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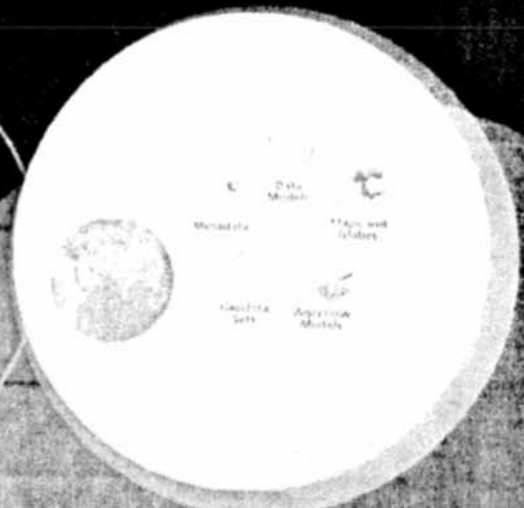
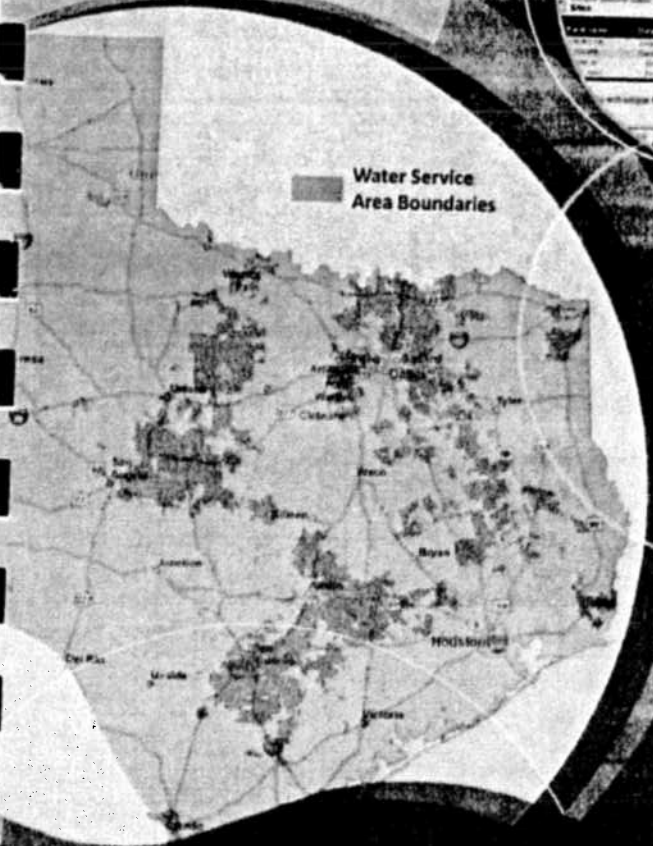
Texas Water System Map

The Compilation of a Statewide Geodataset and Digital Maps of Water Service Area Boundaries



July 5, 2010

Feature Class	Source	Projection	Units	Coordinate System
Water Service Area Boundaries
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...



Texas Water System Map

The Compilation of a Statewide Geodataset and Digital Maps of Water Service Area Boundaries



May 16, 2011

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From: Sumant Mallavaram Noel Gonsalvez Chris Amaral Sam Vaughn, PE	Project: Texas Water System Map
CC:	
Date: July 1, 2011	Project No: 147492

INTRODUCTION

As the responsible water planning organization in the State of Texas, the Texas Water Development Board (TWDB) oversees the state and regional water planning process for surface water and groundwater supply development and management. Recent advancements in the areas of groundwater modeling and the increased emphasis on conservation metrics for water utilities combined with the 2010 census results and an increase in the number of non-city utilities, necessitate the creation of a unified and comprehensive spatial database (geodatabase) of water system providers and the areas they serve.

The Texas Commission on Environmental Quality (TCEQ), as part of its regulatory function is tasked with creation and maintenance of Certificate of Convenience (CCN) boundaries in a spatial format that depicts the boundaries of various water systems and the corresponding providers. Currently, this is the only centralized source of data for water system boundaries. However, from a regional planning perspective, this dataset does not contain planning information such as population served, projected water demands, water use rates, and conservation metrics that are important fundamental data for the state and regional water planning process and the identification and development of appropriate water management strategies. With several thousand such systems in both rural and urban areas, the development of such a comprehensive geodatabase would prove to be very useful for state agency staff and regional planning groups as they cycle through the state water planning process every five years. It is understood that this geodatabase will facilitate more accurate allocations of population and water demand estimates.

Not only would this geodatabase support standardized basic data that TWDB staff and regional water planning groups use, but the geodatabase could be expanded to incorporate any other data that might help facilitate the planning process.

1. DATA COMPILATION

1.1. INTRODUCTION

The TWDB provided HDR with the following datasets that are current (as of April 2010) and form the basis upon which the Public Water System (PWS) service area boundaries (SABs) were delineated.

- Certificate of Convenience (CCN) facility boundaries (polygon shapefile).
- Certificate of Convenience (CCN) facility lines (line shapefile).
- District boundaries (polygon shapefile).
- Spreadsheet databases:
 - SYSMSTR: Table containing all the PWS entities for the entire state of Texas.
 - WUD Code Relationship_ALL: Table containing all the related PWSs, CCNs and Districts.
- WUD CODES.doc, and WUD CUSTOMER LIST.pdf: Documents listing all the customer type, ownership type, activity status, and system type categories and their descriptions. These documents are included in the Appendix A.

The above datasets were compiled and analyzed to determine the number of entities in the following three categories:

- **Category 1:**
PWS entities that serve all areas within a District boundary, CCN boundary, or along a CCN facility line.
- **Category 2:**
Multiple PWS entities serving within a District boundary, or a CCN boundary, or along a CCN facility line.
- **Category 3:**
PWS entities with no associated District boundary or CCN boundary.

1.2. DATA ANALYSIS

Relationships were established among PWS entities, District boundaries, CCN boundaries and CCN facility lines and PWS entities were categorized into the three categories based on certain criteria as described below. These datasets were first brought into a Microsoft Access database to facilitate queries. At TWDB direction, four filters were applied on the SYSTEMR table to select only those PWS entities with the following:

1. Customer Type (C2TCAT) code:

- Residential Area (RA)
- Other Residential Area (OR)
- Mobile Home Park Principle Residence (MP) and

AND

2. Population served by the PWS entity (A2RETP):
 - Greater than 25

AND

3. System Type (A2PWST) code:
 - Community (C)

AND

4. Activity Status (A2AFLG) code:
 - Active (A)

This filtering process reduced the 12,137 unique entities from the original SYSMSTR table to 4,052 entities for which the SABs were delineated. The flow chart in Appendix B depicts the process of data analysis and querying carried out to further group these 4,052 entities into the following three categories and eight subsets based on the relationship of a PWS to either a district, CCN boundary or facility line:

- **CATEGORY 1 (One PWS within a District or CCN):**
 - 1a. 1 PWS :: 1 District
 - 1b. 1 PWS :: 1 CCN Boundary
 - 1c. 1 PWS :: 1 CCN Facility Line
- **CATEGORY 2 (Multiple PWSs within a District or CCN):**
 - 2a. Multiple PWSs :: 1 District
 - 2b. Multiple PWSs :: 1 CCN Boundary
 - 2c. Multiple PWSs :: 1 CCN Facility Line
- **CATEGORY 3 (PWS with no associated CCN and/or District):**
 - 3a. PWS with no associated CCN and/or District
 - 3b. PWS with a CCN but no corresponding feature in the shapefile

Table 1-2 below provides a breakdown of the above categories.

Table 1-2

PWS Grouping by Category and Subset

CATEGORY	SUBSET	SUBSET_DESC	#PWS Entities
1	1a	1 PWS :: 1 District	670 ¹
	1b	1 PWS :: 1 CCN Boundary	1,442 ³
	1c	1 PWS :: 1 CCN Facility	154
2	2a	Multiple PWS :: 1 District	79 ¹
	2b	Multiple PWS :: 1 CCN Boundary	1,064 ^{2,3}
	2c	Multiple PWS :: 1 CCN Facility	14
3	3a	No CCN, No District	257 ¹
	3b	1 PWS :: 1 CCN (no SHP Feature)	368
TOTAL			4,048

¹ Technical Memorandum 1 showed 705 entities for Subset 1a, 76 for Subset 2a, and 225 for Subset 3a. 35 of the 705 entities for Subset 1a did not have a corresponding boundary in the District shapefile. Therefore, 32 of these were moved to Subset 3a (increasing its total to 257) and the remaining 3 were moved to Subset 2a (increasing its total to 79) based on their district to PWS relationships.

² Technical Memorandum 1 showed 1,067 entities for Subset 2b, 4 of these 1,067 entities are not in existence anymore and therefore, these entities are not part of the final geodatabase. They are:

- PWS 0140168 – Sparta Oaks Water Corp
- PWS 1460144 – Lake Livingston Old Snake River ES
- PWS 1700659 – Southwind Ridge Subdivision
- PWS 2490039 – City of Chico West

This resulted in a reduction of the total number of PWS SAB's delineated from 4,052 to 4,048.

³ PWS 0150545 was originally part of Subset 1b and was moved to Subset 2b during the final updates to the geodatabase.

2. GEODATABASE DESIGN

2.1. SCHEMA DEVELOPMENT

The geodatabase (data model) design was carried out in two phases, a conceptual or preliminary design phase wherein HDR provided TWDB with a structure and a geodatabase template designed using Microsoft Visio and based on the data analysis and compiled datasets. The creation of the data model considered all datasets including tables that would be housed in the geodatabase and included appropriate feature datasets, feature classes with required attributes and domains and relationships among the geodatabase entities.

