A GIS APPROACH TO AUTOMATED REDISTRICTING OF LDS CHURCH WARD BOUNDARIES IN THE ST. LOUIS MISSOURI NORTH STAKE

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A GIS Approach to Automated Redistricting of LDS Church Ward Boundaries in the St. Louis Missouri North Stake

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ABSTRACT

Redistricting is typically a very time-intensive process. Software packages available to aid in redistricting, either available commercially or to government, can aid in the redistricting process, but most can only handle optimizing or balancing a single parameter. Due to the multiple parameters and complexity of the process required to reorganize ward boundaries of The Church of Jesus Christ of Latter-day Saints (LDS Church), current redistricting software packages cannot fulfill the requirements and the process is still undertaken by hand.

The current ward boundaries of the St. Louis, Missouri North Stake are not optimized to take advantage of new ward meetinghouses that have been built to accommodate concurrent attendance by two wards, nor are they aligned with school district boundaries. It is possible for children in one ward to attend as many as three different school districts. This can make it difficult to plan youth activities because the children are all on different schedules.

For this thesis, a GIS approach to the recreation of ward boundaries for wards in the LDS Church was developed. This was done by gathering and creating digital versions of the same data currently utilized when determining new boundaries for wards (current stake boundary, current school district boundaries, natural boundaries, etc.). After the data was

gathered, models and scripts were written to further prepare and eventually summarize the data, taking into consideration all the same factors that are currently used when doing this by hand.

After the data had been properly prepared and attributed, it was used in re-creating the current boundaries as a baseline and then was used in creating a newer, more geographically compacted version of the boundaries. The new, updated boundary plan was created in a fraction of the time that it would normally take to create or allocate new boundaries. Not only would this process be immediately applicable to other LDS Church stakes, but because of the boundary sub-unit creation process, it provides a benefit for other redistricting operations, not just for redistricting LDS Church ward boundaries.

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CHAPTER 1: Introduction

The topic of my thesis is to develop a GIS approach to the creation/restructuring of ward boundaries for The Church of Jesus Christ of Latter-day Saints (LDS Church). In the LDS Church, a local congregation is referred to as a "ward". A ward consists of a minimum number of church members, typically 200 to 500 active church members within an area that is within a reasonable travel time of the meetinghouse. If there are not enough church members to exist as a ward, then the congregation is referred to as a branch. Sometimes, in special circumstances, a branch is created to allow church members to worship together, without regard to geographic location. Two such examples in the St. Louis Missouri North Stake are a branch specifically for Spanish-speaking church members and a branch for young, single adults. Since these two branches are not geographically-based, inclusion of these branches in this research, particularly with regard to boundary realignment, is unnecessary since any changes to the ward boundaries will have no impact on the demographics of each branch. Several geographically-contiguous wards or branches are grouped to make up a stake, which will also include the geographically-independent branches, if there are any.

In the LDS Church, each ward or branch has defined boundaries that demarcate its attendance area. Members attend the ward or branch in which they reside. As populations grow and shift, boundaries of wards and branches are adjusted to create or consolidate wards or branches to keep the membership at the desired size of 200 to 500 active members per ward.

To understand the criteria used to draw ward and branch boundaries, it is necessary to provide some background on church organization and ecclesiastical leadership. A stake is an administrative unit, composed of at least three wards and up to a total of sixteen congregations, either wards or branches. A stake is comparable to a diocese in the Catholic Church and other Christian denominations, such as Anglicans and Eastern Orthodox, where a bishop is the head of a specific diocese. The name "stake" derives from the phrase "stake in the tent of Zion" and is a reference to the stakes that upheld the Biblical tabernacle housing the Ark of the Covenant (Isaiah 54:2). For this reason, a stake is sometimes referred to as a "stake of Zion" (Wikipedia, 2007). The ecclesiastical leader of a ward is called a “bishop” and will typically serve for a period of approximately six years.

In the LDS Church, the Melchizedek Priesthood is one of two governing priesthoods. The greater priesthood is the Melchizedek Priesthood. The Church in ancient days called the priesthood “the Melchizedek Priesthood” after a great high priest who lived during the time of Abraham (Hebrews 7). The lesser priesthood is called the Aaronic Priesthood because it was first conferred on Aaron and his sons. It is called the lesser priesthood because it is an appendage to the greater, or the Melchizedek Priesthood (The Church of Jesus Christ of Latter-day Saints, 2006a).

All members of the Church, and therefore, the priesthood, are laymen or women and are not paid for their service. Ordination to the priesthood is based on the recipient's

personal moral worthiness without regard to education or other socio-economic status, and thus, all worthy males may be ordained to the priesthood (The Church of Jesus Christ of Latter-day Saints, 1997a). The two most common offices in the Melchizedek Priesthood at the local ward and stake levels are High Priest and Elder, though there are three other offices in the Melchizedek Priesthood, namely Seventy, Patriarch, and Apostle, which are church-wide offices, not at the ward and stake levels. It is, typically, the number of High Priests and Elders that determines when a branch becomes a ward and when a ward needs to be split or consolidated, specifically ninety-six Elders (The Church of Jesus Christ of Latter-day Saints, 1997b). However, the number of "Prospective Elders" (Aaronic Priesthood holders that are at least 18 years of age) is also taken into account during that process (T. Slezak, personal communication, July 5, 2006). The offices of the Aaronic Priesthood with their most common age ranges are Deacon (12-14), Teacher (14-16), and Priest (16-18), though, as previously stated, some Aaronic Priesthood holders are above the age of 18.

1.1 Problem/Current Process

Demographic and other population changes over time create situations where one region's resources are overused while others remain under-utilized. Adjustments are then required in the assignment of resources to various regions and/or a redrawing of the boundaries of each region to create a more balanced scenario (Hejazi and Dombrowski, 2006). As populations of church members vary over time in certain areas, boundaries of wards and branches are adjusted to either create or consolidate wards and branches. Since these sub-areas of a stake must be contiguous and contain the appropriate amount of male church members, the process can be very detailed and meticulous. The current process to

redraw ward boundaries is fundamentally manual, similar to the old "pin-mapping" procedures used for other types of applications. The current method generally takes several months, even up to a year, to come to final decisions on new ward boundaries (T. Slezak, personal communication, July 5, 2006).

The following "demographic" criteria, herein referred to as "LDS Redistricting Criteria" are essential when redrawing ward boundaries:

- Current "time-in-service" for each Bishop
    - A new Bishop will generally not be drawn out of his current ward, but if he is coming to the end of his service, then it may be okay.
- Number of male church members per ward
- Meetinghouse chapel & chapel overflow seating capacity
- Total Melchizedek Priesthood
- Active Melchizedek Priesthood
- Active Prospective Elders
- Adult female members
- Young men (ages 12-18)
- Young women (ages 12-18)
- Children (ages 0-11)
- Ability of each meetinghouse to handle concurrent ward attendance;

  In the LDS Church two or three wards often share the same building but meet at different and offset times. If a building can only logistically handle one ward

meeting at a time, then this will be attributed with a "1" to designate this limitation.

- Location of stake meetinghouse in relation to wards

The following "physical" criteria are also considered when redrawing ward boundaries:

- School district boundaries
- Natural physical boundaries (rivers, creeks, etc.)
- Man-made physical boundaries (roads, freeways, etc.)

The current ward boundaries in some stakes, including the St. Louis Missouri North Stake, are not optimized to take advantage of new ward meetinghouses that have been built to accommodate concurrent attendance by two wards, nor are they aligned with school district boundaries. It is possible for children in one ward to attend as many as seven different school districts. This makes it difficult to plan youth activities because the children are all on different schedules. In one ward (St. Peters Ward) in the St. Louis Missouri North Stake, the youth are spread amongst four school districts and attend five different high schools. Also, due to the size of the meetinghouse or even the parking lot, some meetinghouses can support only one ward at a time. Thus, in those circumstances, ward meeting times cannot overlap and must have a "buffer" of time to allow for one ward's members to leave before the other ward can meet. Problems have also been encountered in other wards and stakes, such as when surrounding, wealthy neighborhoods make up one ward, and everyone else is grouped into another ward or branch, so that the poorer members "could have more leadership opportunities." (Call, 2003). Other problems with ward boundaries have arisen in a manner similar to

problems encountered with creating voter tabulation districts (VTDs). Namely, VTDs traditionally followed township and range lines. These "invisible" lines resulted in possible misassignments of households (Turner and LaMacchia, 1999). Similarly, some ward boundaries still have comparable invisible lines, which often create confusion or misassignment when determining to which ward a church member actually belongs. The Church has now instituted a practice of only using visible features as boundary lines when creating ward boundaries (T. Slezak, personal communication, July 5, 2006).

1.2 Research Question

There is currently a need in the St. Louis Missouri North Stake for a reorganization of ward boundaries. Instead of employing the current manual method, could leveraging previous and current automated "redistricting" techniques be utilized or augmented slightly to streamline or speed-up the creation of new ward boundaries, accounting for all necessary parameters? Could a geoprocessing script or model to evaluate multiple parameters be developed that is more dynamic than the Districting for ArcGIS extension (Esri, 2007) currently available?

1.3 Justification

The methodology used to redraw LDS ward boundaries is complex and almost entirely a manual process and would benefit from any automation or computer assistance. The evaluation of several parameters concurrently is necessary and requires the need for dynamic evaluation of parameters. By undertaking this research, I was able to show the possibilities of performing more complex redistricting operations, specifically with regards to LDS ward redistricting.

Esri's Districting for ArcGIS relies on pre-existing geographic unit data, out of which districting plans can be created, but can be utilized for the process of redistricting LDS ward boundaries. However, geographic unit data with all the necessary attributes are needed when redrawing LDS Ward and Stake boundaries, but are not currently available. After the creation of the tools and utilities developed for this research, it was possible to enhance the pre-existing geographic unit data to have the necessary attributes that are required for LDS boundary creation or modification.

The process of LDS ward redistricting is similar to traditional political redistricting and can adhere to many of the same criteria and goals while still honoring the "religious" goals inherent in the process. The St. Louis Missouri North Stake is in need of redistricting due to current geographic non-compactness and imbalance of several of the LDS demographic categories amongst wards. Automation of much of the data preparation work provides time-savings and utilization of computer-aided redistricting software provides near real-time feedback on the impacts to LDS demographic information and measures of compactness, also resulting in time-savings.

CHAPTER 2: Research Background

2.1 History of Computer-Aided Redistricting

Redistricting was originally done in a similar technique as pin-mapping. During the past three decades, computers have emerged as an integral redistricting tool (Altman et al., 2005). In the relatively short period of time since the microcomputer revolution, it has become generally accepted that IT has had, and continues to have, a significant and widespread influence on politics (Altman and Klass, 2005). But it wasn't until the 1990s that the rapid development of computer hardware and GIS software came together to revolutionize the technical aspects of electoral cartography (Eagles et al., 1999). However, while the advances in hardware and software have "made the process faster and cheaper, they have not led to any fundamental changes in redistricting outcomes" (Altman and McDonald, 2010).

It is understood that redistricting software can generate maps custom-fitted to meet any group's needs (Buchman, 2003). While much effort has been expended on redistricting for political purposes, not much effort has been spent on districting automation for non-political purposes, evidenced by a lack of scholarly and market research on the subject. However, the use of redistricting software and districting automation techniques holds promise for providing benefit in the realm of LDS ward boundary redistricting.

2.2 Limitations of Currently-available Redistricting Software

Districting automation generally is based on two desired outcomes: population equality and/or geographical compactness (Altman, 1998). Many of the current redistricting

applications, such as the Texas Legislative Council's RedAppl 2001 program (Texas Legislative Council, 2000), or Esri's Districting for ArcGIS, only employ "simple" redistricting. These two systems take into account bounding areas, but generally only do so in a single parameter aspect, attempting to optimize or maximize one criterion and cannot balance between competing criteria. That is, the user has to pick one parameter that the system will attempt to balance amongst the districts (i.e. population, median income, etc.). This is commonly referred to as the "control field" or "control variable". The user then specifies a target value for this field and the software attempts to create balanced districts according to that single variable.

It is perhaps for this reason that following the 2000 census, the Texas Legislative Council developed their own automated algorithm for redistricting that could generate plans based on multiple criteria, known as the Texas Automated Redistricting plan Generation and Evaluation Tool (TARGET). This tool was far more powerful than any redistricting tool commercially available then, or now. Even in Texas, it appears to have been used to produce maps only as a starting point for negotiations among legislators, rather than to produce the ultimate end product (Altman et al., 2005). According to the Texas Legislative Council (2000), to use TARGET, a client would have to work with trained council staff to construct a quantitative expression of a set of goals, which would then be transferred to the client's PC to run. TARGET could not produce an optimum redistricting plan, but rather would be a tool to more quickly generate a starting point, explore possibilities, or search for solutions to problems. While you can do the aforementioned in TARGET, it is generally unavailable to the public, outside of the

Texas legislature.

However, the sophistication of the TARGET system does suggest that this aspect of redistricting technology may have greater impact in future rounds of redistricting (Altman *et al.*, 2005). Current automated algorithms cannot simultaneously balance the multiple criteria that must be respected when drawing districts, and the software products don't readily allow for customization.

The Districting for ArcGIS software was identified by the author as the best-available commercial districting software easily available to the author for the following reasons:

- Districting for ArcGIS is a free download/add-on for ArcGIS
- ArcGIS software is already currently in use by the LDS Church
- Districting for ArcGIS allows for user-provided geographic unit data
- Geographic unit data can be modified prior to use with Districting for ArcGIS

Since it will be used for the development of the baseline districting plan, more in-depth understanding of Districting for ArcGIS is needed. According to Esri's website (Esri, 2012):

> The Districting for ArcGIS add-on simplifies the redrawing of political boundaries that local, state, and federal government agencies use to account for population changes. The add-on transforms what was once a long, manual process into a convenient way of defining police beats; sales territories; voting, school, and fire districts; and many other boundaries.
>
> Once you have the base data established, such as counties or ZIP Codes, you can group the units simply by selecting them in ArcMap. Districting for ArcGIS can

> help you analyze population densities, housing breakdowns, income and race statistics, and other data.
>
> Districting for ArcGIS also makes it easy to quickly draw various alternative boundaries for consideration.

Regarding the possibility of customizing Districting for ArcGIS to provide a single method to redistrict LDS Ward boundaries, Esri has decided not to freely distribute the source code for the Districting for ArcGIS add-on, so it can't be customized at this time (Esri, 2012). One possibility would be to simply provide point features for each member/family and have the software auto-allocate or group these into potential wards; however, "at this time, the Districting for ArcGIS add-on only works with polygon data" (Esri, 2012). Since the LDS Church doesn't currently keep geographic sub-unit polygon data for ward and stake polygons, existing census block polygon data will need to be augmented for performing LDS Ward Redistricting.

Reviewing the possibility of having Districting for ArcGIS automatically assign geographic units for a fully-automated redistricting, "the Districting for ArcGIS add-on is designed so that users interactively assign geographic units to districts" (Esri, 2012). So at this time, Districting for ArcGIS won't provide a fully-automated redistricting environment, but does provide an easy, intuitive environment in which to redistrict, once the data has been prepared.

2.3 Traditional Political Redistricting Criteria

Because of what they attempt to accomplish, there are five common criteria that are considered "good" redistricting goals (Grofman, 1985; Lijphart 1989):

1. *Population equality*
2. *Contiguity*
3. *Compactness*
4. *Creating fair electoral contests*
5. *Protection of communities/Non-dilution of minority representation*

"Population equality" generally refers to making sure that each geographic area has similar population and/or other demographic criteria. "Contiguity" commonly is concerned with making sure that the geographic units/areas are joining without overlapping or leaving gaps in coverage, as well as if any fragmentation occurs as a result of the redistricting (i.e., a ward splits a county or covers multiple counties). "Compactness" is a measure for the geographic units/areas to be spatially and geographically optimized, with a circle being the perfect, compact area. It is generally some measure of comparison of the area of a geographic unit to the perimeter of the geographic unit. This value is then compared against the values from a circle, with an equivalent area. Specifically, the measurement that will be used in evaluating "compactness" is called the Isoperimetric Quotient.

