Purgatoire-Dakota but was redesignated because of the total number of water-bearing units and the less used Purgatoire nomenclature. The new name is based on a local geographic feature.

Selected References: 16, 41, 76

Ellenburger – San Saba

The Ellenburger-San Saba aquifer consists of the Ellenburger Group (Tanyard, Gorman, and Honeycut Formations), and the San Saba Member of the Wilberns Formation. They are considered one aquifer due to their hydrologic communication.

The aquifer crops out and dips into the subsurface in a circular pattern around the Llano Uplift.

The downdip limit of water containing less than 3,000 mg/l dissolved solids is based on data interpretations from field investigations that are currently underway. Faulting influences the downdip boundary.

Selected Reference: 77

Blossom

The Blossom aquifer occurs in a discontinuous sand within the Austin Group.

Downdip it is overlain by the Brownstown Formation and underlain by the Bonham Formation, both of which act as aquitards.

Overlying alluvium in hydraulic contact with the Blossom, primarily in eastern Red River County, is included in the aquifer.

The western boundary of the aquifer is placed at a sand facies pinchout at the western edge of the City of Paris in Lamar County. Because of this, the aquifer is used very little beyond that point.

Lithology and facies changes limit usable-quality water primarily to wells located on the formation's outcrop. The exception is in the vicinity of Clarksville in Red River County where the downdip limit of water containing less than 3,000 mg/l dissolved solids extends about six miles south beyond its outcrop.

Selected Reference: 47

Marble Falls

The Marble Falls aquifer was delineated on the basis of its surface or outcrop extent. The aquifer is composed of limestone situated between the overlying Smithwick Formation and underlying Mississippian and Devonian rocks.

The aquifer crops out along the northern and eastern flanks of the Llano Uplift and dips into the subsurface in a circular pattern around the uplift.

The downdip limit of water containing less than 3,000 mg/l dissolved solids is based on data interpretations from field investigations currently underway. It is apparent, however, that faulting influences the downdip boundary.

Selected Reference: 77

Rustler

The Rustler aquifer includes the outcrop of the Rustler Formation and a portion of its subcrop.

The downdip boundary of water containing less than 5,000 mg/l dissolved solids was based on the aquifer's most extensive use for livestock, industrial, and minor irrigation purposes. The boundary was delineated from a limited number of chemical analyses.

In parts of Loving and Reeves Counties the Rustler aquifer is hydrologically connected to the Cenozoic Pecos Alluvium aquifer.

Selected References: 5, 49, 64

Capitan Reef Complex

The Capitan Reef Complex aquifer occurs in reef, fore-reef, and back-reef facies of Permian age strata around the edge of the Delaware Basin.

The aquifer is composed of the Capitan and Goat Seep Limestones, and most or all of the Carlsbad facies of the Artesia Group, including the Grayburg, Queen, Seven Rivers, Yates, and Tansill Formations.

These formations crop out in the Guadalupe, Apache, and Glass Mountains in Texas and are elsewhere found in the. subsurface.

The reef complex is approximately 10 to 14 miles wide and extends into New Mexico. In the subsurface, the reef complex is identified on geophysical logs especially along the basins edge.

Within Texas, the aquifer generally contains water of poor quality; however, because of its extensive industrial and minor irrigation use, the entire occurrence of the aquifer is recognized.

The aquifer was previously referred to as the Capitan Limestone but was redesignated Capitan Reef Complex to include the entire lateral extent of the reef

Selected References: 38,64

Marathon

The Marathon aquifer consists of commonly used water-bearing units in steeply folded and faulted rocks of Pennsylvanian and Ordovician age.

It includes the outcrop extent of the Gaptank, Dimple, Tesnus, Caballos, Maraviallas, Fort and Marathon Formations.

The Marathon Limestone Formation is the most productive unit and is the source of municipal supply for the town of Marathon.

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