A data model diagram of the schema is provided for reference in Appendix C.

3. SERVICE AREA BOUNDARY DELINEATION FOR PILOT AREAS

3.1. OVERALL APPROACH

The 4,052 PWS entities are broken down into 3 categories and 8 subsets based on their relationship (or lack thereof) with the District or CCN boundary and CCN facility lines as shown in Table 1-2.

The workflow for the delineation of the SABs consisted of the following steps:

- i. Send a letter on behalf of the Texas Water Development Board (TWDB) to the 1,750 PWS entities from Categories 2 and 3 requesting information about their SABs. The SABs for Category 1 PWS entities will be based on an existing District, CCN, or facility boundaries and, therefore, no letters were sent to those entities. A sample template of this letter is included in Appendix D.
- ii. Starting with Category 1, perform a reasonability check for the delineated SABs for Subsets 1a, 1b, and 1c based on the best available supplemental datasets such as District boundaries, CCN boundaries, CCN facility lines, city boundaries, census blocks and associated population, and/or water supply wells in the TWDB database. Such checks include a comparison of the population served by the PWS (source: SYSMSTR table) with the population of the delineated SAB based on the underlying Census Block Group from year 2000 (best available data). An additional check could be to identify water supply wells (if any) and consider their general spatial distribution relative to the delineated SAB.
- iii. Build on the processes thus established and adapt them to delineate the SABs for Categories 2 and 3.

- iv. Test the above established workflow on the six different problem areas identified by TWDB and provided to HDR during the July 22, 2010 meeting.
- v. Modify the workflow and the geodatabase design as needed.

3.2. SAB DELINEATION WORKFLOW

The following sections provide a step by step explanation of the logic/workflow for the SAB delineation process. Appendix E provides a graphical representation of these processes in the form of a comprehensive flowchart depicting all the steps outlined in the following sections.

3.2.1. CATEGORY 1

3.2.1.1. Subset 1a (1 PWS :: 1 District)

An initial Subset 1a feature class (FC or layer) was created by joining the District boundary FC (DISTRICTBND) with the Subset 1a table based on PWS_ID. Subsequent reasonability checks were systematically performed on this initial dataset as follows:

- i. Attribute CCN Overlaps: Checked for overlaps with CCN boundaries (CCNBND) and facility lines (CCNFAC) and updated attribute table.
- ii. Population Check: Performed a visual reasonability check of the geographic area relative to the population served by the PWS entity (A2RETP field from SYSMSTR table).
- iii. TWDB Wells Check: As necessary, checked to see the presence (or absence) of any wells associated with the PWS entity (same name), in the TWDB well database.
 - a. If wells were present:
 - i. Created a 1 mile buffer representing the PWS SAB around all of the wells combined.
 - ii. Performed CCN overlap check and update attribute table.
 - iii. Checked PWS population served with the underlying population from the census block(s).
 - b. If wells are absent:
 - i. The existing PWS boundary was retained and flagged for further verification. If not verifiable, it was appropriately commented for modification by TWDB at a later date.
- iv. CCN Overlap Check: In case of any overlaps between the PWS SAB and CCNBND and/or CCNFAC, the SAB was modified to conform to the CCN boundary since a CCN is legally defined. For CCNFAC, a 200 foot buffer around the facility line was created as being representative of the area served.

- v. District Overlap Check: Any overlaps among the District boundaries were flagged, but not modified, since Districts are legally defined entities and assumed to be spatially accurate.

3.2.1.2. Subset 1b (1 PWS :: 1 CCN Boundary)

An initial Subset 1b FC was created by joining the CCN boundary FC with the Subset 1b table based on PWS_ID. Subsequent reasonability checks were systematically performed on this initial dataset as follows:

- i. Checked for overlaps with CCNBND and CCNFAC. For CCNFAC, create a 200 foot buffer around the facility line as being representative of the area being served.
- ii. In case of SAB overlap with either a CCNBND OR a CCNFAC:
 - a. If the CCN_ID of SAB is the same as that of the overlapping CCNBND (or CCNFAC), then modified the SAB by combining it with the overlapping CCNBND (or CCNFAC).
 - b. If the CCN_ID of SAB is different than that of the overlapping CCNBND (or CCNFAC), then modified the SAB by excluding the overlapping CCNBND (or CCNFAC).
- iii. In case of SAB overlap with both CCNBND AND CCNFAC:
 - a. If the CCN_IDs of the overlapping CCNBND and CCNFAC are the same, then combined the two boundaries into one.
 - b. If the CCN_ID of SAB is the same as that of the above combined CCNBND, then modified the SAB by combining it with the overlapping CCNBND.
 - c. If the CCN_ID of SAB is different than that of the above combined CCNBND, then modified the SAB by excluding the overlapping CCNBND.

3.2.1.3. Subset 1c (1 PWS :: 1 CCN Facility)

An initial Subset 1c FC was created by joining the CCN boundary FC with Subset 1c table based on PWS_ID. Subsequent reasonability checks will be systematically performed on this initial dataset as follows:

- i. Checked for overlaps with CCNBND and CCNFAC. For CCNFAC, created a 200 foot buffer around the facility line as being representative of the area being served.
- ii. In case of SAB overlap with either a CCNBND OR a CCNFAC:
 - a. If the CCN_ID of SAB is the same as that of the overlapping CCNBND (or CCNFAC), then modified the SAB by combining it with the overlapping CCNBND (or CCNFAC).

- b. If the CCN_ID of SAB is different than that of the overlapping CCNBND (or CCNFAC), then modified the SAB by excluding the overlapping CCNBND (or CCNFAC).
 - iii. In case of SAB overlap with both CCNBND AND CCNFAC:
 - a. If the CCN_IDs of the overlapping CCNBND and CCNFAC are the same, then combined the two boundaries into one.
 - b. If the CCN_ID of the SAB is the same as that of the above combined CCNBND, then modified the SAB by combining it with the overlapping CCNBND.
 - c. If the CCN_ID of the SAB is different than that of the above combined CCNBND, then modified the SAB by excluding the overlapping CCNBND.
 - iv. Performed a final check on all Category 1 PWS SABs for any overlapping SABs and modified as needed.

3.2.2. CATEGORY 2

3.2.2.1. Subset 2a (Multiple PWS :: 1 District)

- i. Several PWS entities in the SYSMSTR table have the same contact person. We have prioritized these information requests and followed up with these entities to maximize the number of SAB delineations.
- ii. Checked if the PWS has responded to the letter mailed out on behalf of the TWDB with a definition of the SAB:
 - a. If yes:
 - i. Created the PWS SAB using the information received.
 - ii. Repeated CCN Overlap Check (Step 4) from Subset 1a.
 - b. If not:
 - i. Determined approximate location of the PWS SAB using the following information is available.
 - Contact information (name, mailing address and/or county), ESRI Gazetteer, Tele Atlas address search, Google Maps.
 - County Subdivision Data.
 - Repeated CCN Overlap Check (Step 4) from Subset 1a.
 - c. In the absence of any of the above supplemental information, created a temporary place holder SAB, flagged appropriately for future verification by TWDB.

3.2.2.2. Subset 2b (Multiple PWS :: 1 CCN Boundary)

- i. Several PWS entities in the SYSMSTR table have the same contact person. Therefore, we have prioritized these information requests and follow up with these entities to maximize the number of SAB delineations.
- ii. Checked if the PWS has responded to the letter mailed out on behalf of TWDB with a definition of the SAB:
 - a. If yes:
 - i. Created the PWS SAB using the information received.
 - ii. Repeated CCN Overlap Check (Step 4) from Subset 1a.
 - b. If not:
 - i. Determined approximate location of the PWS SAB using the following information as available:
 - Contact information (name, mailing address and/or county), ESRI Gazetteer, Tele Atlas address search, Google Maps.
 - County subdivision data.
 - ii. Repeated CCN Overlap Check (Step 4) from Subset 1a.
- iii. In the absence of any of the above supplemental information, created a temporary place holder SAB, flagged appropriately for future verification by TWDB.

3.2.2.3. Subset 2c (Multiple PWS :: 1 CCN Facility)

- i. Several PWS entities in the SYSMSTR table have the same contact person. Therefore, we have prioritized these information requests and follow up with these entities to maximize the number of SAB delineations.
- ii. Checked if the PWS has responded to the letter mailed out on behalf of TWDB with a definition of the SAB:
 - a. If yes:
 - i. Created the PWS SAB using the information received.
 - ii. Repeated CCN Overlap Check (Step 4) from Subset 1a.
 - b. If not:
 - i. Determined approximate location of the PWS SAB using the following information as available:
 - Contact information (name, mailing address and/or county), ESRI Gazetteer, Tele Atlas address search, Google Maps.
 - County subdivision data.
 - ii. Repeated CCN Overlap Check (Step 4) from Subset 1a.
 - c. In the absence of any of the above supplemental information, created a temporary place holder SAB, flagged appropriately for future verification by TWDB.

- iii. Performed a final check for overlaps among the delineated SABs and resolve.