The standard formula used for a compactness ratio (CR) is the area (A) of the unit divided by the perimeter (P) squared, or more simply: $CR = A / P^2$. With the formula for the area of a circle being $A = \pi r^2$ and the formula for the perimeter of a circle being $P = 2\pi r$, simple substitution yields: $CR = \pi r^2 / (2 \pi r)^2$ or , when expanded: $CR = \pi r^2 / 4\pi^2 r^2$. When reduced further, the formula for the compactness ratio of a circle is:

CR = 1 / 4π. So, for ANY circle, the compactness ratio is the same; thus, a circle is the perfectly compact geographic unit, regardless of its radius or size.

To arrive at the Isoperimetric Quotient (IPQ), when comparing any other geographic unit against a circle, the compactness ratio for that unit is divided by the compactness ratio for a circle. When expressed as an equation, it yields: $IPQ = (A / P^2) / (1 / 4\pi)$, or when simplified: $IPQ = 4\pi A / P^2$. So, when evaluating a circle, one would be left with: $IPQ = 4\pi / 4\pi$, or a value of 1. Therefore, the maximum value for an Isoperimetric Quotient would be 1, and geographic units with values closer to 1 would be "more compact" than geographic units with smaller IPQ values.

The last two criteria are perhaps where automated redistricting faces its greatest challenges as they are highly subjective, which means that the criteria are best evaluated in a semi-automated, or reviewed, redistricting process. "Creating fair electoral contests", without delving into the semantics of "what is fair", refers to making sure that either no one demographic group has a majority or that if one does, there is another area weighted equally and opposite, in the vein of compromise. "Protection of communities/Non-dilution of minority representation" is similar to the previous criterion, with the exception that "fairness" isn't respected so much as keeping a community or minority group together, to avoid diluting their vote in a pool of potentially opposite-minded voters. The desire to protect the voice of communities is just one among a number of competing concerns that factor into drawing congressional districts (Altman and McDonald, 2011). For example, the odd shape of Arizona's 2nd Congressional

District is not to protect an incumbent or to favor a particular party, but to separate members of the small Hopi Tribe from their longstanding, more numerous rivals in the surrounding Navajo Tribe (Altman and McDonald, 2011).

The three previously mentioned software programs, TARGET, RedAppl, and Districting for ArcGIS, do not address all five criteria. While all three programs can aim to balance or strive for optimal figures of population equality, contiguity, or compactness, the remaining two criteria still have to be manually reviewed.

2.4 LDS Redistricting Criteria

LDS ward redistricting has objectives similar to the five criteria, as clarified or adjusted as below:

1. *Population Equality - As outlined for all LDS Redistricting Criteria in Section 1.1*
2. *Contiguity - All areas need to be covered and all areas must not overlap, clarified in Section 3.3, with relation to Topology Rules*
3. *Compactness - No difference or deviation from the standard measures.*
4. *Creating fair "burdens" on members - In particular, driving times and distances from homes to meetinghouses*
5. *Protection of communities/neighborhoods/school districts and non-alienation of any demographic groups - Attempts to not create any demographically imbalanced wards (i.e. One ward with no children, one ward with many children, etc.)*

For this research, I attempted to create a methodology to reduce the time that it takes to "redistrict" or redraw LDS Church Ward boundaries, while respecting the five redistricting goals outlined above, albeit in a non-political setting. Since the current process is mainly manual, almost any automation or computer assistance would be advantageous. Like TARGET, the research provides a starting point for Church administrators to begin ward boundary discussions, similar to providing a starting point for legislators to begin negotiations. Unlike TARGET, which relies on pre-compiled and pre-attributed data, the research expands "redistricting" beyond a strictly political arena by attributing geographic data with LDS demographic data and then using that data in a "traditional" redistricting aspect, but in an attempt to provide an environment/outcome like TARGET, but one that is available to non-legislators, more specifically, to LDS Church leadership.

CHAPTER 3: Methodology

3.1 Description of Study Area

The study area for this thesis will be the St. Louis Missouri North Stake, currently consisting of its ten constituent wards and two branches:

- Dardenne Creek Ward
- Florissant Ward
- Hazelwood Ward
- Lake St. Louis Ward
- Missouri River Ward
- O'Fallon Ward
- St. Charles Ward
- St. Peters Ward
- Warrenton Ward
- Weldon Spring Ward
- Oak Valley Branch (Young Single Adults)
- San Carlos Branch (Spanish Speaking Members)

When a stake is considering reorganizing geographically (redistricting), LDS Church Headquarters will send out paper copies of maps of the stake (Figure 1) and maps of each ward or branch (if the branch is geographically-based).

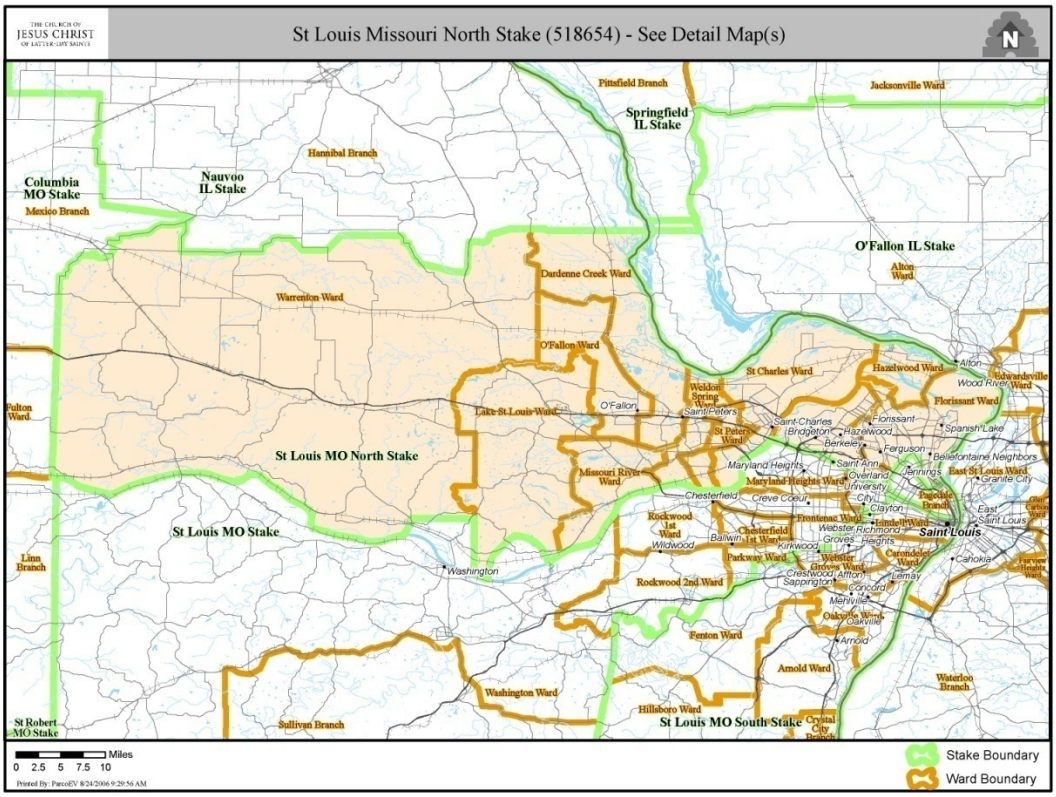

Figure 1 - St. Louis Missouri North Stake

Due to the level of detail and the scale of the map, as well as the text size, a simplified version of the map was created, showing the ward and stake boundaries, and the meetinghouse locations (Figure 2).

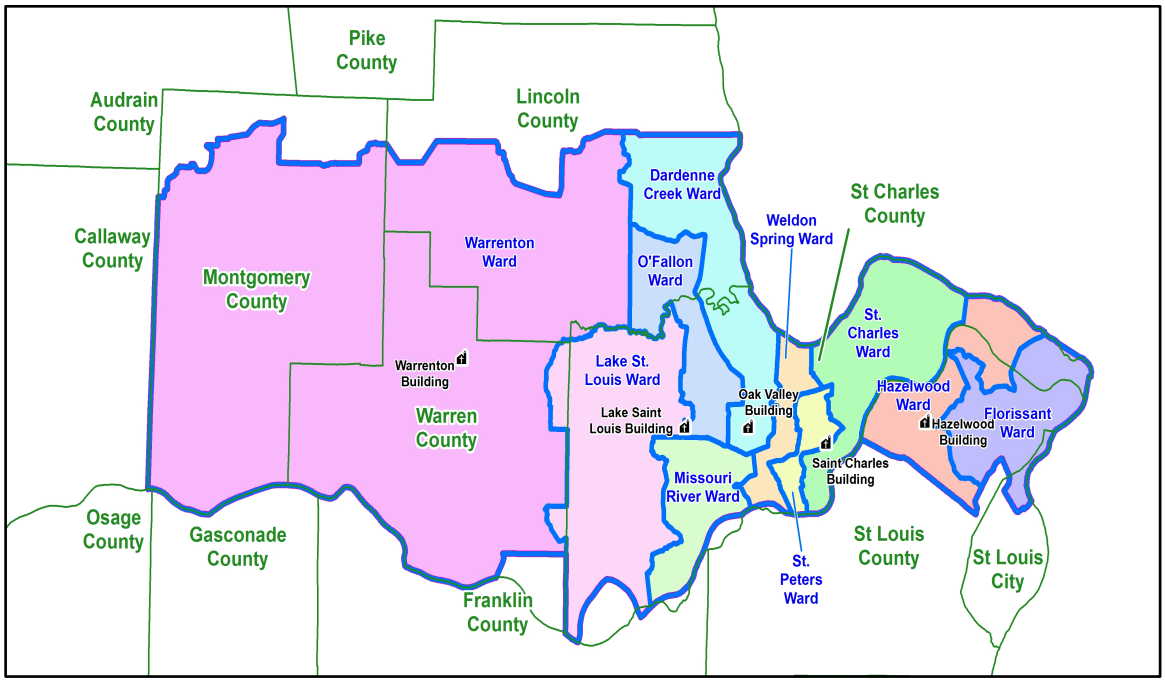

Figure 2 - Simplified St. Louis North Stake Map

Geographically, the St. Louis Missouri North Stake encompasses almost all of St. Charles County and Warren County, most of Montgomery County, most of the entire lower half of Lincoln County, and a small section of the northeastern corner of St. Louis County (parts of Hazelwood and Florissant). The two small "cutouts" at the southern ends of Warren and St. Charles counties are due to portions of those counties' LDS members being assigned to attend the Washington, Missouri Ward and building, due to a bridge across the Missouri River, making the drive time to the nearest meetinghouse shorter than attending at the Lake St. Louis or Warrenton Buildings.

Currently, five buildings are being utilized for ward meetinghouses in the St. Louis Missouri North Stake:

- Hazelwood Building (also serving as the Stake Center – serving two wards: Hazelwood & Florissant Wards), Hazelwood, MO
- Lake St. Louis Building (serving three wards: O'Fallon, Lake St. Louis, and Missouri River Wards), Lake St. Louis, MO
- Oak Valley Building (serving two wards and one branch: Dardenne Creek and Weldon Spring Wards and Oak Valley Branch), St. Peters, MO
- St. Charles Building (serving two wards and one branch: St. Charles and St. Peters Wards and San Carlos Branch), St. Charles, MO
- Warrenton Building (only building serving one ward: Warrenton Ward), Warrenton, MO

3.2 Description of Data Sources

The data sources listed below were used for the thesis.

Stake and Ward Boundaries:

- St. Louis Missouri North Stake boundary (The Church of Jesus Christ of Latter-day Saints, 2006b).
- Dardenne Creek Ward boundary (The Church of Jesus Christ of Latter-day Saints, 2006b).
- Florissant Ward boundary (The Church of Jesus Christ of Latter-day Saints, 2006b).
- Hazelwood Ward boundary (The Church of Jesus Christ of Latter-day Saints, 2006b).
- Lake St. Louis Ward boundary (The Church of Jesus Christ of Latter-day Saints, 2006b).
- Missouri River Ward boundary (The Church of Jesus Christ of Latter-day Saints, 2006b).

- O'Fallon Ward boundary (The Church of Jesus Christ of Latter-day Saints, 2006b).
- St. Charles Ward boundary (The Church of Jesus Christ of Latter-day Saints, 2006b).
- St. Peters Ward boundary (The Church of Jesus Christ of Latter-day Saints, 2006b).
- Warrenton Ward boundary (The Church of Jesus Christ of Latter-day Saints, 2006b).
- Weldon Spring Ward boundary (The Church of Jesus Christ of Latter-day Saints, 2006b).

County School District Boundaries:

- Lincoln County School District boundaries (Missouri Spatial Data Information Service, 2004).
- Montgomery County School District boundaries (Missouri Spatial Data Information Service, 2004).
- St. Charles County School District boundaries (Missouri Spatial Data Information Service, 2004).
- St. Louis County School District boundaries (Missouri Spatial Data Information Service, 2004).
- Warren County School District boundaries (Missouri Spatial Data Information Service, 2004).

County Road Data:

- Lincoln County Missouri Department of Transportation (MoDOT) Roads (Missouri Spatial Data Information Service, 2005a).
- Montgomery County MoDOT Roads (Missouri Spatial Data Information Service, 2005a).

- St. Charles County MoDOT Roads (Missouri Spatial Data Information Service, 2005a).
- St. Louis County MoDOT Roads (Missouri Spatial Data Information Service, 2005a).
- Warren County MoDOT Roads (Missouri Spatial Data Information Service, 2005a).

County Hydrography Data:

- Lincoln County Hydrography (Missouri Spatial Data Information Service, 2005b).
- Montgomery County Hydrography (Missouri Spatial Data Information Service, 2005b).
- St. Charles County Hydrography (Missouri Spatial Data Information Service, 2005b).
- St. Louis County Hydrography (Missouri Spatial Data Information Service, 2005b).
- Warren County Hydrography (Missouri Spatial Data Information Service, 2005b).

Other Data:

- 2000 Census Data (Missouri Spatial Data Information Service, 2000).
- 2010 Census Data (Missouri Spatial Data Information Service, 2010).
- National Agricultural Imagery Program (NAIP) Imagery (Missouri Spatial Data Information Service, 2012).

3.3 Methodology

The methodology can be separated into two logically distinct phases: Data Preparation and Redistricting. Figure 3 illustrates the workflow methodology and is discussed in the following paragraphs.

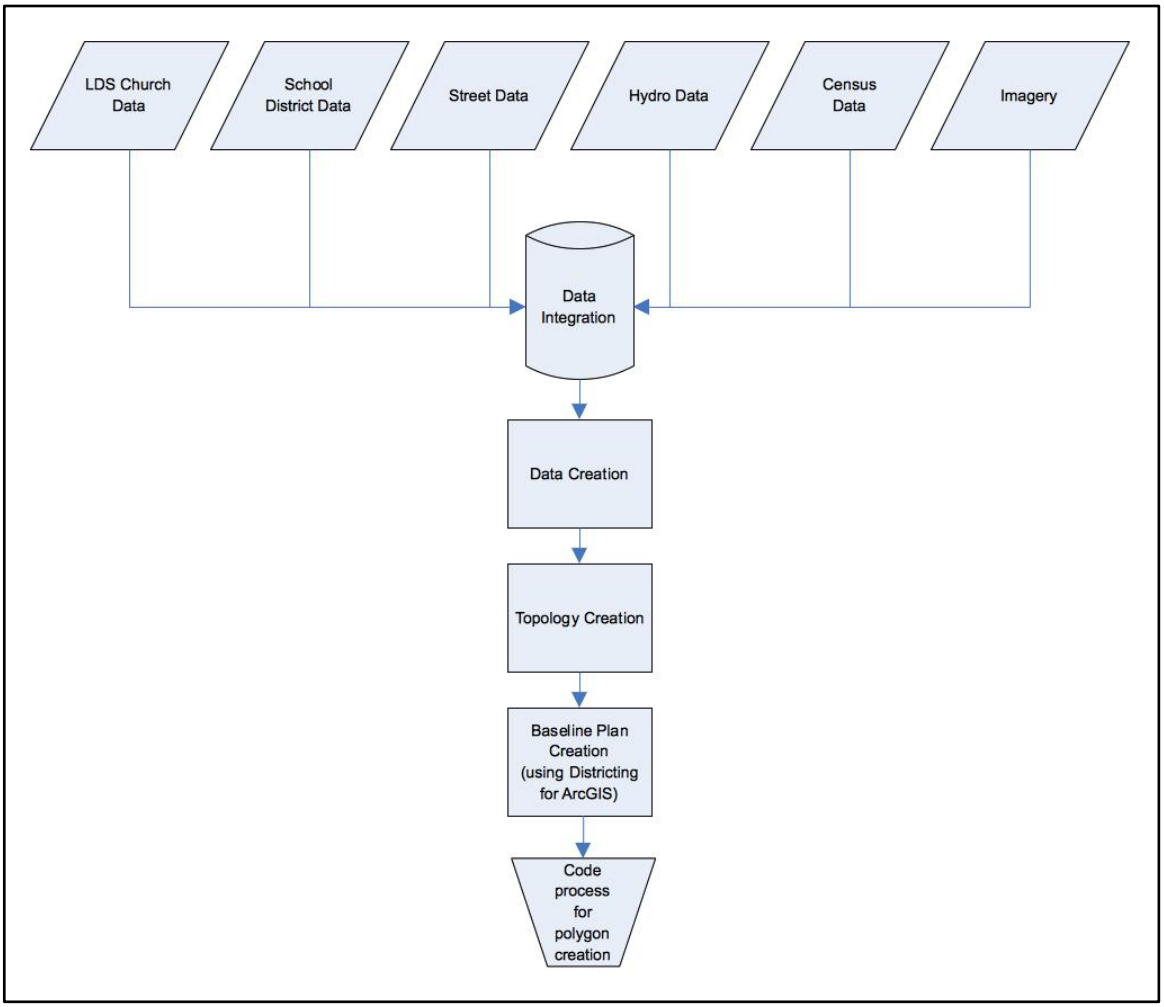

Figure 3 - Methodology Diagram

3.3.1 Data Preparation Phase

The work involved with preparing all needed data can be further separated with respect to the data involved as well as the intent behind the work.

3.3.1.1 Data Preparation – Stake & Ward Boundaries

Stake and ward boundaries were obtained from LDS Church headquarters in Salt Lake City, Utah, in hardcopy format because the Church's privacy policy prohibits the dissemination of digital data. The remaining necessary data was downloaded from the Missouri Spatial Data Information Service (MSDIS) website. This data was loaded into a

central geodatabase, used in conjunction with the hardcopy maps to digitize the current ward and stake boundaries (as the stake and ward boundaries rely heavily on physical features to serve as partial boundary segments, though political boundaries are sometimes used).

3.3.1.2 Data Preparation – Meetinghouses and Bishops Points

A point feature class was created for the meetinghouses at their correct geospatial locations. This was done by geocoding the addresses of the meetinghouses against the MoDOT data. Locations were then verified against 2006 NAIP imagery. Attributes were placed on the meetinghouse points designating the current and capable number of concurrent wards the meetinghouse can support, if any. A point feature class was also created for bishops, depicting the approximate location of their residences, with an attribute for their time-in-service.

3.3.1.3 Data Preparation – Membership Points

Membership data from the Stake was obtained, in comma-separate-value (csv) format. Since the csv file had latitude and longitude attributes for each member's residence, a point feature class was created by utilizing the "Create Feature Class from XY" functionality in ArcGIS. One point feature class was created for each ward. These point feature classes represented all of the LDS members in the stake: the priesthood holders, male members, female members, teenage members, and children. By utilizing the real data for the stake, I was able to create my code to be immediately applicable by the Church, though it did preclude the inclusion inside of this thesis of the maps and data that disclosed the residences and distribution of members, in order to comply with the Church's Privacy Policy. However, maps showing the general outlines of wards, before

and after realignment, could be shown, as well as data in tabular format, showing general or summarized information. For the point feature classes, several fields were added (detailed later) to assist with the summarization of the membership for each geographic unit.

3.3.1.4 Data Preparation - Topology

With the data in a geodatabase, topology rules were created to enforce geospatial relationships and integrity, with a particular focus on the redistricting goal of contiguity. These rules were used for validation of the data and assisting in the continuity goal and not directly used in the rule-based evaluation for redistricting. The following rules were used:

- **Wards** *Must not overlap*
- **Wards** *Contains point* **Bishops**
    - A topology error may be raised on this rule if the Bishop is at the end of his time in service and gets drawn out of his ward.
- **Wards** *Must be covered by* **Stakes**
- **Stakes** *Must be covered by feature class of* **Wards**
- **Wards** *Must not have gaps*

3.3.1.5 Data Preparation - Census Block Polygons

Consideration has to be given to using polygons of an appropriate size. Using polygons that are too large will result in a lack of detail and control over individual sub-divisions and neighborhoods. For this reason, and in the purpose of this research, county, city, and even census block group polygons are all considered "too large". Using polygons that are too small will result in an increased workload for the user of the Districting for

ArcGIS software, as the user will have to select each and every small polygon for inclusion. For this reason, and in the purpose of this research, polygons such as parcel data are considered "too small". Census block data was chosen as the optimal data of scale to use for this research, as identified by the author as the best balance between the level of detail needed and the level of effort required to obtain the amount of control over approximating the decisions faced by those that control LDS redistricting (allocating neighborhoods, sub-divisions, etc., to one ward or another). Because census block polygons utilize physical features for boundary coincidence (i.e. rivers, roads, etc.), they were nearly optimal for use in determining ward boundaries. For this reason, the census block polygons inherently incorporate hydrography features, since census blocks will not span or intersect most hydrographic features that the LDS Church would also use as delimiting features between ward boundaries. As such, utilization of the census block polygons will satisfy the need to utilize hydrography features during the redistricting process.

3.3.1.6 Data Preparation - Models

The models presented later in Chapter 4 help to prepare the existing census block data that is utilized with the Districting for ArcGIS software. After all of the models have been run to prepare the census block data, the summarization script, presented in 3.3.1.7 and 3.3.1.8, rapidly summarizes all LDS demographic information, appending it to the census block polygons. The benefit that is realized is that the time-consuming portion of tallying up LDS membership and demographic data and then allocating it to geographic sub-units in preparation for the redistricting process to begin takes, in total, less than five

minutes, as opposed to the previous time requirement of a few months (T. Slezak, personal communication, July 5, 2006).

3.3.1.7 Data Preparation - VBA Summarization Script

Using Visual Basic for Applications (VBA) for ArcGIS, a script was written to take the following as inputs and create the desired output:

Inputs:

- Bounding stake polygon
- Potential boundary features; The boundary features used for the redistricting plans run for this research were school district boundaries, county boundaries, hydrography features, and census blocks.
- Building point features
- Membership point features

Output:

- Ward polygons with tallied/summarized membership information

The VBA program was used to evaluate all the parameters as needed, as opposed to the linear flow that is solely available in ModelBuilder. Due to the end of support of VBA (Microsoft, 2008) in ArcGIS (Esri, 2009), as well as changes to the ArcGIS software program at version 10.0, using VBA prevented the use of the script within a model in ModelBuilder. The script still had value for use as a necessary data preparation step, which data could then be made available in the model. Through several iterations, modeling attempts, and parameter weighting, the previous data preparation portion of the ward redistricting process was streamlined. Models incorporating geoprocessing (GP)

tools were created to assist in the data preparation portion, to speed up the analysis and tallying of the LDS redistricting criteria, when performing LDS redistricting.

3.3.1.8 Data Preparation - Python Summarization Script

The VBA script was able to quickly summarize all necessary values for all wards to provide the end user with the ability to view all needed statistics and summarizations to aid in the redistricting process. Because of the changes to ArcGIS, further use of the VBA script is severely limited. As such, all of the code was re-written using Python. This allows for the code to be used within a geoprocessing model, which provides a seamless utility, or tool, for the end-user. The limitations of using the VBA code are outlined in Section 4.5, and the benefits gained when switching to the Python code are described in Section 4.6.

3.3.2 Redistricting Process

After all the data was loaded into the geodatabase and validated, then the redistricting process began. The *Districting for ArcGIS* extension was utilized to provide a baseline plan that was then used for comparison purposes. In order to take advantage of this extension, census blocks were utilized, because the Districting extension cannot create polygons, but merely groups smaller polygons into a "district". One problem that was encountered was that because some of the ward boundaries still used "imaginary lines", it wasn't possible to get a 100% match between the current ward and stake boundaries (shown as digitized boundaries in Figure 4) and the ward and stake boundaries derived by grouping census blocks (shown in baseline plan in Figure 4).

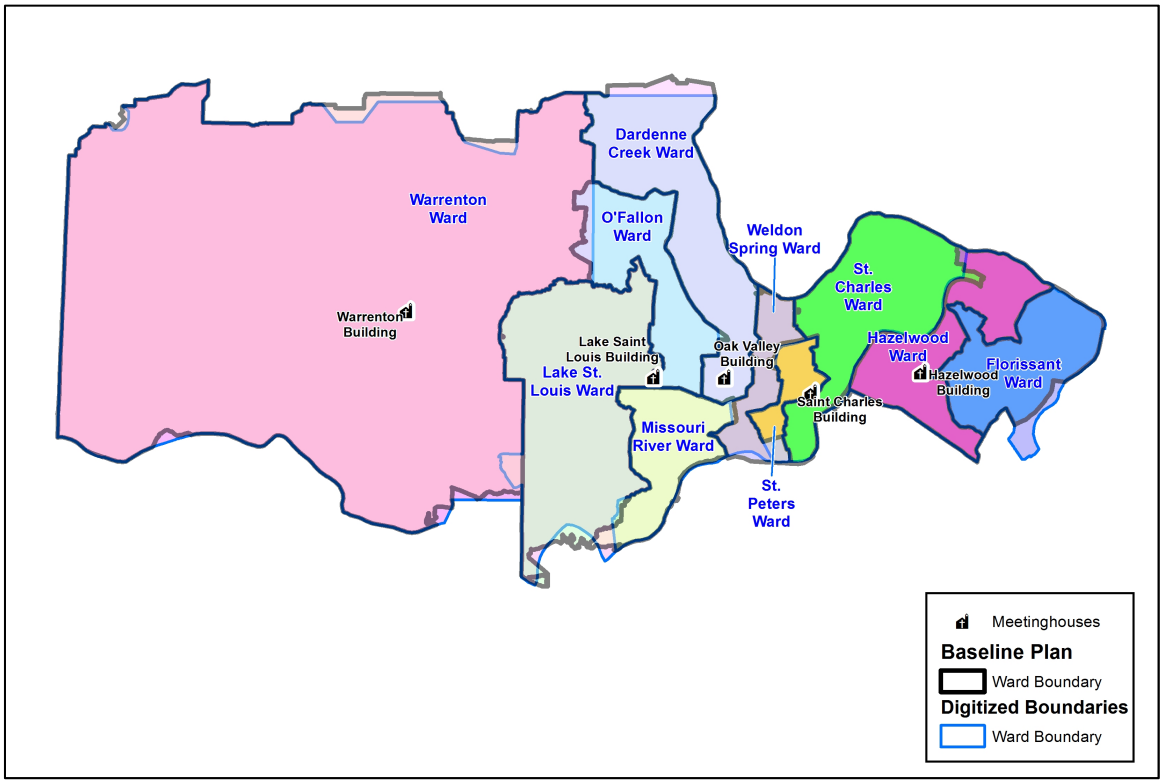

Figure 4 - Baseline Boundary Discrepancies

The LDS redistricting criteria, listed earlier, outlined the parameters that are necessary in the creation and modification of ward boundaries. With regard to the five redistricting goals mentioned in Chapter 2, all of the criteria were analyzed, such as the population equality goal: attempting to arrive at balanced numbers for Melchizedek Priesthood holders, balanced female members, balanced young men, balanced young women, and balanced children populations. Since the two non-geographic branches (Oak Valley Branch and San Carlos Branch) are not impacted by any boundary realignment, they are excluded from all maps and tables.

3.3.2.1 Redistricting - Plan Geography

The Districting for ArcGIS software refers to "Plan Geography" as the user-provided polygon data that will be used in the creation of districting plans. The polygon data has

to meet specific criteria to be valid for usage in the software as "Plan Geography". Users can specify a polygon feature class that contains both the geographic data as well as the attribute data or can use separate polygon data (containing geographic data) and table (containing attribute data). The "Plan Geography" (whether polygon feature class or separate table) cannot be altered after specifying during setup of the Districting for ArcGIS software, so pre-planning and data preparation has to happen prior to specifying which polygon dataset will be used. Modifications to include LDS-specific attributes onto the Census Bureau's block polygons has to be done prior to setting up the Districting for ArcGIS software.

3.3.2.2 Redistricting - Baseline Plan Creation

After the census block data is adequately prepared, as outlined previously, the data is loaded into the Districting for ArcGIS software package by using the augmented census block polygons as the "Plan Geography" and the Districting for ArcGIS software is ready to create the baseline plan. To expedite the creation of the baseline plan to resemble the current ward boundaries as close as possible, "Selection by Location" operations were performed iteratively for each current ward boundary polygon and the intersecting and contained census block polygons. For example, the "Dardenne Creek Ward" polygon was selected, after which a "Selection by Location" operation was performed to select all census blocks that fell completely within the Dardenne Creek Ward. All resultant selected polygons from this operation were then assigned in the Districting for ArcGIS software to belong to one ward. All selections were then cleared and the process was repeated for all other wards, assigning census block polygons to their "respective" wards

in which they resided, geographically. After all census block polygons had been assigned appropriately, creation of the baseline plan was considered finished.

3.3.2.3 Redistricting - Summarized LDS Demographics

Table 1 summarizes the baseline plan demographics, with only the publicly releasable information revealed. In Table 1, the headings "Male" and "Female" refer to the total number of males and females, while the headings "Men" and "Women" refer to the total males and female aged 18 years and older. The headings "Young Men" and "Young Women" refer to the total males and females between the ages of 12 and up to but not including 18 years of age. The heading "Children" refers to the total number of male and female children, combined, ages 11 and younger.

Table 1 - Baseline Plan Demographics

Ward	Individuals	Families	Male	Female	Men	Women	Young Men	Young Women	Children
Dardenne Creek Ward (W5)	317	145	165	152	103	116	20	14	64
Florissant Ward (W10)	429	196	223	206	140	157	27	19	86
Hazelwood Ward (W9)	481	220	250	231	157	176	30	21	97
Lake St. Louis Ward (W2)	398	182	207	191	130	146	25	17	80
Missouri River Ward (W3)	258	118	134	124	84	95	16	11	52
O'Fallon Ward (W4)	415	190	216	199	135	152	26	18	84
St. Charles Ward (W8)	446	204	232	214	145	164	28	20	89
St. Peters Ward (W7)	387	177	201	186	126	142	24	17	78
Warrenton Ward (W1)	523	239	272	251	170	192	32	23	106
Weldon Spring Ward (W6)	315	144	164	151	103	116	20	14	62
TOTALS	***3969***	***1815***	***2064***	***1905***	***1293***	***1456***	***248***	***174***	***798***
AVERAGES	***397***	***182***	***206***	***191***	***129***	***146***	***25***	***17***	***80***

3.3.2.4 Redistricting - Need for an Alternative Plan

After creation of the baseline plan, creation of subsequent plan variations is quick, as the software takes advantage of a "starting plan" to begin reassignment of the plan geography polygons (in this case, the augmented census block polygons). There are several reasons for creating alternative plans, such as a desire to obtain wards that do not cross school districts, so all families in a ward would be in the same school district and operating off of the same school calendar. Another reason to create an alternative plan is the need or desire to not cross political boundaries, such as county or state boundaries. Additionally, the aspiration to achieve greater geographical compactness or any of the other redistricting criteria are reasons to create alternative plans.