3.2.3. CATEGORY 3

3.2.3.1. Subset 3a (No District — No CCNs)

- i. Several PWS entities in the SYSMSTR table have the same contact person. Therefore, we have prioritized these information requests and follow up with these entities to maximize the number of SAB delineations.
- ii. Checked if the PWS has responded to the letter mailed out on behalf of TWDB with a definition of the SAB:
 - a. If yes:
 - i. Created the PWS SAB using the information received.
 - ii. Repeated CCN Overlap Check (Step 4) from Subset 1a.
 - b. If not:
 - i. Determined approximate location of the PWS SAB using the following information as available:
 - Contact information (name, mailing address and/or county), ESRI Gazetteer, Tele Atlas, address search, Google Maps.
 - County subdivision data.
 - ii. Repeated CCN Overlap Check (Step 4) from Subset 1a.
 - iii. In the absence of any of the above supplemental information, created a temporary place holder SAB, flagged appropriately for future verification by TWDB.

3.2.3.2. Subset 3b (1 PWS :: 1 CCN; CCN Boundary Not Available)

- i. Several PWS entities in the SYSMSTR table have the same contact person. Therefore, we have prioritized these information requests and follow up with these entities to maximize the number of SAB delineations.
- ii. Checked if the PWS has responded to the letter mailed out on behalf of TWDB with a definition of the SAB:
 - a. If yes:
 - i. Created the PWS SAB using the information received.
 - ii. Repeated CCN Overlap Check (Step 4) from Subset 1a.
 - b. If not:
 - i. Determined approximate location of the PWS SAB using the following information as available:

- Contact information (name, mailing address and/or county), ESRI Gazetteer, Tele Atlas address search, Google Maps.
 - County subdivision data.
- c. Repeated CCN Overlap Check (Step 4) from Subset 1a.
- iii. In the absence of any of the above supplemental information, created a temporary place holder SAB, flagged appropriately for future verification by TWDB.

Once PWS SABs for all the categories were delineated, a final topology check was performed to flag any overlapping boundaries. This step serves as an additional quality control measure.

3.3. PILOT AREA DELINEATIONS

At the July 22, 2010 meeting, TWDB provided HDR with specific examples of what were thought to be complicated areas for resolving the PWS SABs. The workflow described in Section 3 addresses these issues. However, it should be noted that the workflow does not necessarily encompass all potential issues related to SAB delineation and there could be several other unique situations that might arise during subsequent tasks that are not covered in this technical memorandum. Changes to the workflow and, therefore, the geodatabase design will be made as needed and documented accordingly.

Pilot Area #1

- PWS: Lubbock County WCID 1
- Subset: 1a
- County: Lubbock County
- Issue: District boundary much larger than the Service Area
- SAB delineation workflow: See Section 2.1.1 (Subset 1a: 1 PWS :: 1 District)

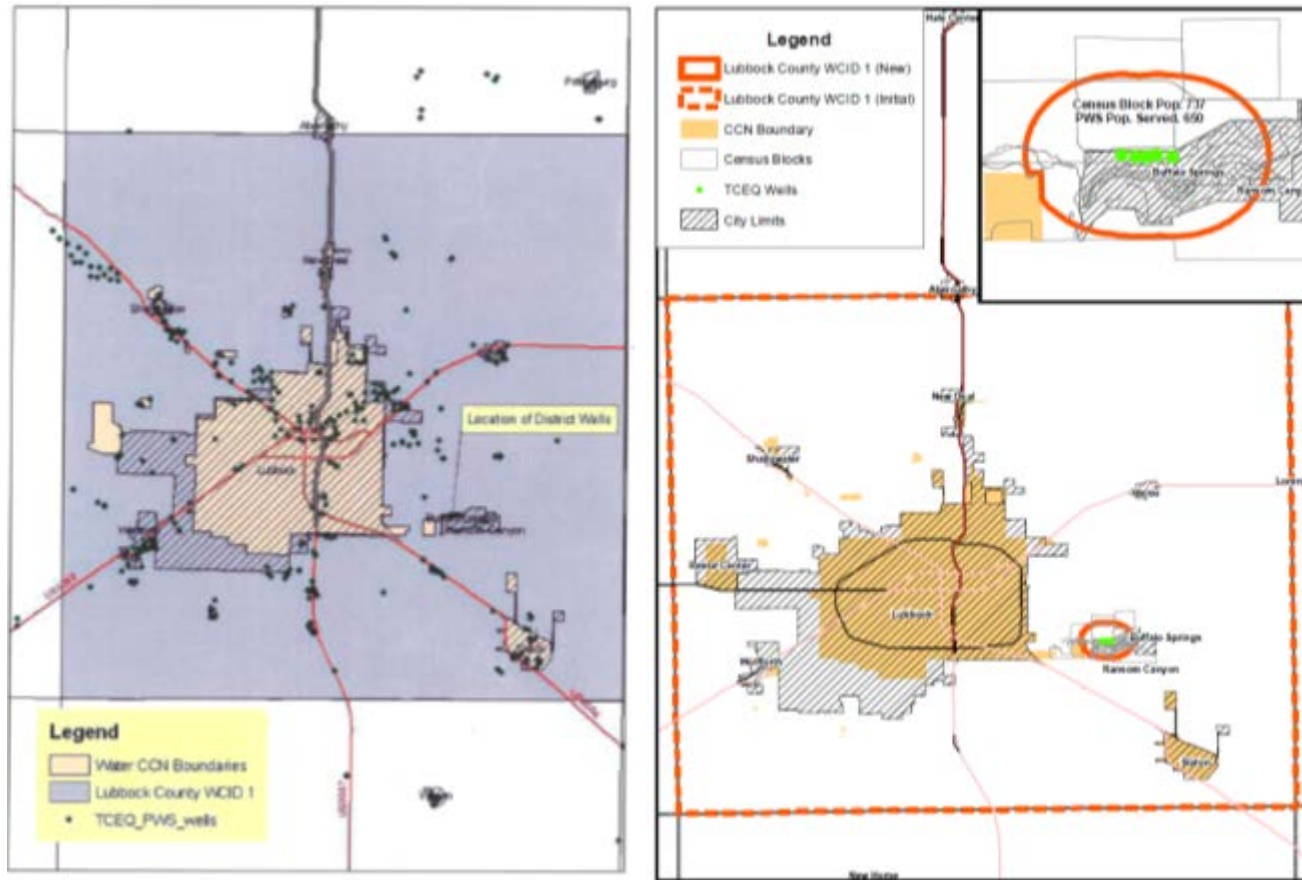


Figure 3-1. SAB Delineation for Pilot Area #1

Pilot Area #2

- PWS: Dogwood Hills East and Dogwood Hills North
- Subset: 2b
- County: Anderson
- Issue: Multiple PWS :: 1 CCN Boundary
- SAB delineation workflow: See Section 2.2.2 (Subset 2b: Multiple PWS :: 1 CCN Boundary)

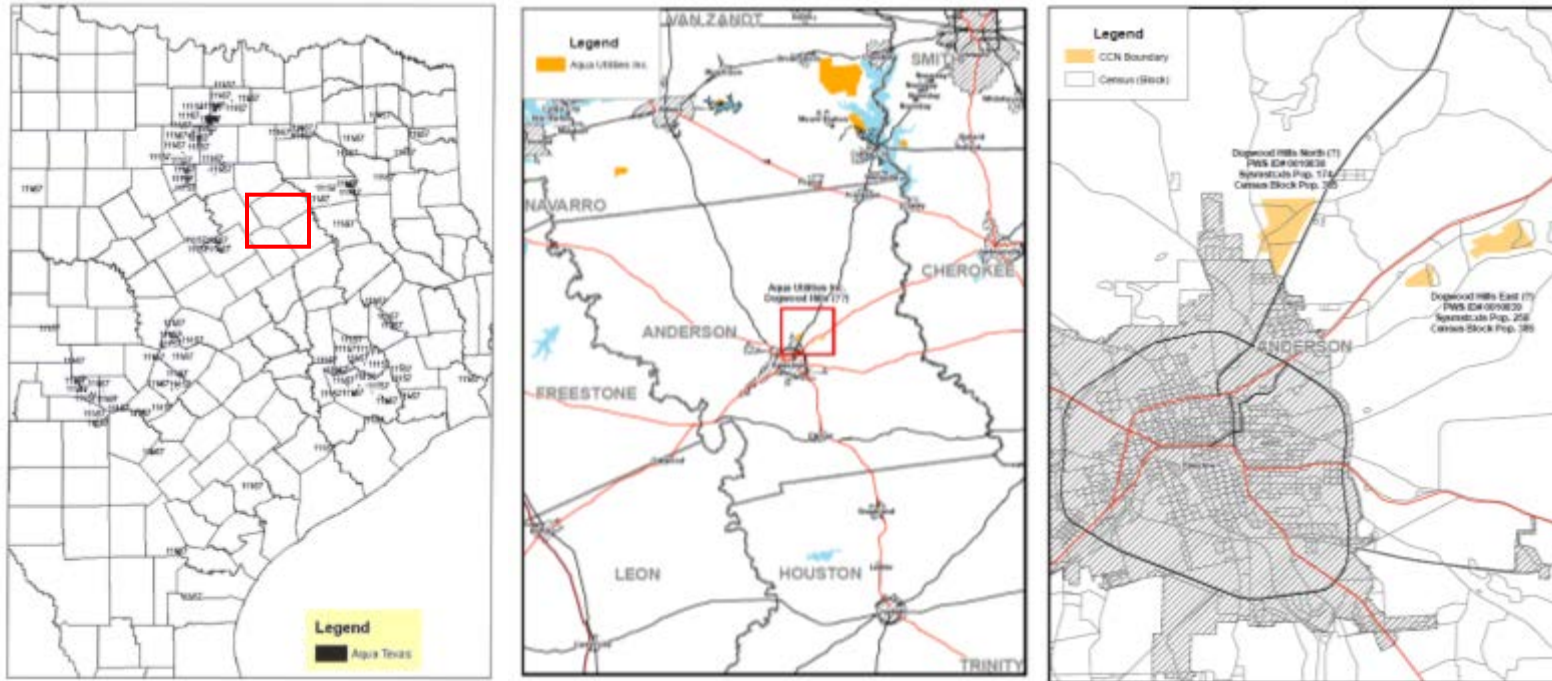


Figure 3-2. SAB Delineation for Pilot Area #2

Pilot Area #3

- PWS: Bell Milam Falls WSC
- Subset: 2c
- County: Bell, Falls, Milam, Williamson
- Issue: Multiple PWS :: 1 CCN Facility
- SAB delineation workflow: See Section 2.2.3 (Subset 2c: Multiple PWS :: 1 CCN Facility)

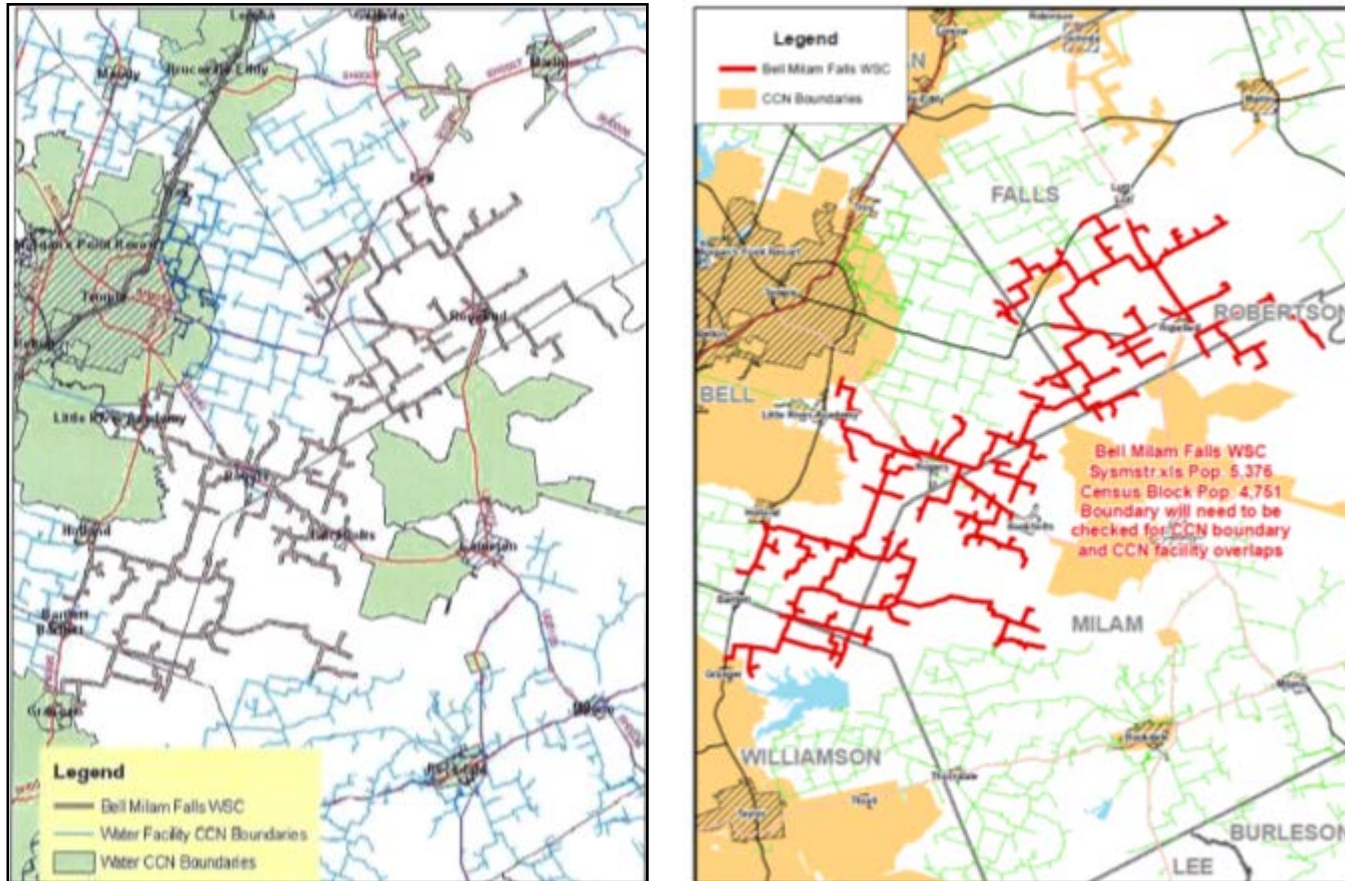


Figure 3-3. SAB Delineation for Pilot Area #3

Pilot Area #4

- PWS: City of Austin
- Subset: 1b
- County: Travis
- Issue: SAB a combination of city limit and CCN boundary/facility.
- SAB delineation workflow:
 - See Section 2.1.2 (Subset 1b: 1 PWS :: 1 CCN Boundary)
 - If no response, merge the city boundary with CCN boundary/facility to form the SAB.
 - Repeat steps for Subset 1a (Section 2.1.1)

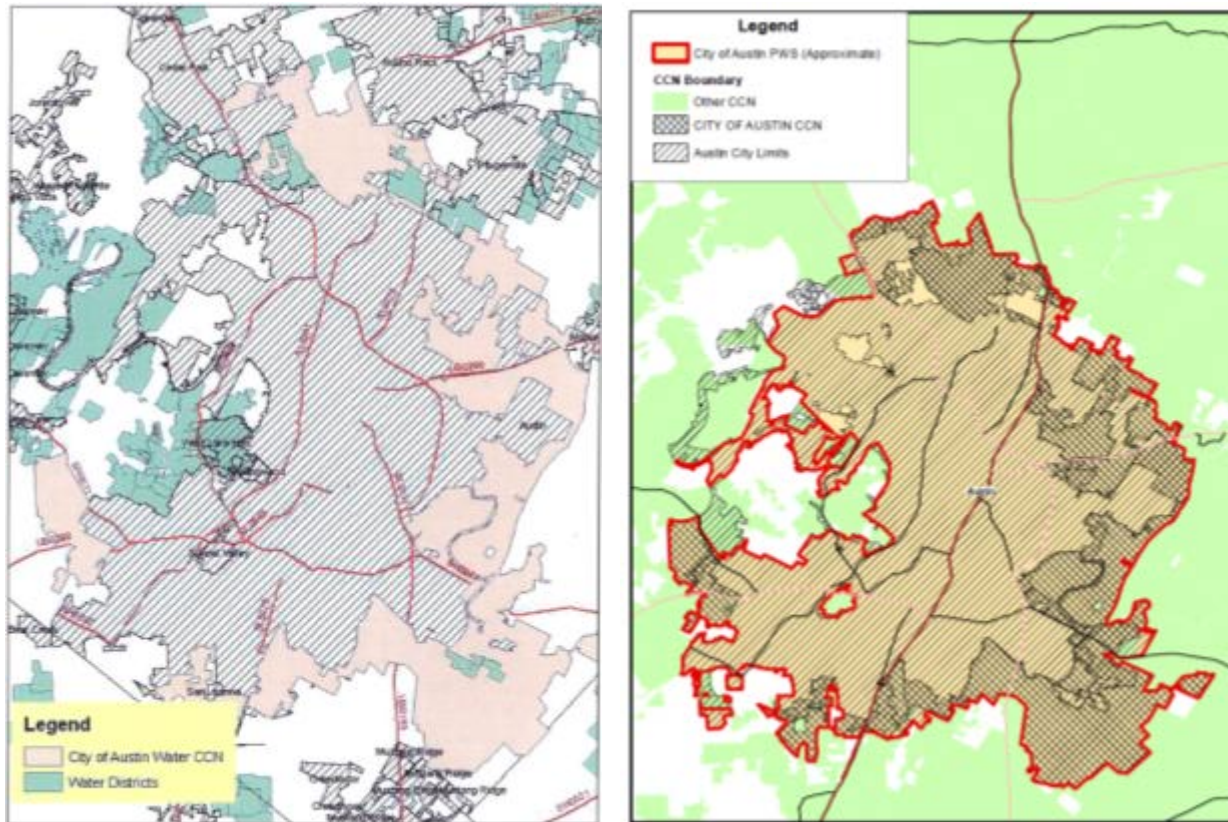


Figure 3-4. SAB Delineation for Pilot Area #4

Pilot Area #5

- PWS: Bexar Metropolitan Water District.
- Subset: Combination of 2a, 2b and 2c.
- County: Bexar
- Issue: Multiple PWSs in Multiple CCN and with CCN beyond city limits.
- SAB delineation workflow:
 - See Section 2.2.1 (Subset 2a: Multiple PWS :: 1 CCN Boundary).
 - If no response, merge the city boundary with CCN boundary/facility to form the SAB.
 - Repeat steps for Subset 1a (Section 2.1.1).



Figure 3-5. SAB Delineation for Pilot Area #5

4. SERVICE AREA BOUNDARY DELINEATION FOR CATEGORY 1

Service area boundaries (SABs) for the 2,266 Public Water Supply (PWS) entities that constitute Category 1 (Table 1-2) were delineated first. This category consists of three subsets – 1a, 1b, and 1c representing those PWS entities that have a one to one relationship with a District, or a CCN Boundary, or a CCN Facility.