3.3.2.5 Redistricting - Alternative Plan Creation

Similar "Selection by Location" operations were performed, and selections were further refined either including or excluding census block polygons that intersected school district boundaries, county boundaries, or hydrography boundaries. For example, selecting the St. Charles School District polygon and then selecting all census block polygons that intersected it resulted in some census block polygons that would be better included in another ward. In these instances, selected polygons were excluded by simply un-selecting them. Conversely, after selection operations were performed, if the selection operation did not select a census block polygon that would be better included in a particular ward, that polygon could be included simply by selecting it. In both circumstances ("manually unselecting polygons that got automatically selected" and "manually selecting polygons that did not get automatically selected"), control over attempting to obtain the desired end-result (wards that do not cross school district

boundaries) is realized. This process of automatic selection with manual selection refinement can then be repeated with other geographic limiters, such as neighborhoods or counties.

After selection operations were performed and selections refined using the inclusion or exclusion methods of selecting or de-selecting polygons, all remaining selected features would be assigned, in batch, to a ward in the Districting for ArcGIS software by simply using the built-in "Assign" functionality available via the context menu, exposed via a mouse right-click. With the ability to batch assign or reassign entire neighborhoods, school districts, or counties to a ward, the redistricting process for LDS Church ward boundaries is greatly enhanced, mostly in part because the census block polygons had been previously prepared with all LDS demographic information, coupled with the capability of the Districting for ArcGIS software to rapidly summarize each ward and present proposed changes to each demographic category, allowing users to see what impacts moving one neighborhood, school district, or county from one ward to another would create. When a suitable proposed plan has been created, the plan geography (new ward polygons) can be exported as a shapefile, containing all plan statistics and demographic information.

CHAPTER 4: Models, Tools, and Scripts

The following four models were created to assist in the data preparation stage of ward redistricting: "Add and Calculate Age Field", "Add LDS Fields to Feature Class", "Calculate Null Values to Zero on LDS Fields", and "Perform Identity on Membership Points". Each model, its purpose, required inputs, calculations performed, and outputs is discussed in detail in sections 4.1-4.4. The overview of the process of preparing the census block data before it can be utilized in the VBA or Python scripts (Figure 5) shows the relationship between and order of processing for the models and scripts.

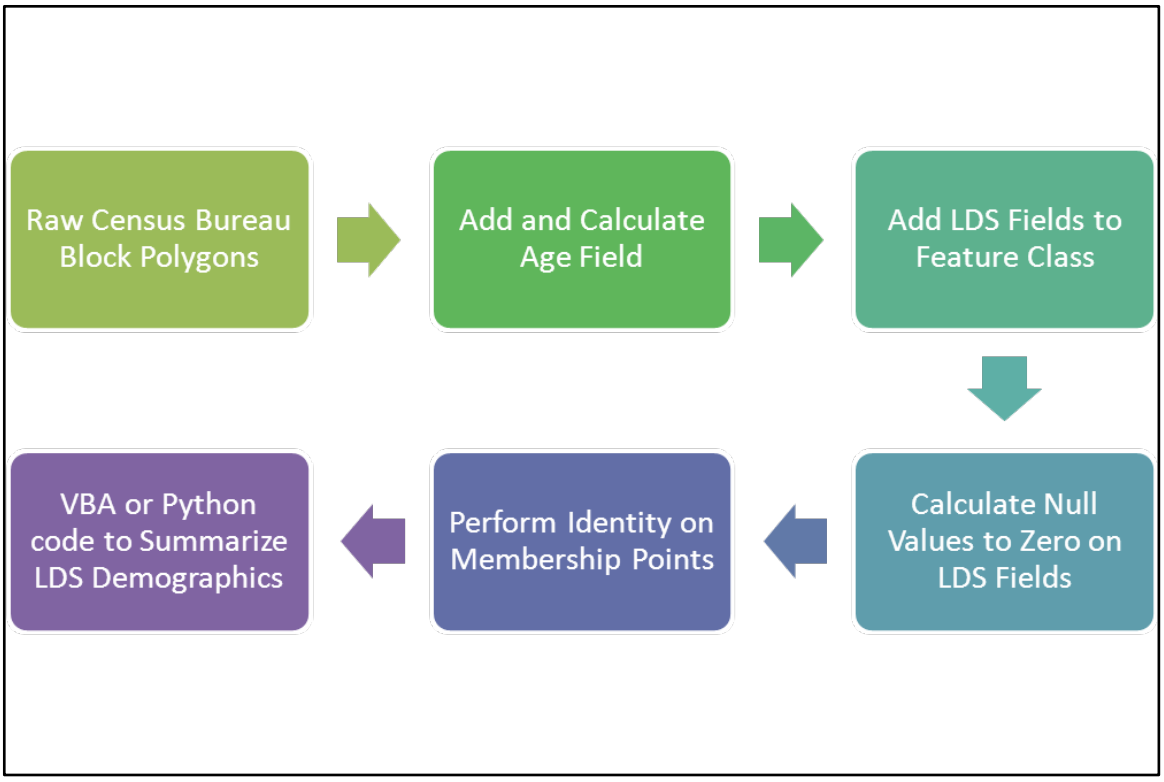

Figure 5 - Model and Script Workflow

4.1 Add and Calculate Age Field

The "Add and Calculate Age Field" model (Figure 6) was created to assist in the determination and categorization of the membership points based on the age of the LDS Church member. Since only birth date is contained in the record, not age, this field was created and calculated based off the difference between "today" (date of running of the model) and the member's birth date.

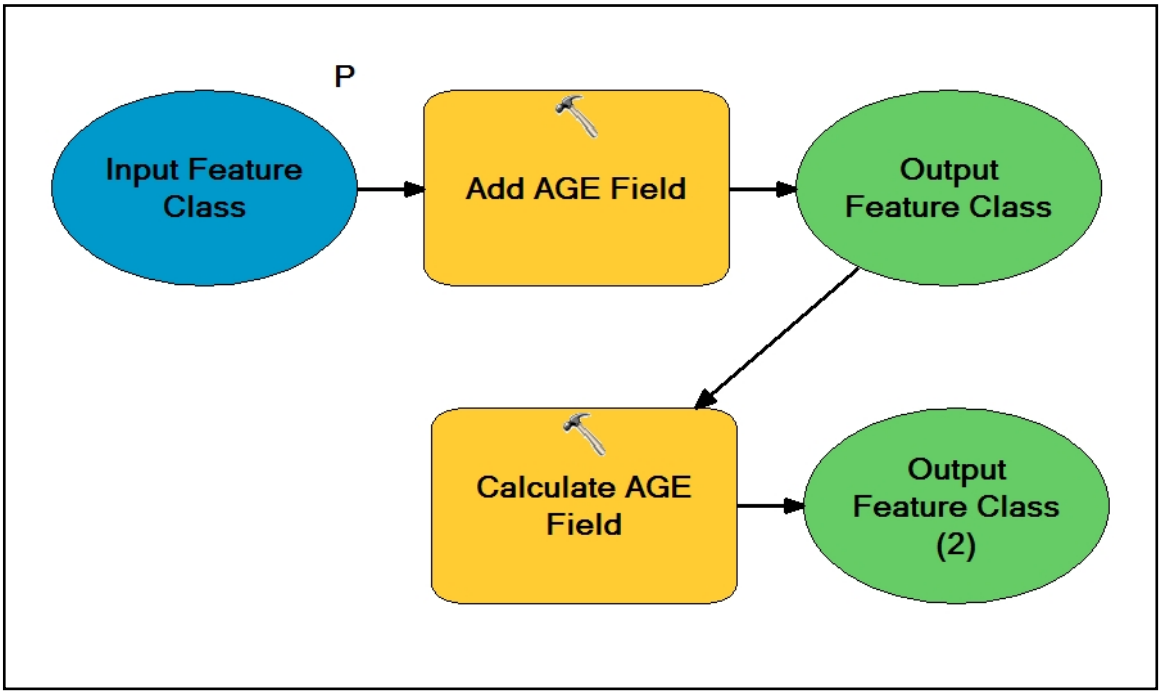

Figure 6 - "Add and Calculate Age Field" Model Diagram

The "AGE" field that is added is of data type "Double", which allows for a decimal equivalent of the person's age, which is useful in determining if a child or youth is getting close to changing classes.

The following is the calculation used in determining the age value:

Equation 1 - "Add and Calculate Age Field" calculation

```
Dim numDays, numYears, newYears
numDays = DateDiff ( "d", [Birth_Date], Now )
numYears = numDays / 365
newYears = FormatNumber(numYears, 2)
```

Running of the tool is as simple as double-clicking it to open up a graphic user interface (GUI) and setting the input data to be the point feature class of members (Figure 7).

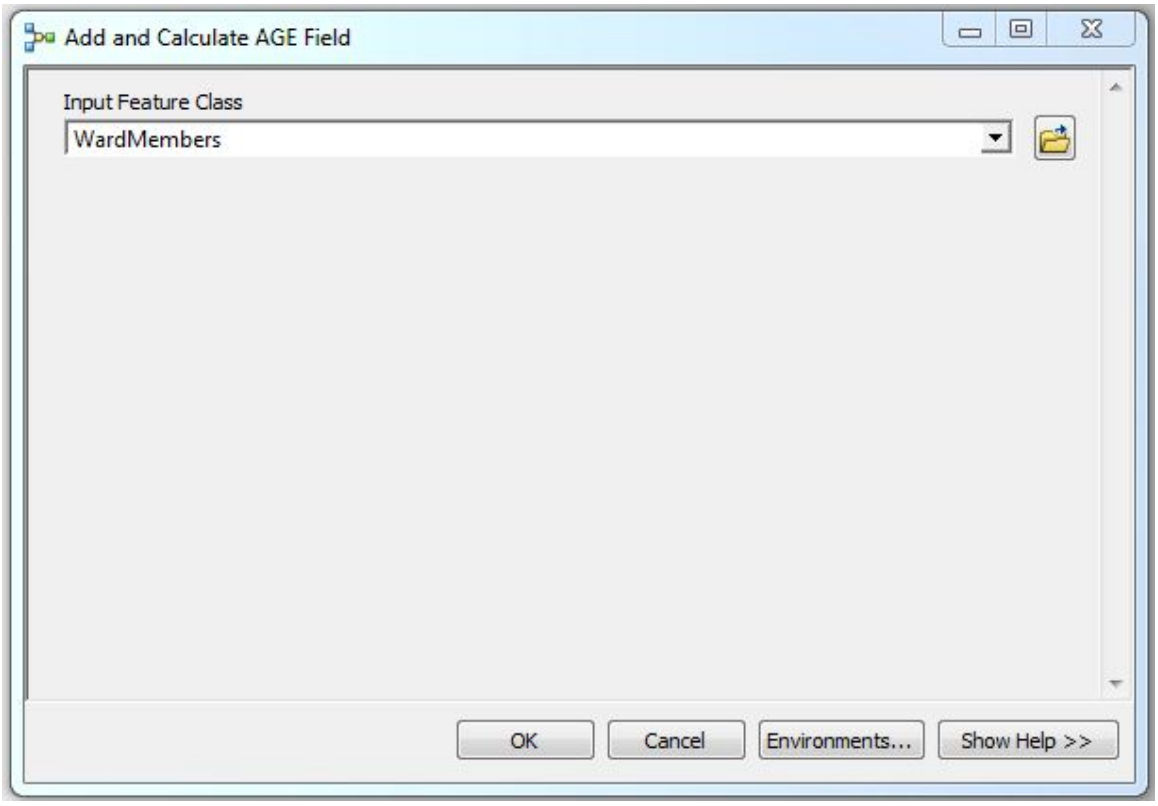

Figure 7 - "Add and Calculate Age Field" Tool Interface

4.2 Add LDS Fields to Feature Class

The "Add LDS Fields to Feature Class" model (Figure 8) was created to quickly create all the fields that will hold the necessary information in determining many of the needed criteria that are used when redistricting ward boundaries. The following fields (descriptions provided for clarification), all of type Long Integer, are created by the model:

- LDS_Total - Total number of LDS Members (all of these will be "LDS Members in a given geographical unit", so it is unnecessary to repeat in the description)

- LDS_Male - Total number of the male gender
- LDS_Female - Total number of the female gender
- LDS_Men - Total number of males, aged 18 years or older
- LDS_Women - Total number of females, aged 18 years or older
- LDS_Primary - Total number of Primary age children, aged 18 months up to, but not including, 12 years
- LDS_Primary_Boys - Total number of male Primary age children
- LDS_Primary_Girls - Total number of female Primary age children
- LDS_YM - Total number of male youth, aged 12 years up to, but not including, 18 years
- LDS_YW - Total number of female youth, aged 12 years up to, but not including, 18 years
- LDS_Eligible_Priesthood - Total number of males, aged 12 years and older
- LDS_Unordained - Total number of males, aged 12 years and older not holding any priesthood office
- LDS_Unordained_Youth - Total number of males, aged 12 years up to, but not including, 18 years, not holding any priesthood office
- LDS_Unordained_Men - Total number of males, aged 18 years and older, not holding any priesthood office
- LDS_Aaronic - Total number of males, aged 12 and older, holding an office in the Aaronic Priesthood (Deacon, Teacher, or Priest)
- LDS_Aaronic_Youth - Total number of males, aged 12 years up to, but not including, 18 years, holding an office in the Aaronic Priesthood

- LDS_Aaronic_Men - Total number of males, aged 18 years and older, holding an office in the Aaronic Priesthood
- LDS_AP_Deacons - Total number of males, aged 12 and older, holding the office of Deacon in the Aaronic Priesthood
- LDS_AP_Deacons_Youth - Total number of males, aged 12 years up to, but not including, 18 years, holding the office of Deacon in the Aaronic Priesthood
- LDS_AP_Deacons_Men - Total number of males, aged 18 years and older, holding the office of Deacon in the Aaronic Priesthood
- LDS_AP_Teachers - Total number of males, aged 14 and older, holding the office of Teacher in the Aaronic Priesthood
- LDS_AP_Teachers_Youth - Total number of males, aged 14 years up to, but not including, 18 years, holding the office of Teacher in the Aaronic Priesthood
- LDS_AP_Teachers_Men - Total number of males, aged 18 years and older, holding the office of Teacher in the Aaronic Priesthood
- LDS_AP_Priests - Total number of males, aged 16 and older, holding the office of Priest in the Aaronic Priesthood
- LDS_AP_Priests_Youth - Total number of males, aged 16 years up to, but not including, 18 years, holding the office of Priest in the Aaronic Priesthood
- LDS_AP_Priests_Men - Total number of males, aged 18 years and older, holding the office of Priest in the Aaronic Priesthood
- LDS_Melchizedek - Total number of males, aged 18 years and older, holding an office in the Melchizedek Priesthood (Elder, High Priest, Seventy, Patriarch, and Apostle)

- LDS_MP_Elders - Total number of males, aged 18 years and older, holding the office of Elder in the Melchizedek Priesthood
- LDS_MP_HighPriests - Total number of males, aged 18 years and older, holding the office of High Priest in the Melchizedek Priesthood
- LDS_MP_Others - Total number of males, aged 18 years and older, holding any of the other offices (Seventy, Patriarch, Apostle) in the Melchizedek Priesthood