SABs belonging to each subset were delineated independently of each other using the procedures described in *Section 3.2.1.1 Subset 1a (1 PWS :: 1 District)*. The three separate feature classes for subsets 1a, 1b, and 1c were merged into a single interim geodatabase and a final topology check was performed to identify and flag any overlaps among Subsets 1a, 1b, and 1c for further verification.

5. SERVICE AREA BOUNDARY DELINEATION FOR CATEGORIES 2 and 3

Categories 2 and 3 (Table 1-2) constitute a total of 1,782 Public Water Supply (PWS) entities.

Category 2 consists of three subsets – 2a, 2b, and 2c representing those PWS entities that have a multiple to one relationship with a District, or a CCN Boundary, or a CCN Facility, respectively. Category 3 consists of two subsets – 3a, representing those PWS entities that have no relationship to a District, or a CCN Boundary, or a CCN Facility; and 3b representing those PWS entities that have a CCN_ID, but no corresponding boundary in the shapefile. SABs belonging to each subset were delineated independently of each other and combined into a single geodatabase feature class after all the boundaries were delineated and/or accounted for.

5.1. PWS INFORMATION REQUEST / RESPONSE

On November 3rd, 2010, letters (Appendix D) were mailed out to the 1,750 PWS contacts in Categories 2 and 3 requesting information regarding their SABs.

A total of 1,156 responses were received of which:

- 1,152 were considered “complete” i.e, sufficient information provided for SAB delineation.
- 4 entities no longer exist.
- 594 entities did not respond.

The level of detail in these responses varies with some entities providing the actual outline of their boundaries and other entities providing points depicting the general location of their service areas. Based on the available information, procedures outlined Section 3 were followed when delineating the SABs for these entities. Appropriate comments are provided in the attribute table for the PWS boundary serving as the metadata for each entity. The responses are organized in a folder structure including the PWS_ID for easy identification and retrieval.

Table 5-1 shows a summary of the final status of SAB responses received. In cases where no additional information is available, a standard place holder polygon was used for easy identification and flagging.

**Table 5-1
Overall PWS Response Summary**

Response Status	# Entities
Complete	1152
No Response	594
No longer Exists	4
TOTAL	1,750

Table 5-2 shows a breakdown of responses by subsets within each category.

**Table 5-2
Breakdown of PWS Responses by Subset**

Category	Subset	Status	#Entities
2	2a	Complete	61
		No Response	15
	2b	Complete	787
		No Response	276
		No Longer Exists	4
	2c	Complete	6
No Response		8	
3	3a	Complete	107
		No Response	118
	3b	Complete	191
		No Response	177
TOTAL			1750

5.2. PWS SAB DELINEATION SUMMARY

In categories 1, 2, and 3 combined, 64 of the 4,048 PWS entities have been left as place holders due to the lack of information for these entities. The remaining 3,984 PWS entities have a SAB delineated using the best information available at this time in accordance with the procedures described in Section 3. The metadata for the geodatabase PWSBND FC provides detailed descriptions of the attributes and how they were used in the SAB delineation process.

5.3. SAB VALIDITY CHECKS

The 3,984 SABs not flagged as placeholders were checked for their validity and reasonableness by performing PWS SAB overlap and population checks. General procedures for these checks are described in the following sub-sections.

5.3.1. PWS SAB Overlap Checks

As noted in the previous sections, some PWS entities overlap with each other because boundaries were provided by the PWS entities or derived from CCN (legal) boundaries that overlap with each other. In accordance with the procedures described in Section 3, such overlapping SABs were considered “legitimate” and were left as is. With the goal of the TWDB being the estimation of census population within each PWS SAB, such overlapping boundaries would result in the double counting of population when overlaid with census boundaries. An overlap check was performed by creating and validating the topology for the SABs to flag all the overlapping areas within the entire dataset and resolve those overlaps by using a set of criteria provided by the TWDB and procedures devised by HDR as described below:

A total of 1,392 overlaps were flagged as a result of the topology check. These overlaps were exported to a separate FC (PWS_Overlaps) for further analysis. Each overlap area identifies two overlapping SABs. Each overlap area was arranged as a combination of PWS1, Area1, Source1, PWS2, Area2, Source2, where in PWS 1, Area 1 and Source 1 define the PWS_ID, PWS Area and the source for one of the two overlapping SABs and PWS 2, Area 2 and Source 2 define the same for the other overlapping SAB. An area threshold of 10 acres was applied to categorize the overlapping areas as follows.

5.3.1.1. Overlaps less than 10 acres

150 of the 1,392 overlaps fell in this category. These overlap areas were allocated to the smaller of the two overlapping SABs by clipping the overlap area out of the larger SAB and leaving the smaller SAB as is.

5.3.1.2. Overlaps greater than or equal to 10 acres

1,242 overlaps fall in this category. These overlaps were categorized into Criteria 1, Criteria 2a, Criteria 2b and Criteria 2c based on a comparison of PWS source, PWS area and overlap area as shown in table 5-3 below.

Table 5-3
SAB Overlap Resolution Criteria

Criteria	Description	Resolution	Action
1	Both SABs derived from a CCNBND and/or CCNFAC (CCN vs CCN)	No changes; retain the overlap	None
2a	Overlap area <i>smaller</i> than 25% of both the individual SAB areas	Assign the overlap to the <i>smaller</i> SAB	Clip the overlap area out of the <i>larger</i> SAB
2b	Overlap area <i>larger</i> than 25% of one SAB AND smaller than 25% of the other SAB	Assign the overlap to the SAB with <i>larger</i> than 25% of its area being overlapped	Clip the overlap area out of the SAB with <i>smaller</i> than 25% of its area being overlapped
2c	Overlap area <i>greater</i> than 25% of both the individual areas	No changes; retain the overlap	None

The retained overlaps from Criteria 1 and 2c were combined into a separate overlap feature class (PWS_Overlaps) and updated with the 2010 census population for TWDB's future reference and further resolution.

5.3.2. Population Checks

The SYSMSTR table provides the total population served (A2RETP) by the PWS. The PWS SABs were overlaid with the Census 2010 data. The sum of the individual fractions of the underlying population was calculated, based on the area of intersection with the SAB, and assigned as the total population for the SAB. The absolute difference and the percent difference between the population served and the Census population were then calculated and sorted in order to flag those SABs with large differences in one or both of the population measures.

In accordance with guidance received from the TWDB, the population checks focused on a smaller subset of the delineated SABs that are associated with large community systems and meet the following criteria:

- i) Difference between PWS population served and census population greater than 100 %.
- ii) Absolute population difference > 10,000

43 SABs met all of these criteria and have been flagged in the geodatabase for further verification and refinement.

6. CONCLUSION

Of the 4,048 PWS SABs delineated, 3,178 (PWS_CLARIFICATION = "NOT REQUIRED") are considered to be final. The remaining 870 PWS SABs will need further verification and/or refinement.

APPENDIX – A

Activity Status Type List

A ACTIVE
C CCN CANCELLED
D DELETED/DISSOLVED
I INACTIVE
M MERGED/ANNEXED
N NON-PUBLIC
P PROPOSED
R RECEIVER / TEMPORARYMANAGER
T TRACKING
U UNKNOWN
W UTILITY WATER SYS EXFER
X MISC/UNKNOWN

OWNERSHIP TYPE LIST

A AFFECTED COUNTIES
C COUNTY
D DISTRICT/AUTHORITY
E EXEMPT
F FEDERAL GOVERNMENT
I INVESTOR
M MUNICIPALITY
N NATIVE AMERICAN
P PRIVATE
R SUBMETER /ALLOCATION
S STATE GOVERNMENT
U NOT RETAIL PUBLIC UTILITIES
W WATER SUPPLY CORPORATION
X MISC/UNKNOWN

SYSTEM TYPE LIST

C COMMUNITY
CNG COMMUNITY (NON-GOVERNMENT OWNED)
NC TRANSIENT/NON-COMMUNITY
NP NON-PUBLIC
NTNC NON-TRANSIENT/NON-COMMUNITY