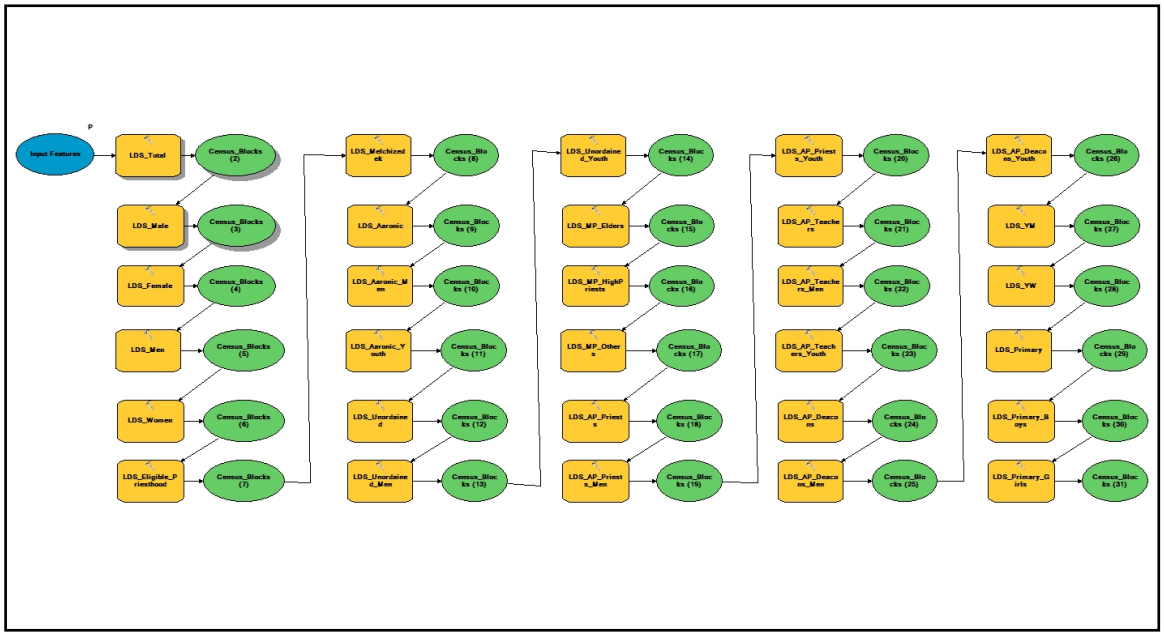

Figure 8 - "Add LDS Fields to Feature Class" Model Diagram

Because of the size of the model, even when arranged in an orderly manner, it doesn't effectively fit to depict appropriately. Figures 9 and 10 show zoomed in portions of Figure 8.

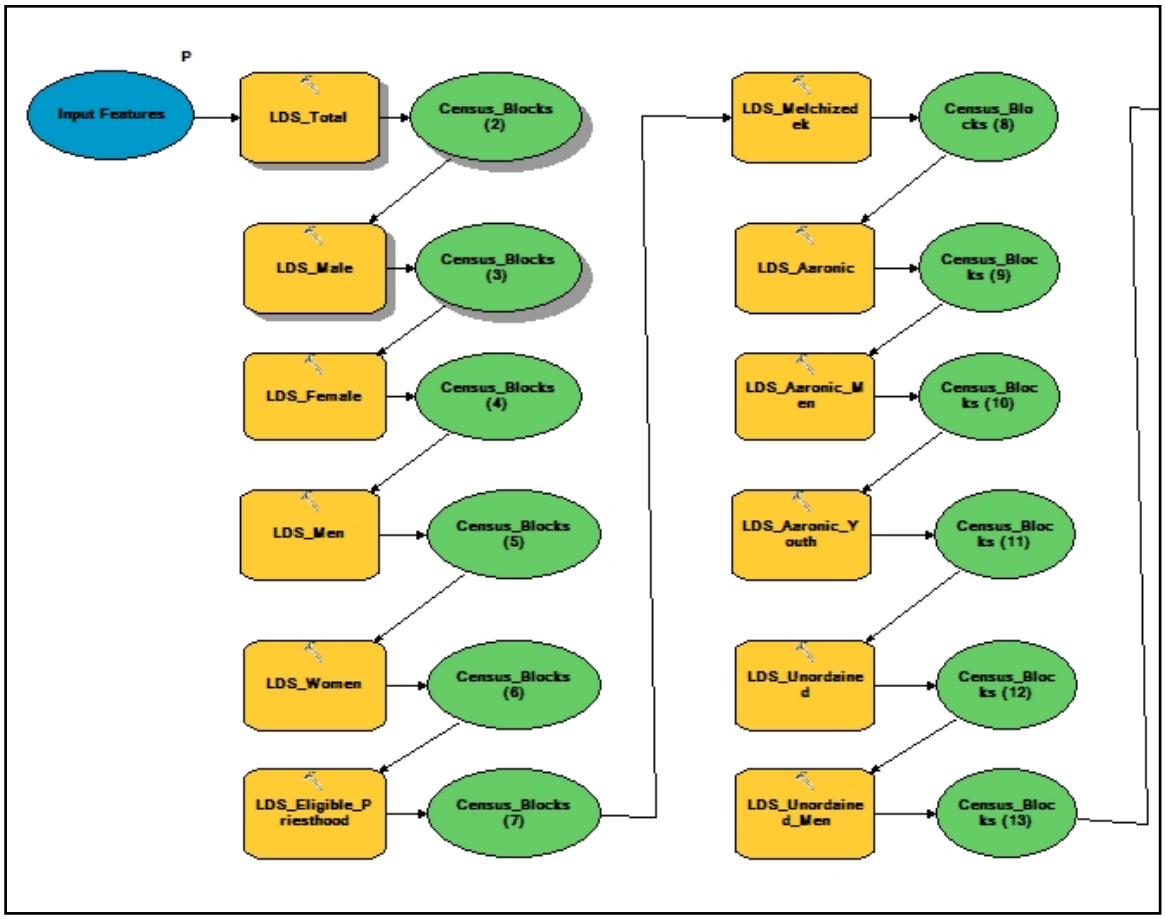

Figure 9 - Zoomed in View of Model Diagram (Left-side)

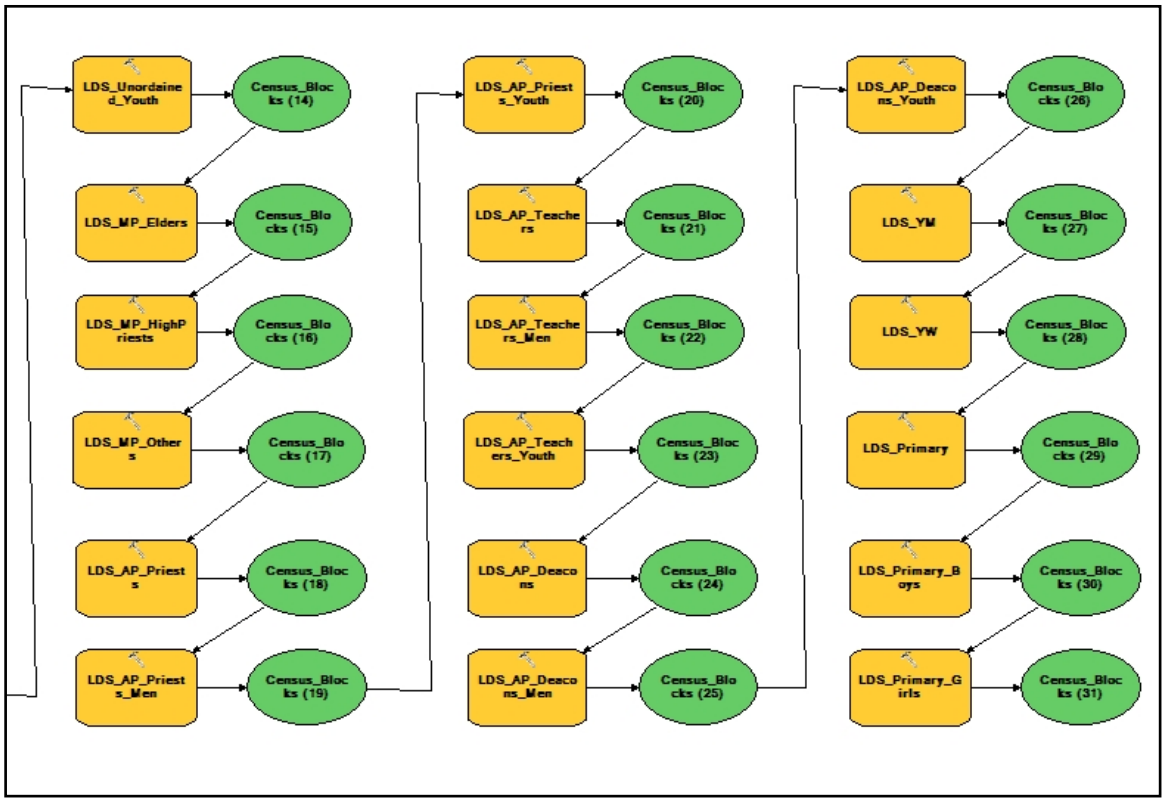

Figure 10 - Zoomed in View of Model Diagram (Right-side)

Similar to the "Add and Calculate Age Field" tool, running of the tool is as simple as double-clicking it to open up a GUI and setting the input data to be the table or geographic units/sub-units of choice (Figure 11), where the VBA or Python script stores the summarized values for all the categories and fields listed above.

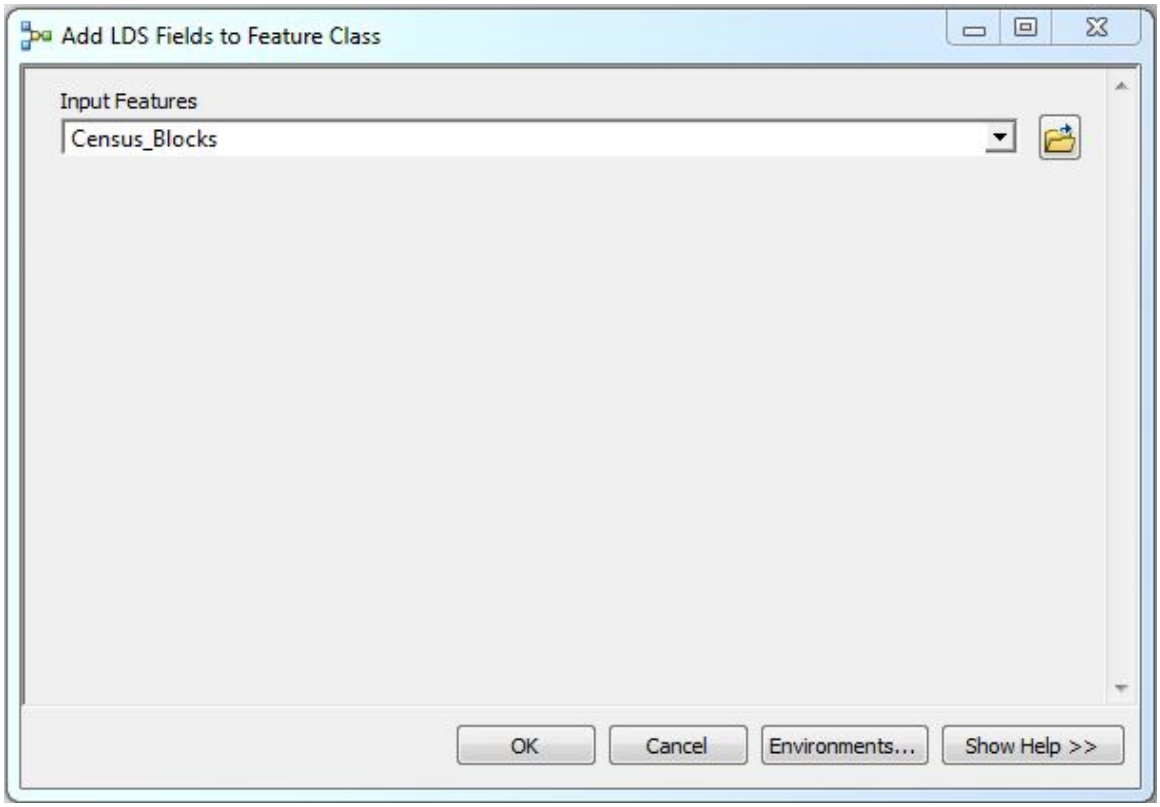

Figure 11 - "Add LDS Fields to Feature Class" Tool Interface

4.3 Calculate Null Values to Zero on LDS Fields

The “Calculate Null Values to Zero on LDS Fields” model (Figure 12) was created to assist in the final tallying and summarization of values for the geographic units. Because of the way that some software programs handle null values, it was found that a zero value still represented the lack of an LDS member for that particular categorization, but didn’t negatively affect calculations or percentages the way that null values did.

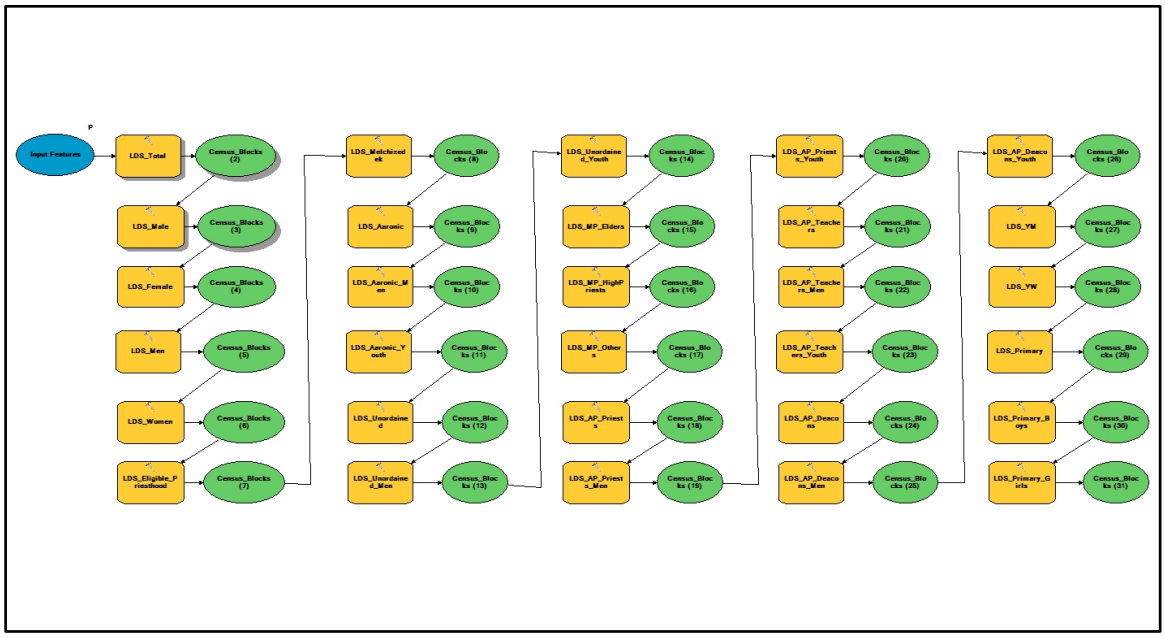

Figure 12 - "Calculate Null Values to Zero on LDS Fields" Model Diagram

Similar to Figure 8, Figure 12 is too large to appropriately depict and was split into Figures 13 and 14 to display at a scale where detail can be identified.

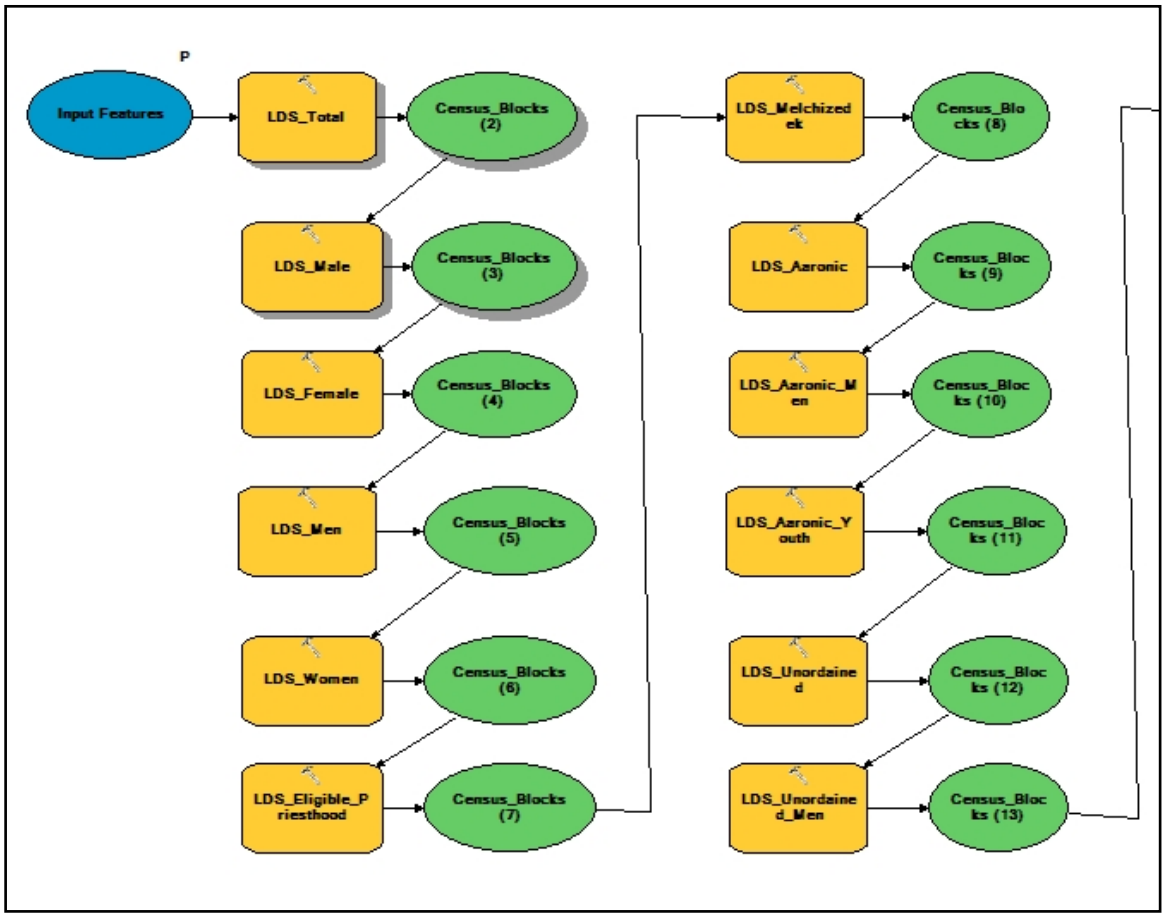

Figure 13 - Zoomed in View of Model Diagram (Left-side)

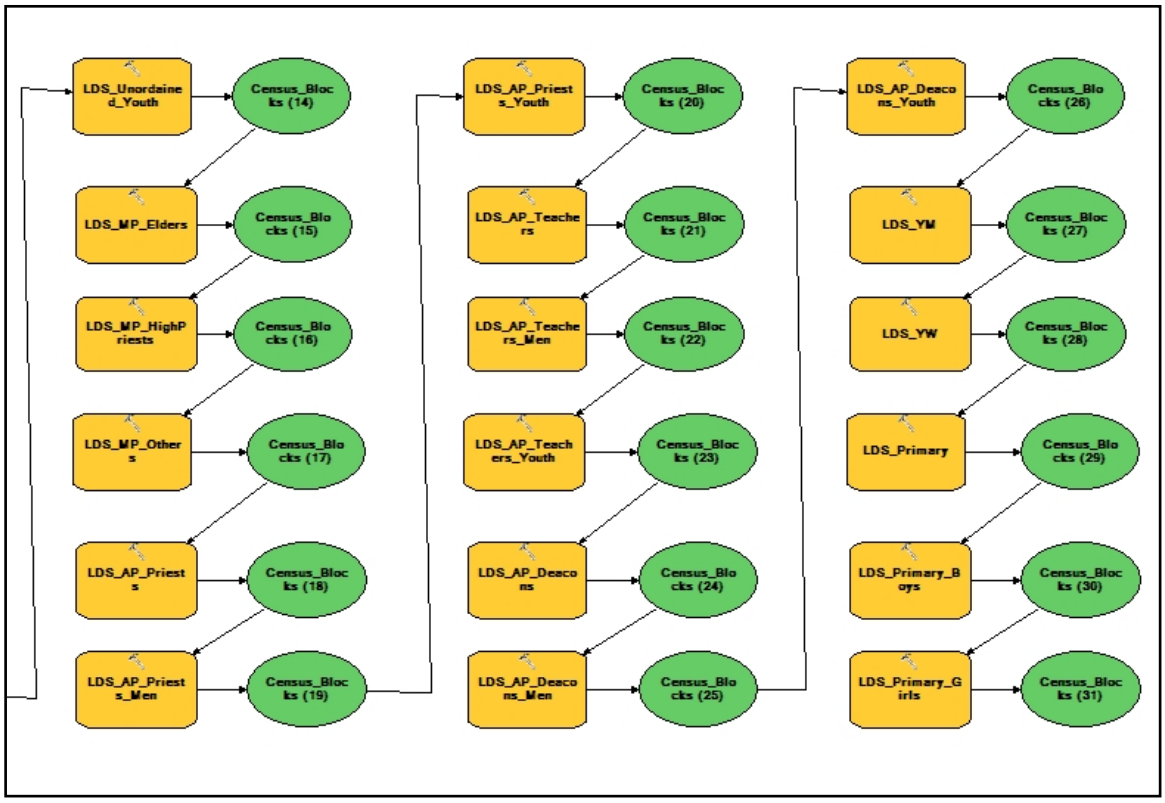

Figure 14 - Zoomed in View of Model Diagram (Right-side)

If a valid value already exists, the calculation will use that value. Otherwise, the value will be changed from null to zero. The following is the calculation used to set each field's value from null to zero:

Equation 2 - "Calculate Null Values to Zero on LDS Fields" calculation

```
Dim val, newVal
val = [LDS_MP_HighPriests]
If val = Null Then
  newVal = 0
Else
  newVal = val
End If
```

Running of the tool is as simple as double-clicking it to open up a GUI and setting the input data to be the table or geographic units/sub-units of choice (Figure 15).

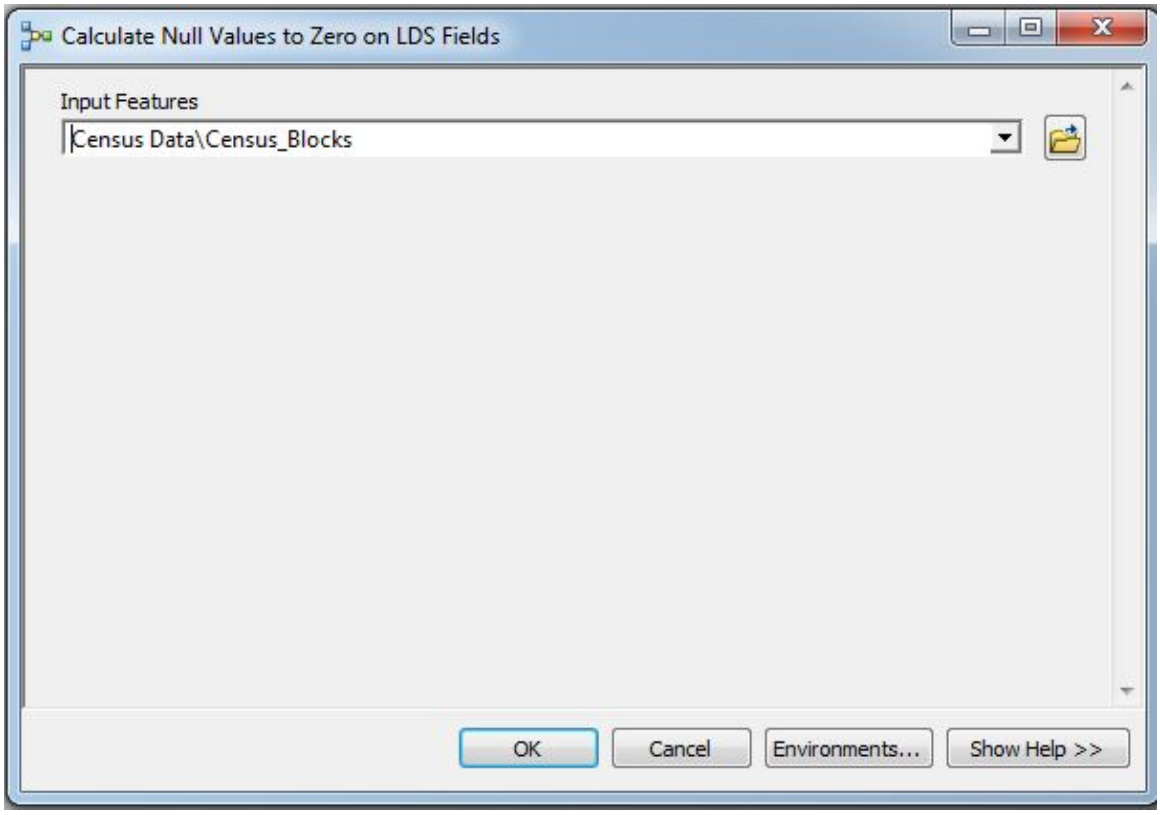

Figure 15 - "Calculate Null Values to Zero on LDS Fields" Tool Interface

4.4 Performing Identity on Membership Points

The "Performing Identity on Membership Points" model (Figure 16) was created as a data preparation step to quickly associate (copy attribute information from polygons over to points) the membership points with the chosen geographic units, in this case, census block polygons. This is a quick way to get the unique name field and value from each geographic unit (census block id field and value) associated with, or copied over to, the membership points. Since the LDS Church does not keep polygon-level demographic information, this step is essential in "associating" each LDS member point to the census block in which they reside. By doing so, the point data is prepared for the summarization portion (done via the VBA or Python code) that will summarize all LDS demographic information for each geographic unit, particularly in this research, census block polygons.

After the summarization portion of the redistricting process (presented in sections 3.3.1.7 and 3.3.1.8), and the data has been loaded into the Districting for ArcGIS software as the "Plan Geography", it enables quick assessment of how moving one geographic unit from one ward to another affects the balance of membership.

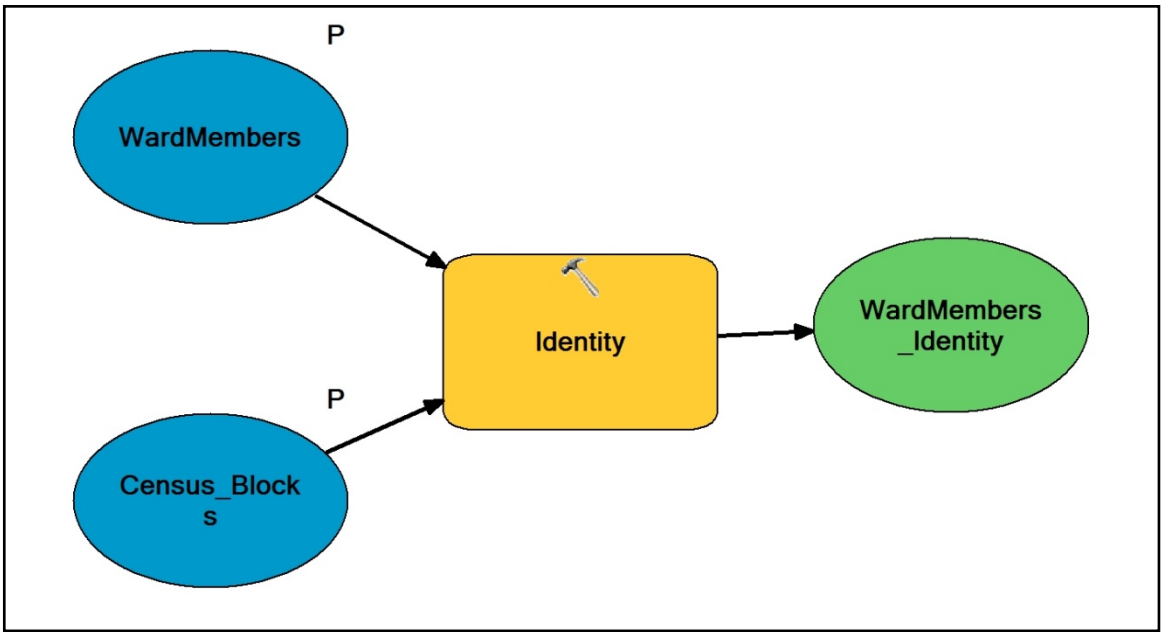

Figure 16 - "Performing Identity on Membership Points" Model Diagram

Running of the tool is as simple as double-clicking it to open up a GUI and setting the input data to be the ward membership points feature class and the geographic units/sub-units of choice polygon feature class (Figure 17). The output is a point feature class that retains all of the information that existed on the ward membership point feature class, but also has the associated information from the polygon feature class. For this research, the individual ward member point feature class and the census block polygon feature class were used as the inputs for this model.

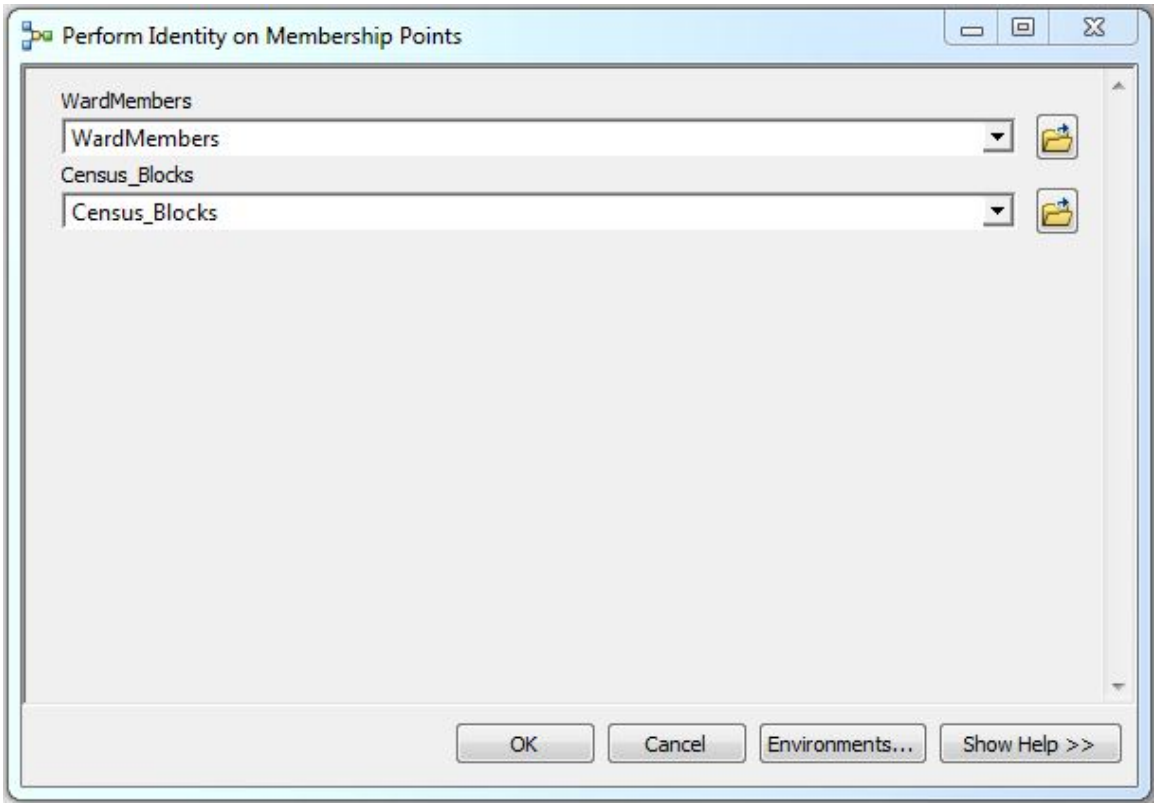

Figure 17 - "Performing Identity on Membership Points" Tool Interface

4.5 VBA Coding

The initial code for the summarization portion, presented in section 3.3.1.7, was written in VBA, and while functional, was less than stream-lined. Appendix A lists the VBA code that was initially used for the summarization portion. Simply creating each of the variables and setting up the cursors used to iterate through the data and write the tallies to each field takes over 100 lines of code, just for initialization…before any analysis is even done. Also, the code to "reset" the counter variables, found in Appendix A after the comment/line: "Resetting the counters to zero" consists of about 30 lines of code and is repeated three times: once to initially set the variables to zero, and then two times to reset them before tallying up the next geographic unit's members. The code to tally up the members and increment each variable's value, found in Appendix A after the

comment/line “Setting up values to compare before deriving counts” consists of about 120 lines of code and is repeated twice in the code: once when processing moves to tallying up members in a new geographic unit, and also in the code section that continues tallying up members in the current geographic unit that is being processed.