Customer Type List

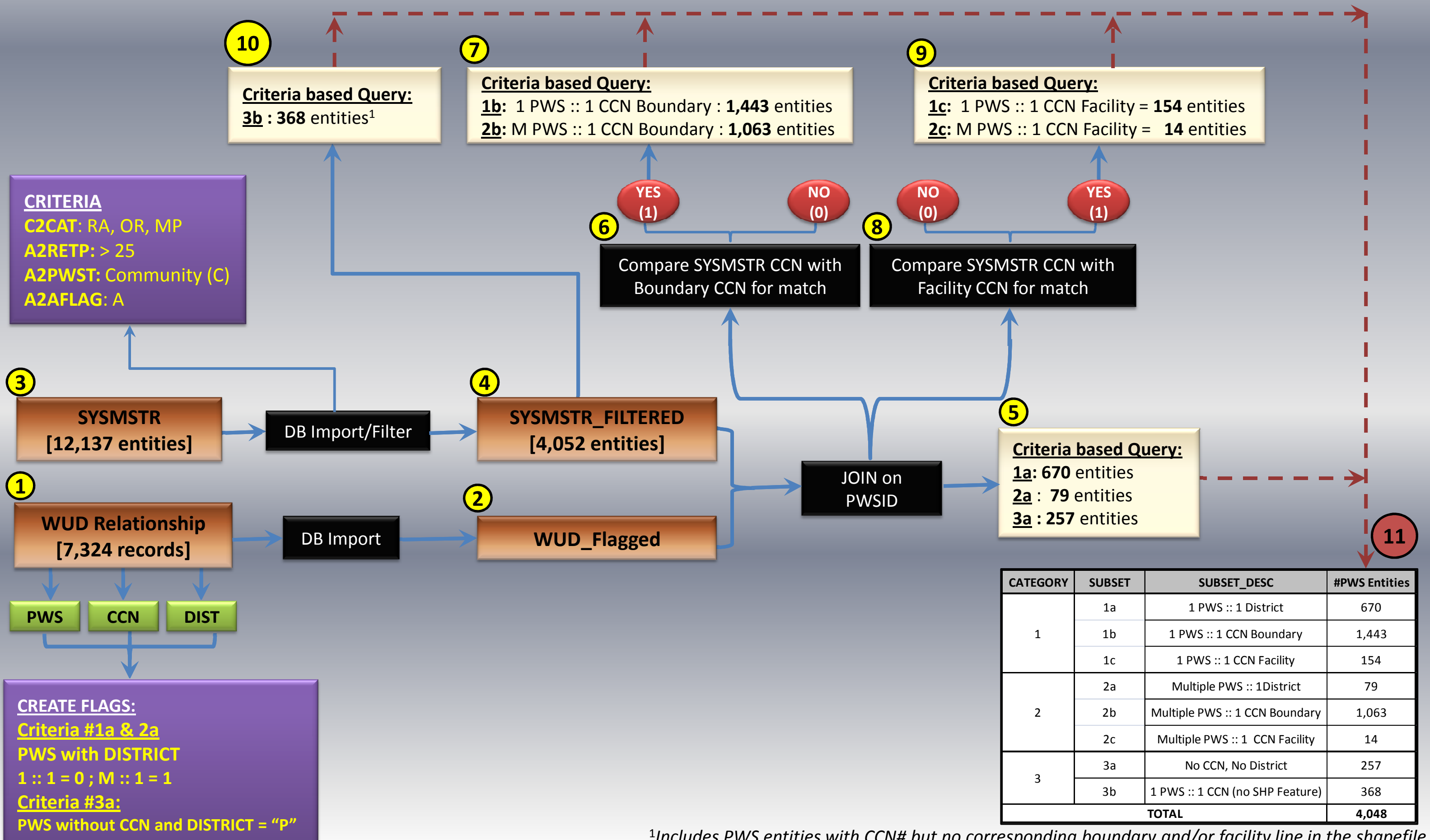
<u>Class</u>	<u>Category</u>		
NT	NON-TRANSIENT	DC	DAY CARE CENTER
NT	NON-TRANSIENT	HM	HOTEL/MOTEL
NT	NON-TRANSIENT	HR	HIGHWAY REST AREA
NT	NON-TRANSIENT	IA	INDUSTRIAL/AGRICULTURAL
NT	NON-TRANSIENT	IC	INTERSTATE CARRIER
NT	NON-TRANSIENT	IN	INSTITUTION
NT	NON-TRANSIENT	MF	MEDICAL FACILITY
NT	NON-TRANSIENT	MH	MOBILE HOME PARK
NT	NON-TRANSIENT	OA	OTHER AREA
NT	NON-TRANSIENT	ON	OTHER NON-TRANSIENTAREA
NT	NON-TRANSIENT	OR	OTHER RESIDENTIAL AREA
NT	NON-TRANSIENT	OT	OTHER TRANSIENT AREA
NT	NON-TRANSIENT	PA	RECREATION AREA
NT	NON-TRANSIENT	RA	RESIDENTIAL AREA
NT	NON-TRANSIENT	RS	RESTAURANT
NT	NON-TRANSIENT	SC	SCHOOL
NT	NON-TRANSIENT	SK	SUMMER CAMP
NT	NON-TRANSIENT	WA	WATER HAULER
NT	NON-TRANSIENT	WH	WHOLESALE (TREATED WATER)
NT	NON-TRANSIENT	WR	WHOLESALE (UNTREATED WATER)
O	OTHER	IC	INTERSTATE CARRIER
O	OTHER	OA	OTHER AREA
O	OTHER	WB	WATER BOTTLER
O	OTHER	WH	WHOLESALE (TREATED WATER)
R	RESIDENTIAL	DC	DAY CARE CENTER
R	RESIDENTIAL	HM	HOTEL/MOTEL
R	RESIDENTIAL	IA	INDUSTRIAL/AGRICULTURAL
R	RESIDENTIAL	IC	INTERSTATE CARRIER
R	RESIDENTIAL	IN	INSTITUTION
R	RESIDENTIAL	MF	MEDICAL FACILITY
R	RESIDENTIAL	MH	MOBILE HOME PARK
R	RESIDENTIAL	MP	MOBILE HOME PARK (PRINCIPAL RESIDENCE)
R	RESIDENTIAL	OA	OTHER AREA
R	RESIDENTIAL	ON	OTHER NON-TRANSIENTAREA
R	RESIDENTIAL	OR	OTHER RESIDENTIAL AREA
R	RESIDENTIAL	OT	OTHER TRANSIENT AREA
R	RESIDENTIAL	PA	RECREATION AREA
R	RESIDENTIAL	RA	RESIDENTIAL AREA
R	RESIDENTIAL	RS	RESTAURANT
R	RESIDENTIAL	SC	SCHOOL
R	RESIDENTIAL	SS	SERVICE STATION
R	RESIDENTIAL	WA	WATER HAULER
R	RESIDENTIAL	WH	WHOLESALE (TREATED WATER)
R	RESIDENTIAL	WR	WHOLESALE (RAW WATER)
T	TRANSIENT	DC	DAY CARE CENTER
T	TRANSIENT	HM	HOTEL/MOTEL
T	TRANSIENT	HR	HIGHWAY REST AREA
T	TRANSIENT	IA	INDUSTRIAL/AGRICULTURAL
T	TRANSIENT	IN	INSTITUTION
T	TRANSIENT	MF	MEDICAL FACILITY
T	TRANSIENT	MH	MOBILE HOME PARK
T	TRANSIENT	OA	OTHER AREA
T	TRANSIENT	ON	OTHER NON-TRANSIENTAREA
T	TRANSIENT	OR	OTHER RESIDENTIAL AREA
T	TRANSIENT	OT	OTHER TRANSIENT AREA
T	TRANSIENT	PA	RECREATION AREA
T	TRANSIENT	RA	RESIDENTIAL AREA
T	TRANSIENT	RC	RESTAURANT/CONVENIENCE STORE
T	TRANSIENT	RS	RESTAURANT
T	TRANSIENT	SC	SCHOOL

Customer Type List

<u>Class</u>		<u>Category</u>	
T	TRANSIENT	SK	SUMMER CAMP
T	TRANSIENT	SS	SERVICE STATION
T	TRANSIENT	WA	WATER HAULER
T	TRANSIENT	WB	BOTTLED WHOLESALER OR DISPENSER
T	TRANSIENT	WH	WHOLESALER (TREATED WATER)

APPENDIX - B

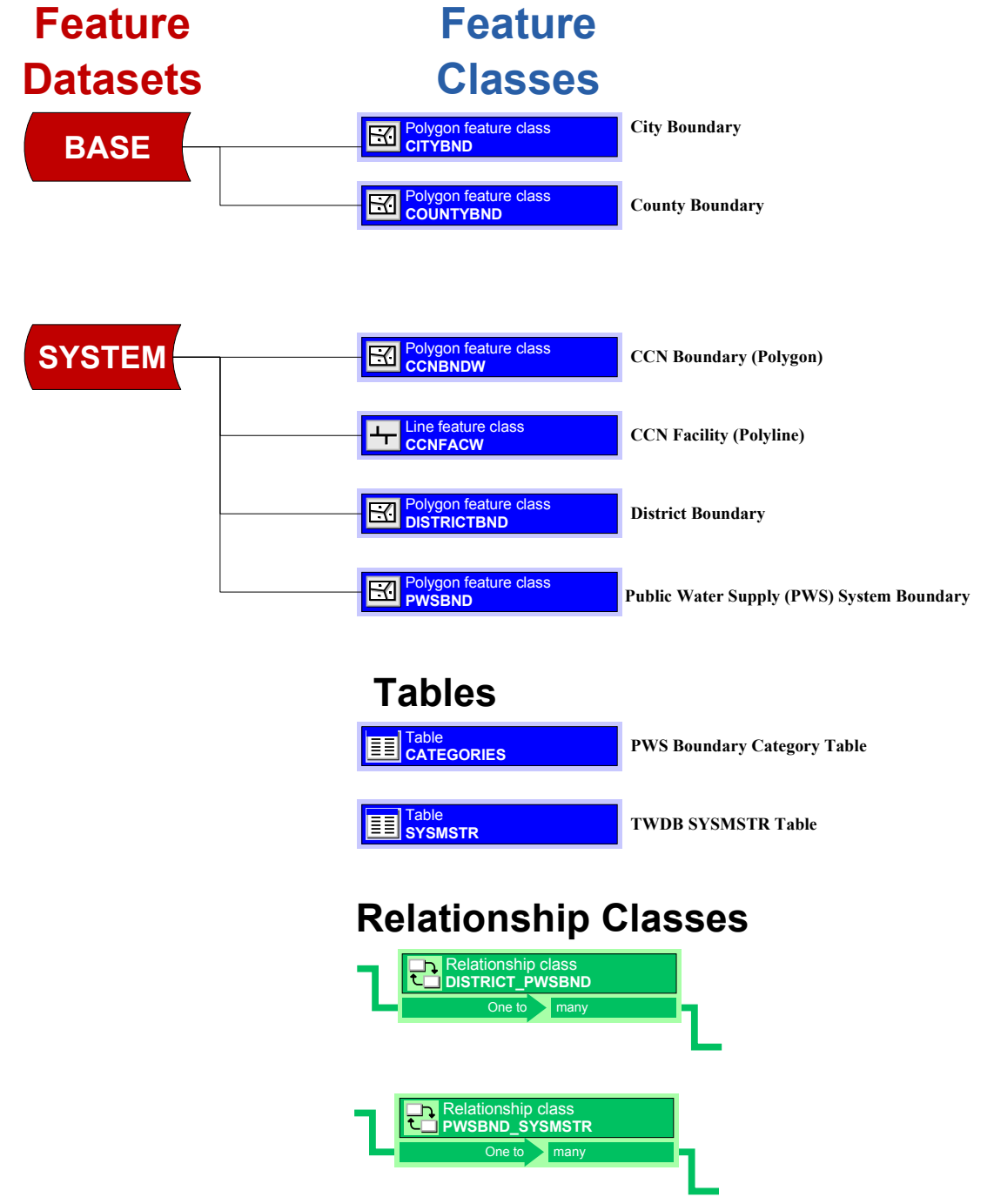
TEXAS WATER SYSTEM MAP - DATA COMPILATION AND ANALYSIS PROCESS



APPENDIX – C

TEXAS WATER SYSTEM MAP CONCEPTUAL GEODATABASE SCHEMA SCHEMAS

GEODATABASE OBJECT LISTING



Simple feature class CITYBND
Geometry: Polygon
Contains M values: No
Contains Z values: No

Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length
OBJECTID	Object ID						
Shape	Geometry	Yes					
SOURCE	String	Yes			20		
NAME	String	Yes			30		
PUBLISH_DATE	Date	Yes			8	0	0
SOURCE_LEV	String	Yes			100		
GLASS	String	Yes			15		
AREASQMI	Double	Yes			0	0	0
Shape_Length	Double	Yes			0	0	0
Shape_Area	Double	Yes			0	0	0

2010 Census City Boundary
(Using 2000 Census as placeholder for now)

Simple feature class COUNTYBND
Geometry: Polygon
Contains M values: No
Contains Z values: No

Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length
OBJECTID	Object ID						
Shape	Geometry	Yes					
SOURCE	String	Yes			20		
NAME	String	Yes			50		
STRATMAP_ID	String	Yes			10		
LOCAL_ID	String	Yes			10		
FIPS	String	Yes			10		
TXDOT_ABBR	String	Yes			10		
COG_ABBR	String	Yes			8		
DATE_CREATED	Date	Yes			8	0	0
DATE_MODIFIED	Date	Yes			8	0	0
DATE_RETIRED	Date	Yes			8	0	0
AREASQMI	Double	Yes			0	0	0
Shape_Length	Double	Yes			0	0	0
Shape_Area	Double	Yes			0	0	0

County Boundary

Simple feature class DISTRICTBND
Geometry: Polygon
Contains M values: No
Contains Z values: No

Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length
OBJECTID	Object ID						
Shape	Geometry	Yes					
DISTRICT_ID	String	Yes			20		
NAME	String	Yes			100		
TYPE	String	Yes		dDISTRICT_TYPE	30		
TX_COUNTY	String	Yes			100		
FIPS	String	Yes			10		
AREASQMI	Double	Yes			0	0	0
Shape_Length	Double	Yes			0	0	0
Shape_Area	Double	Yes			0	0	0

District Boundary

Simple feature class CCNBNDW
Geometry: Polygon
Contains M values: No
Contains Z values: No

Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length
OBJECTID	Object ID						
Shape	Geometry	Yes					
CCN_TYPE	Short Integer	Yes			0		
CCN_ID	String	Yes			15		
UTILITY	String	Yes			100		
TX_COUNTY	String	Yes			30		
FIPS	String	Yes			10		
UPDATED	Date	Yes			8	0	0
APPROVED	String	Yes			10		
METHOD	String	Yes		dCCN_Method	10		
AREASQMI	Double	Yes			0	0	0
Shape_Length	Double	Yes			0	0	0
Shape_Area	Double	Yes			0	0	0

Water CCN Boundary (Polygon)

Simple feature class CCNFACW
Geometry: Polyline
Contains M values: No
Contains Z values: No

Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length
OBJECTID	Object ID						
Shape	Geometry	Yes					
CCN_TYPE	Short Integer	Yes			0		
CCN_ID	String	Yes			15		
UTILITY	String	Yes			100		
FACILITY	String	Yes			10		
TX_COUNTY	String	Yes			30		
FIPS	String	Yes			10		
UPDATED	Date	Yes			8	0	0
APPROVED	String	Yes			10		
METHOD	String	Yes		dCCN_Method	10		
AREASQMI	Double	Yes			0	0	0
Shape_Length	Double	Yes			0	0	0

Water CCN Facility (Polyline)

Simple feature class PWSBND
Geometry: Polygon
Contains M values: No
Contains Z values: No

Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length
OBJECTID	Object ID						
Shape	Geometry	Yes					
PWS_ID	String	Yes			25		
ATNAME	String	Yes			100		
CATEGORY	Short Integer	Yes			2		
DISTRICT_ID	String	Yes			20		
CCN_ID	String	Yes			25		
SOURCE	String	Yes			50		
DATE_CREATED	Date	Yes			8	0	0
DATE_MODIFIED	Date	Yes			8	0	0
COMMENT	String	Yes			200		
Shape_Length	Double	Yes			0	0	0
Shape_Area	Double	Yes			0	0	0

PWS Boundary

Table CATEGORIES

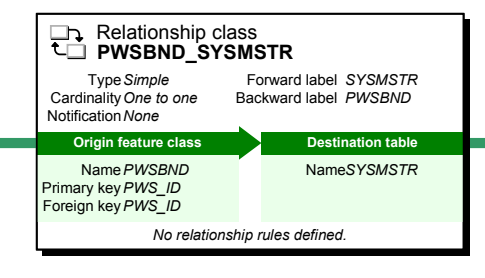
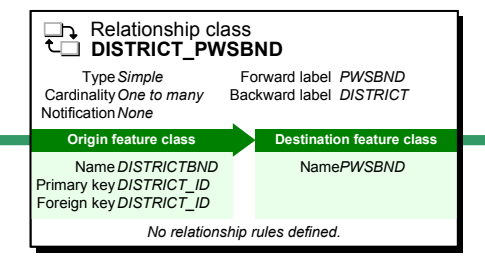
Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length
OBJECTID	Object ID						
CATEGORY	Short Integer	Yes			0		
SUBSET	String	Yes			2		
SUBSET_DESC	String	Yes			40		

PWS Category based on Task 1

Table SYSTMSTR

Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length
OBJECTID	Object ID						
PWS_ID	String	Yes			25		
DISTRICT_ID	String	Yes			20		
CCN_ID	String	Yes			25		
ATNAME	String	Yes			100		
A1ADDRSA	String	Yes			50		
A1ADDRSB	String	Yes			50		
A1CITY	String	Yes			30		
A1STATE	String	Yes			2		
A1ZIPCODE	String	Yes			10		
A3NAME	String	Yes			30		
TITLE	String	Yes			30		
A1TNUM	String	Yes			20		
A2OWMT	String	Yes			5		
C2FCAT	String	Yes		dDOWN_TYPE	3		
A2PWST	String	Yes			5		
A2RETP	Double	Yes			0	0	0
A2RETC	Double	Yes			0	0	0
METERS	Long Integer	Yes			0	0	0
INTERCONNECT	Long Integer	Yes			0	0	0
AVGTEMP	Double	Yes			0	0	0
TOTPROD	Double	Yes			0	0	0
ACC	Double	Yes			0	0	0
TOTSTORAGE	Double	Yes			0	0	0
ELSTORAGE	Double	Yes			0	0	0
BOOSTER	Double	Yes			0	0	0
AUXPROD	Double	Yes			0	0	0
PT	Double	Yes			0	0	0
INSPCODE	String	Yes			40		
DEP	String	Yes			5		
DISTRICT	Long Integer	Yes			0	0	0
A2AFLAG	String	Yes		dACTIVITY_STATUS_VCD	3		
SDATE	Date	Yes			8	0	0
TX_COUNTY	String	Yes			30		
UPDATE_DATE	Date	Yes			8	0	0
CATEGORY	Short Integer	Yes			0	0	0
SUBSET	String	Yes			2		
SUBSET_DESC	String	Yes			35		

TWDB SYSTMSTR Table



DOMAINS

Coded value domain dCUSTOMER_CLASS
Description: Customer Class for the PWS
Field type: entity
Split policy: String
Merge policy: String
Default value: String
Merge policy: String

Code	Description
NT	NON-TRANSIENT
R	RESIDENTIAL
T	TRANSIENT
O	OTHER
DC	DAY CARE CENTER
HM	HOTEL/MOTEL
HR	HIGHWAY REST AREA
IA	INDUSTRIAL/AGRICULTURAL
IC	INTERSTATE CARRIER
IN	INSTITUTION
MF	MEDICAL FACILITY
MH	MOBILE HOME PARK
MP	MOBILE HOME PARK (PRINCIPAL RESIDENCE)
OA	OTHER AREA
ON	OTHER NON-TRANSIENT AREA
OR	OTHER RESIDENTIAL AREA
OT	OTHER TRANSIENT AREA
PA	RECREATION AREA
RA	RESIDENTIAL AREA
RC	RESTAURANT/CONVENIENCE STORE
RS	RESTAURANT
SC	SCHOOL
SK	SUMMER CAMP
SS	SERVICE STATION
WA	WATER HAULER
WB	BOTTLED WHOLESALE OR DISPENSER
WH	WHOLESALE (TREATED WATER)
WU	WHOLESALE (UNTREATED WATER)
WR	WHOLESALE (RAW WATER)