4.6 Python Coding

Due to some of the many inefficiencies of the original coding initiative, coupled with the inability of the code to be used in a model and the previously mentioned deprecation of VBA in ArcGIS, the code that was used for the summarization portion was re-written in Python, presented in section 3.3.1.8, and is found in Appendix B. Not only was the code optimized and redundancies eliminated, but the processing of the code takes considerably less time when running in Python compared to running the VBA code. The re-writing of the summarization portion code from VBA to Python did not affect any of the four models detailed in sections 4.1-4.4, but, as outlined below, did provide several benefits and gains in efficiency.

The variables were placed into sets of Python lists, with all the separate lists placed into one main Python list, which allowed for iteration over the lists when resetting the variables, incrementing the variables, or tallying up membership statistics was needed. Separate functions for each of those three processes (resetting, incrementing, or tallying) were created to remove the redundant code that was previously present, and can be found in the “ResetCounters”, “IncreaseCounters”, and “TallyMemberStatistics” function-definition sections of the Python code, listed in Appendix B. This allowed for the main portion of the code to be focused on iterating through the membership points for each

geographic unit and only call the appropriate functions when needed. The move from VBA to Python reduced the code from 572 lines of code to 213 lines of code (227 lines, with the addition of error handling), removing over 350 lines of redundant or unnecessary code by utilizing Python objects and functions. Moving to Python also allowed for a GUI to be utilized to run the code (Figure 18), as opposed to the previous method of having to run the VBA code from inside ArcMap's Visual Basic Editor.

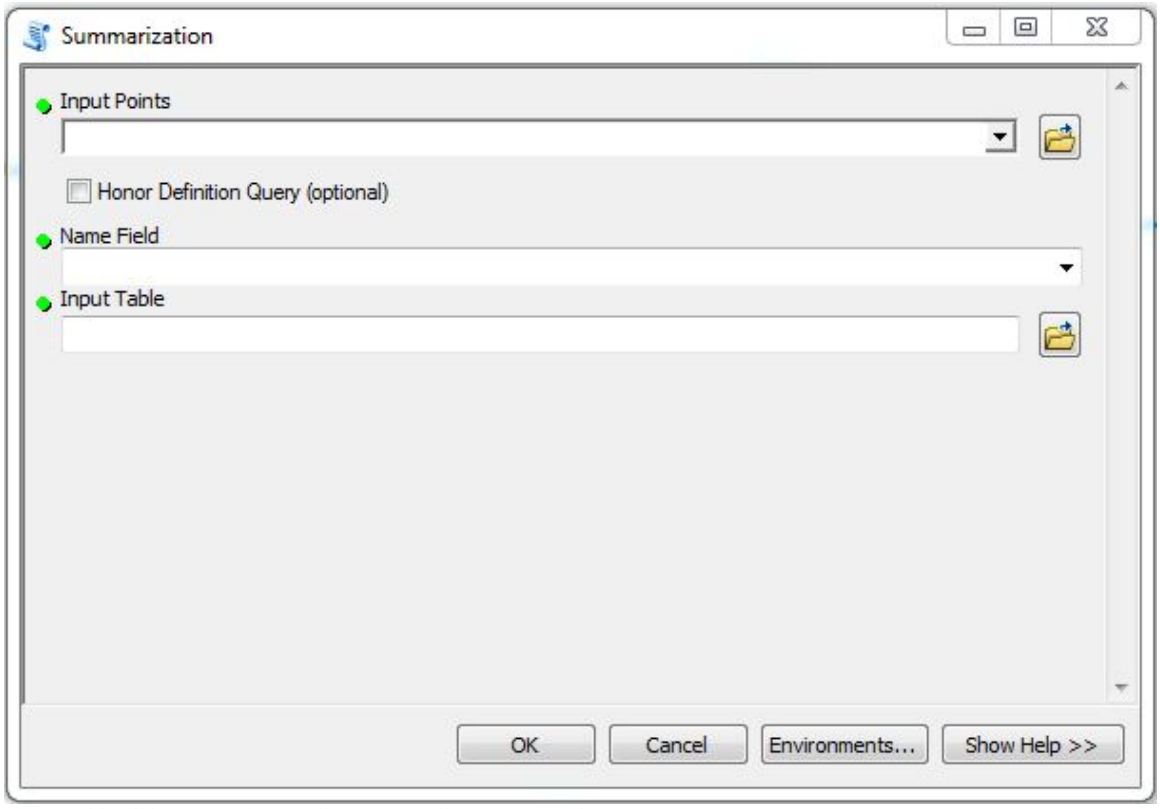

Figure 18 - "SummarizeLDSMembers" Tool Interface

With the previous VBA code, as well as the updated Python code, the data preparation phase, particularly the LDS demographic summarization portion, was greatly streamlined, allowing for quicker transition from the decision for the need for redistricting until the data is prepared for the final analysis. At that point, it simply became a matter of batch assigning neighborhoods or subdivisions by selecting and assigning the census block polygon geographic units from one ward to another inside the Districting for ArcGIS software, as previously defined.

CHAPTER 5: Results and Discussion

As previously mentioned, due to the use of actual Stake membership data, inclusion of the detailed analysis and locations depicting Stake members' residences isn't possible due to privacy policies; however, versions of the "baseline" and "proposed" boundaries along with tables of summary statistics are included for review. The baseline or starting point for comparison is shown in Figure 19. Statistics for the baseline plan can be found in Table 1 (Section 3.3 - Methodology). The updated, proposed boundaries are shown in Figure 20.

5.1 Ward Boundaries - Baseline & Proposed

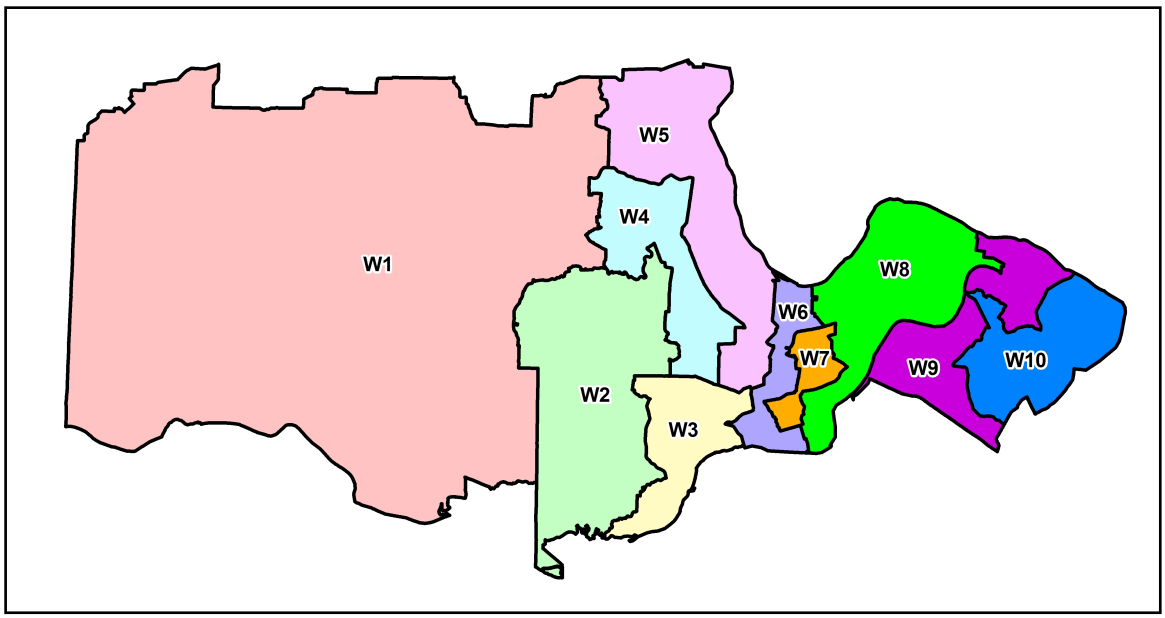

Figure 19 - Baseline Redistricting Plan

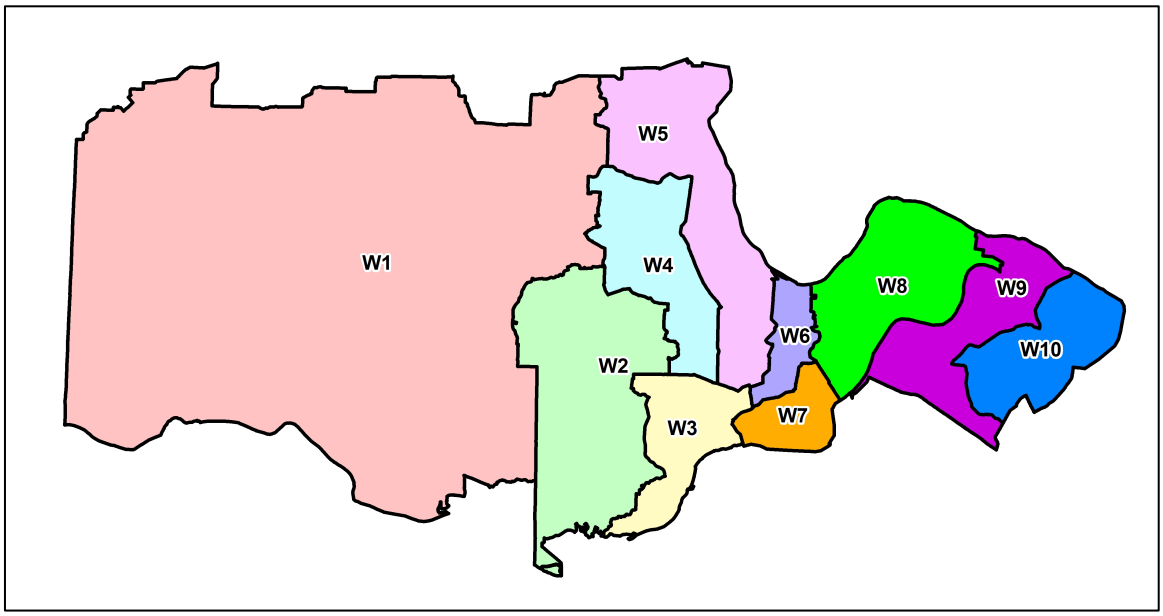

Figure 20 - Proposed Redistricting Plan

Efforts were made to balance all variables as previously outlined in the thesis. To that effect, due to the other constraints inherent in the LDS redistricting process, some of the ward boundaries had minimal geographic changes, notably the Warrenton (W1), Lake St. Louis (W2), O'Fallon (W4), Dardenne Creek (W5), and Missouri River Wards (W3). The greatest geographic differences in ward boundaries are noticeable in the Weldon Spring (W6), St. Peters (W7), St. Charles (W8), Hazelwood (W9), and Florissant Wards (W10). A map depicting the geographic differences in the baseline plan and the proposed plan is shown in Figure 21. The areas of change (that transferred from one ward to another) are indicated with a hatching pattern in Figure 21, with the largest areas clearly visible. Areas of a solid color designate geographic areas that did not change wards.

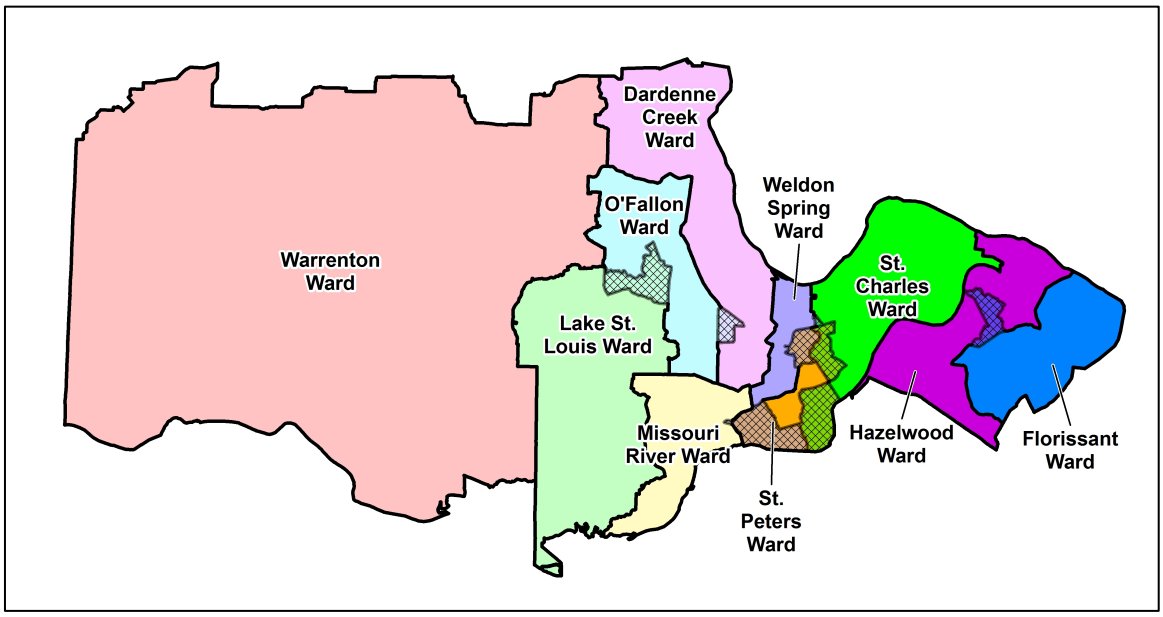

Figure 21 - Comparison of Plan Boundaries (Baseline & Proposed)

5.2 LDS Demographic Changes, Impacts, and Differences

Summary statistics that were allowed to be portrayed for the proposed plan are depicted in Table 2, showing the impact to each ward, broken down by changes in the number of individuals and changes in the number of families for each ward.