Coded value domain dSYSTEM_TYPE
Description: Type of PWS system
Field type: String
Split policy: String
Merge policy: String
Default value: String

Code	Description
A	AFFECTED COUNTIES
C	COUNTY
D	DISTRICT/AUTHORITY
E	EXEMPT
F	FEDERAL GOVERNMENT
I	INVESTOR
M	MUNICIPALITY
N	NATIVE AMERICAN
P	PRIVATE
R	SUBSET/ALLOCATION
S	STATE GOVERNMENT
U	NOT RETAIL PUBLIC UTILITIES
W	WATER SUPPLY CORPORATION
X	MISUNKNOWN

Coded value domain dSYSTEM_TYPE
Description: Type of PWS system
Field type: String
Split policy: String
Merge policy: String
Default value: String

Code	Description
C	COMMUNITY
CO	COMMUNITY (NON-GOVERNMENT OWNED)
NC	NON-PUBLIC
NP	NON-PUBLIC
NTNC	NON-TRANSIENT/NON-COMMUNITY

Coded value domain dCCN_Method
Description: CCN Method
Field type: String
Split policy: String
Merge policy: String
Default value: String

Code	Description
D	DESC_ID
DD	DESC_ID
MB	DESC_MB
DD	DESC_DD

Coded value domain dDISTRICT_TYPE
Description: Type of District
Field type: String
Split policy: String
Merge policy: String
Default value: String

Code	Description
DD	Drainage District
FWSD	Fresh Water Supply District
ID	Irrigation District
LID	Levee Improvement District
MMD	Municipal Management District
MWD	Municipal Water District
ND	Navigational District
CDH	Choke District
RA	River Authority
RD	Regional District
SCD	Stormwater Control District
SUD	Special Utility District
SWCD	Stormwater Control District
WCID	Water Control & Improvement District
WID	Water Improvement District

Coded value domain dACTIVITY_STATUS_TYPE
Description: Activity Status of the PWS
Field type: entity
Split policy: String
Merge policy: String
Default value: String

Code	Description
A	ACTIVE
C	CCN CANCELLED
D	DELETED/DISCONTINUED
I	INACTIVE
M	MERGED/ANNEXED
N	NON-PUBLIC
P	PROPOSED
R	RECEIVER/TEMPORARY MANAGER
T	TRACKING
U	UNKNOWN
W	UTILITY WATER EYES EXTER
X	MISUNKNOWN

APPENDIX - D



TEXAS WATER DEVELOPMENT BOARD



James E. Herring, *Chairman*
Lewis H. McMahan, *Member*
Edward G. Vaughan, *Member*

J. Kevin Ward
Executive Administrator

Jack Hunt, *Vice Chairman*
Thomas Weir Labatt III, *Member*
Joe M. Crutcher, *Member*

October 26, 2010

PWS Contact
PWS Name/PWS ID
PWS Address

RE: Texas Water Development Board - Texas Water System Map Project
Request for Service Area Boundary Map
Public Water System (PWS) No.: XXXXXXXXX (_NAME_)

Dear Sir/Madam:

The Texas Water Development Board (TWDB), in association with HDR Engineering, Inc., is creating a statewide map of the areas currently served by public water systems to support the state's regional water planning program. This statewide map will allow the TWDB to provide the best possible population and water demand projections, as well as assess future needs and potential regional projects.

You are receiving this letter because the TWDB does not have recent information on the extent of your water system. We, therefore, respectfully request that you provide the best available information delineating the geographic location and extent of your water system's distribution facilities. Your timely assistance in providing the requested information will help to ensure that your water system is accurately accounted for in population and water demand projections adopted for regional and state water plans.

Any of the following formats would be acceptable to TWDB:

- 1) Geo-referenced GIS or CAD files.
- 2) Electronic copy of map (PDF, JPEG, etc).
- 3) Paper map.
- 4) A sketch or written description (in the absence of any of the above).

Please transmit the information to the attention of Mr. Noel Gonsalvez of HDR Engineering, Inc. at the email or physical address below on or before November 19, 2010.

Our Mission

To provide leadership, planning, financial assistance, information, and education for the conservation and responsible development of water for Texas.

P.O. Box 13231 • 1700 N. Congress Avenue • Austin, Texas 78711-3231
Telephone (512) 463-7847 • Fax (512) 475-2053 • 1-800-RELAYTX (for the hearing impaired)
www.twdb.state.tx.us • info@twdb.state.tx.us
TNRIS - Texas Natural Resources Information System • www.tnr.is.state.tx.us
A Member of the Texas Geographic Information Council (TGIC)



Email: noel.gonzalez@hdrinc.com
HDR Engineering, Inc.
4401 West Gate Blvd, Suite 400
Austin, TX 78745
Phone: 512-912-5175
Fax: 512-912-5158

Should you have questions regarding this project or need additional information, please do not hesitate to contact the HDR staff listed above or Mr. Kevin Kluge of the TWDB staff (kevin.kluge@twdb.state.tx.us or at 512-936-0829) at your earliest convenience.

Your cooperation in making this important project a success is greatly appreciated.

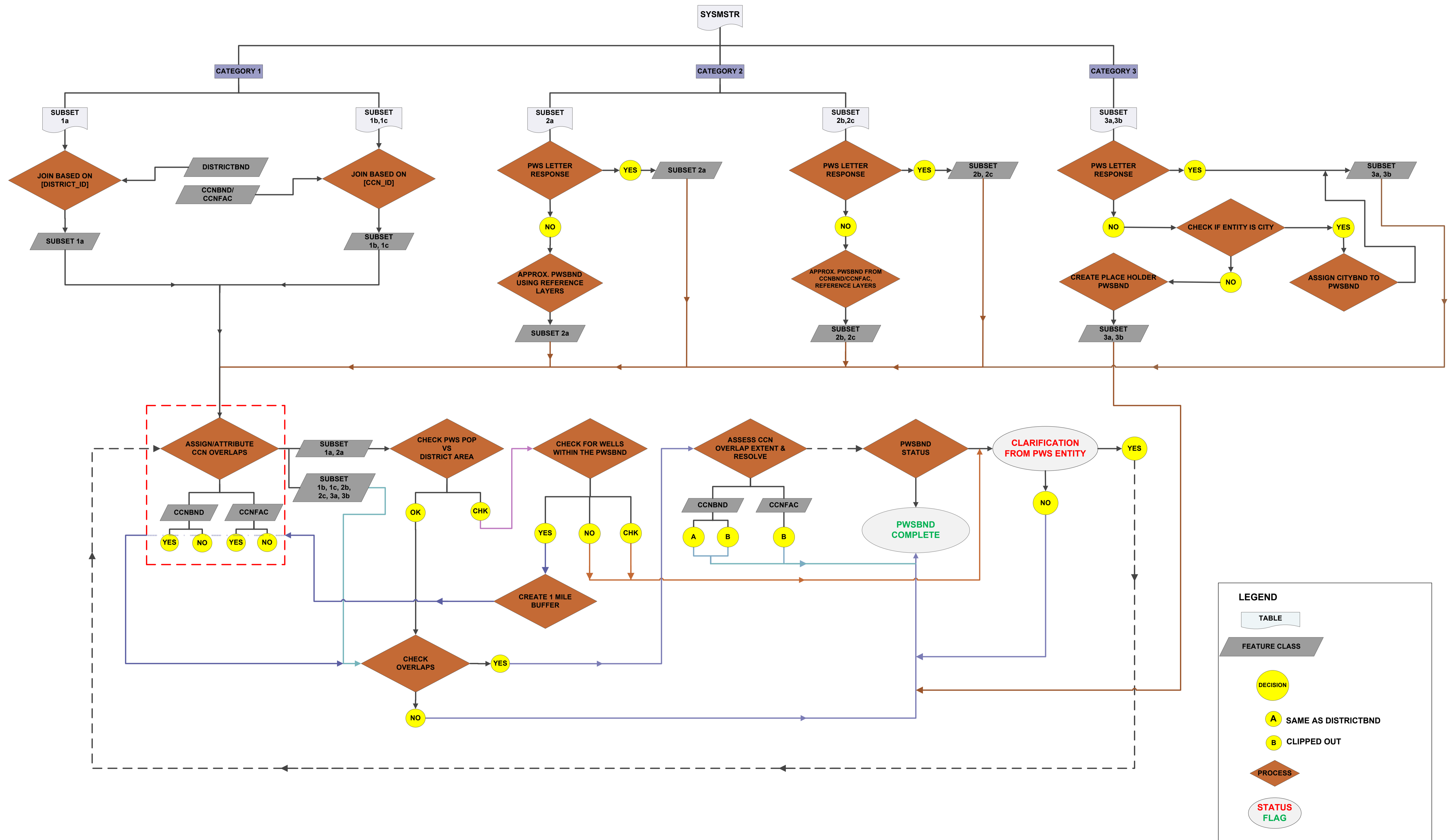
Sincerely,

A handwritten signature in black ink that reads "Dan Hardin". The signature is written in a cursive style with a long, sweeping tail on the final letter.

Dan Hardin, Ph.D.
Director, Water Resources Planning

APPENDIX - E

TEXAS WATER SYSTEM MAP PUBLIC WATER SUPPLY (PWS) SERVICE AREA BOUNDARY DELINEATION WORKFLOW



LEGEND

- TABLE
- FEATURE CLASS
- DECISION
- A SAME AS DISTRICTBND
- B CLIPPED OUT
- PROCESS
- STATUS FLAG