Table 2 - Proposed Plan Demographics

Ward	Individuals (Baseline)	Individuals (Proposed)	Difference	Families (Baseline)	Families (Proposed)	Difference
Dardenne Creek Ward	317	339	22	145	154	9
Florissant Ward	429	448	19	196	204	8
Hazelwood Ward	481	463	-18	220	211	-9
Lake St. Louis Ward	398	398	0	182	182	0
Missouri River Ward	258	285	27	118	133	15
O'Fallon Ward	415	402	-13	190	182	-8
St. Charles Ward	446	404	-42	204	187	-17
St. Peters Ward	387	398	11	177	182	5
Warrenton Ward	523	523	0	239	239	0
Weldon Spring Ward	315	309	-6	144	141	-3
TOTALS		***3969***	-		***1815***	-
AVERAGES		***397***	-		***182***	-

Consistent with Church Policy, all families and members were accounted for and no family or individual member that previously belonged to a ward went unassigned or forgotten. While there were changes to most wards, the trend across the St. Louis Missouri North Stake was that the ward demographics became a little more "balanced" after the proposed realignment. With regard to the Warrenton Ward and the negligible change in individuals and families, there are a few reasons for the lack of change. First, the analysis was done intra-Stake, so given the size of the Warrenton Ward, if any areas were to be "subtracted" from that ward, they would have to be "added" to an adjacent ward, which would increase the travel time for those church members to attend a different building instead of the Warrenton Building. Second, even if those areas could be moved to a different, adjacent stake (which is outside the scope of this thesis), the

western boundary of the stake is actually about half-way between the Warrenton Building meetinghouse and the next-closest meetinghouse, located in Fulton, Missouri, so the stake boundary is already logically located. Third, the majority of the population in that ward lives along Interstate 70, near to the Warrenton Building, with the minority of the ward living in the periphery of the ward. So, only smaller census blocks that actually did not contain any members were transferred to the adjacent wards (O'Fallon Ward, Dardenne Creek Ward, and Lake St. Louis Ward), resulting in the changes to the IPQ of the Warrenton Ward (identified in Table 4), but not any change to ward demographic information (identified in Table 2).

5.3 School District & County Changes, Impacts, and Differences

Table 3 compares and identifies the differences between two of the parameters that were not related to member demographics, namely the number of school districts per ward and the number of counties per ward. A map of the boundaries from the proposed plan, along with county boundaries, is shown in Figure 22. A separate map showing the proposed plan boundaries along with school district boundaries is shown in Figure 23.

Table 3 - County and School District Comparisons

Ward	# of Counties (Baseline)	# of Counties (Proposed)	Difference	# of School Districts (Baseline)	# of School Districts (Proposed)	Difference
Dardenne Creek Ward (W5)	2	2	-	5	5	-
Florissant Ward (W10)	3	3	-	7	7	-
Hazelwood Ward (W9)	2	2	-	6	6	-
Lake St. Louis Ward (W2)	2	2	-	5	5	-
Missouri River Ward (W3)	1	1	-	4	4	-
O'Fallon Ward (W4)	2	2	-	4	4	-
St. Charles Ward (W8)	1	1	-	3	3	-
St. Peters Ward (W7)	1	1	-	4	3	-1
Warrenton Ward (W1)	4	4	-	9	9	-
Weldon Spring Ward (W6)	1	1	-	4	4	-

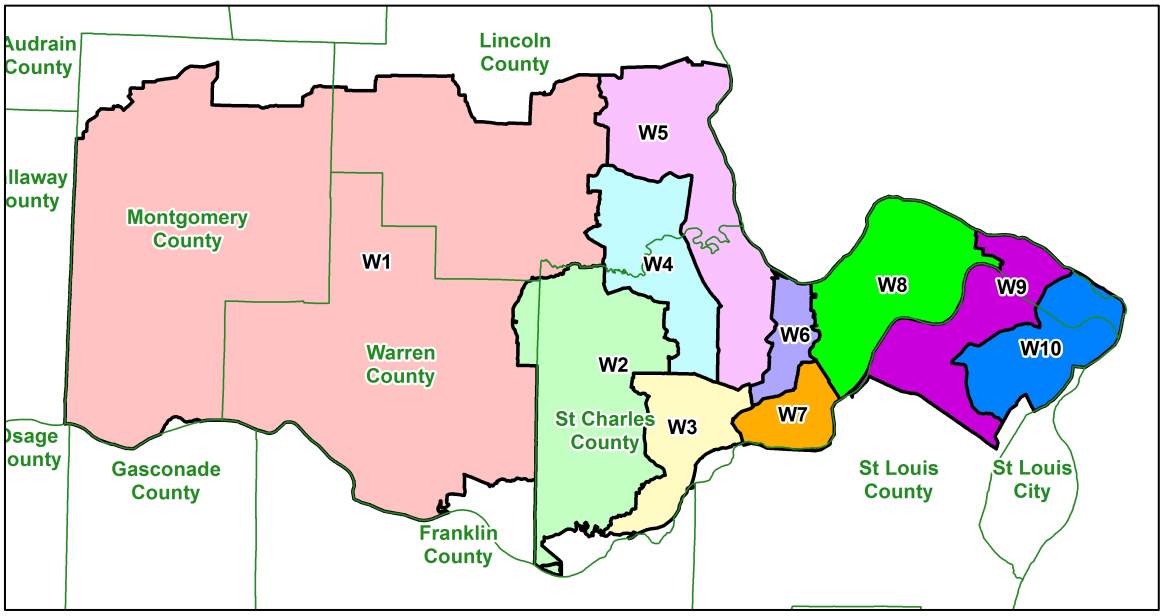

Figure 22 - Proposed Plan with County Boundaries

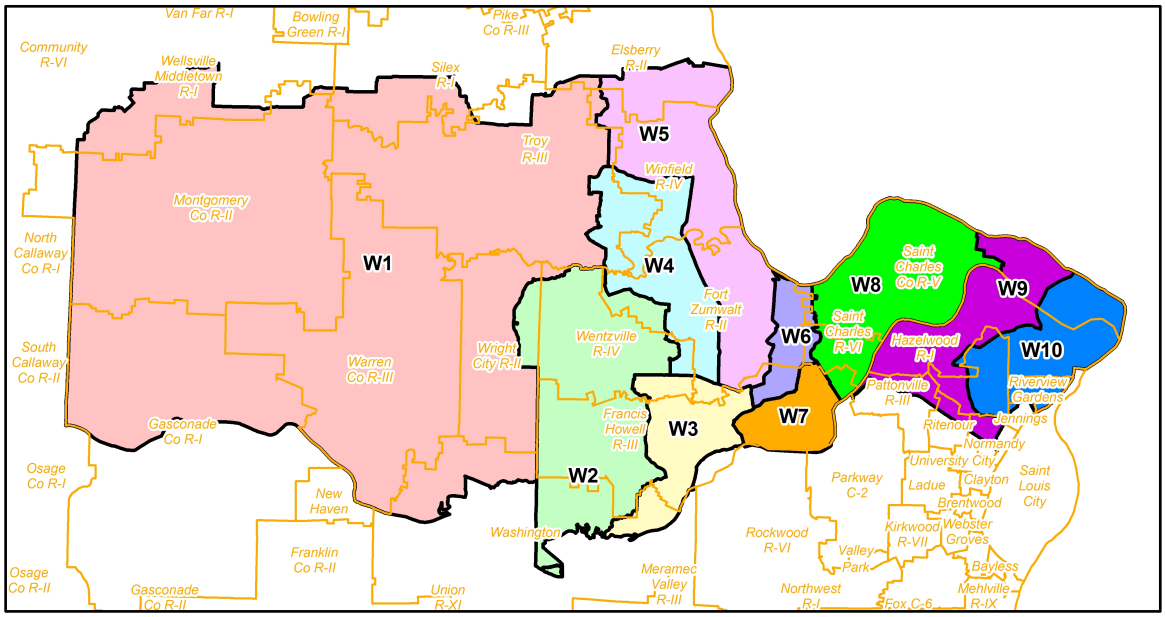

Figure 23 - Proposed Plan with School District Boundaries

Because this analysis was done intra-Stake, it may appear that not much optimization or benefit was achieved when looking at the table; however, this is due to the fact that there are some wards that have small slivers of one or more school districts (due to previous boundary alignments) that might be better served if transferred to the adjacent stake, which could result not only in geospatial optimization, but also in feelings of greater ward unity, since ward members won't be split amongst so many school districts. Further, there are a few areas, specifically in the northwest corner of the Lake St. Louis Ward (W2) and along the border between that ward and the Warrenton Ward (W1), but present in other smaller areas throughout the stake, that are not coincident with the county or school district boundaries. These areas contain multiple LDS families, and if transferred to the Warrenton Ward in order to align with the county or school district boundaries, would result in adding even more members to the Warrenton Ward, further increasing the disparity between the Warrenton Ward and the rest of the stake, with

regard to averages and approaching an optimized number of families and individuals, as noted in Table 2.

5.4 Geographic Compactness Changes, Impacts, and Differences

Table 4 compares and identifies the Isoperimetric Quotient for each ward. Any improvements or decreases in any category are also identified. Due to the geographic size of the St. Louis Missouri North Stake, the author utilized a 10% threshold for a difference in the Isoperimetric Quotient as being "negligible" or having minimal impact to any real gains or losses in a measure of "compactness". Thus, differences of 90%-110% remain depicted in black text, with any losses (<90%) identified in red and any gains in "compactness" (>110%) identified in green.

Table 4 - Isoperimetric Quotient Comparison

Ward	Isoperimetric Quotient (Baseline)	Isoperimetric Quotient (Proposed)	Percent Difference
Dardenne Creek Ward (W5)	0.3013	0.2849	95%
Florissant Ward (W10)	0.3588	0.5482	153%
Hazelwood Ward (W9)	0.2316	0.2438	105%
Lake St. Louis Ward (W2)	0.3226	0.2999	93%
Missouri River Ward (W3)	0.4039	0.3218	80%
O'Fallon Ward (W4)	0.2794	0.3700	132%
St. Charles Ward (W8)	0.3831	0.5021	131%
St. Peters Ward (W7)	0.3108	0.6396	206%
Warrenton Ward (W1)	0.4714	0.4413	94%
Weldon Spring Ward (W6)	0.2313	0.3284	142%

As evidenced in Table 2 and Table 4, some progress was made in being able to arrive at gains, either to a balancing of LDS demographics across wards, achieving a greater "compactness" or geographically-efficient area for a ward and sometimes both. The five

wards that were impacted the most in compactness were the St. Peters Ward (206% difference), Florissant Ward (153% difference), Weldon Spring Ward (142% difference), O'Fallon Ward (132% difference), and the St. Charles Ward (131% difference), and is depicted in Figure 24. The previously designated "Unassigned" areas did not have any change (0% difference).

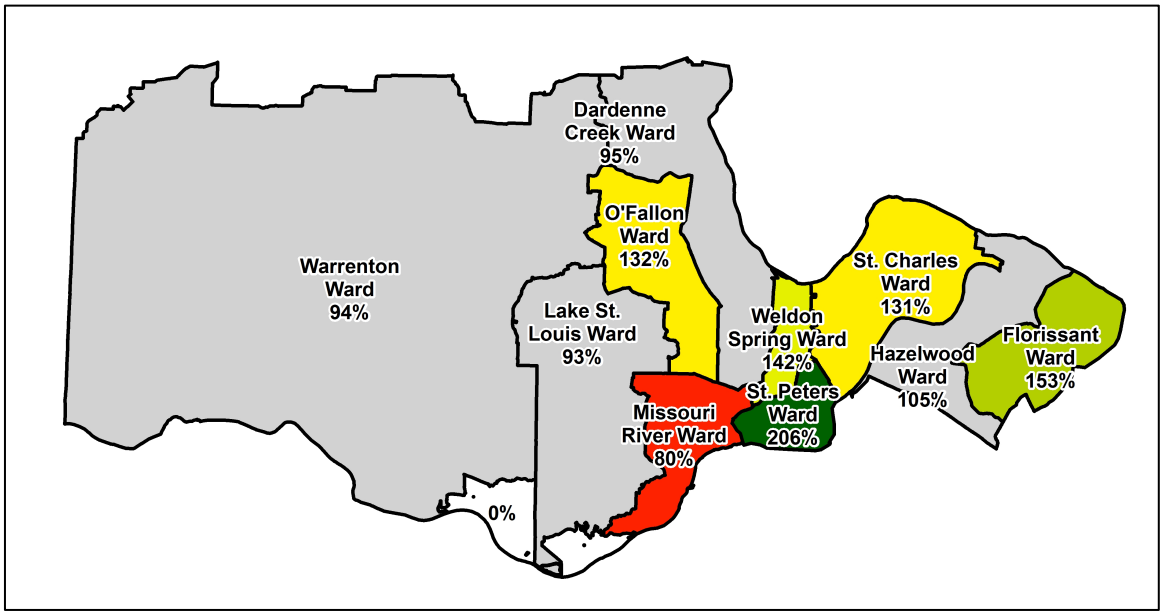

Figure 24 - Proposed Plan with Isoperimetric Quotient Changes

CHAPTER 6: Conclusions, Limitations, and Future Research Suggestions

6.1 Conclusions

By utilizing a GIS approach to the redistricting process of LDS Church ward boundaries, a previously manual and time-consuming process was greatly improved with much efficiency gained. As stated earlier, since the process was entirely manual, any automation or efficiency was an improvement. The models to prepare the data and the scripts that summarize and insert the LDS demographic data onto the polygons remove a few months of work from the LDS ward redistricting process. While the code may not provide a revolutionary breakthrough in the area of political redistricting, it does provide an innovative benefit to LDS redistricting, due to the tallying and analysis capability of the script. Because Districting for ArcGIS and other redistricting software programs, such as TARGET and RedAppl, use census data as the foundation for redistricting, coupled with the LDS Church's shift to using physical boundaries as delimiting features when drawing or altering ward boundaries, the augmentation of census data to have LDS demographic attribution included provides a new approach for LDS redistricting.

Along with this, by utilizing the Districting for ArcGIS software, the reassignment phase of the redistricting process, that previously consumed the remaining months in the nearly year-long process, is quickened by utilizing existing supplemental polygon data (school districts, counties, hydrography, etc.), such that even more time saving is realized. The software's capability to export plan geography, attribute, and statistical information provides a needed "jump start" to the ward redistricting process, providing LDS Church ecclesiastical leaders with all the information needed, as well as maps, to visualize and

understand the impacts associated with LDS Church ward redistricting. With this starting point for further discussions, LDS Church ecclesiastical leaders can then ponder potential changes, and after agreement, submit the proposed plan to LDS Church headquarters in Salt Lake City, Utah for formal approval.

While able to provide a "jump start" to the ward redistricting process, there are numerous improvements and refinements found during the research that could be undertaken. The anticipated end product of a script or tool that can be used again in the future, either by this stake or by other stakes, was achieved, though for greater use, it needs to be "hosted" as an ArcGIS Server tool. For the best use, this tool should ultimately be hosted by the LDS Church Headquarters, as they already have an ArcGIS Server that they are beginning to utilize to serve up read-only data to users. This would eliminate the workload of data compilation, creation, and summarization that a stake normally does for ward redistricting.

While initially conceived as a way to redistrict a stake, the process could actually be used to district/redistrict smaller or larger units, with minimal modification to the underlying code. A ward could be sub-divided into zones and districts for emergency preparedness purposes. Stakes are actually the sub-units of much larger "areas". For example, the St. Louis Missouri North Stake is part of the North America Central Area. The level of detail in the information used for ward-level redistricting would be overwhelming at the area and stake level, though, so the script/model would have to be modified to not summarize all the ward-level data, but rather, give general numbers for wards and stakes.

A suggested redistricting plan will be given to the current Stake President for his evaluation, consultation, and potential implementation, and after receiving his feedback and recommendations, I will be able to make the necessary changes and amendments to the suggested plan.

6.2 Limitations

There were a few limitations to the research, some that affected the actual research, but some that affected the release of information after the fact. First, during the research process, while obtaining approval to not only use but also to release the data and information, the request to use the data was sent up the LDS Church administration leadership, all the way to Salt Lake City, until approval to continue with the research was granted, but with stipulations placed on the release of data, as outlined previously in the research. Because of the data privacy restrictions put in place, it impacted the release of the full impact of new ward boundaries, which would have shown in more detail how a balancing of LDS demographics between wards was achieved because of the redistricting. Research was also constrained to intra-Stake, ultimately bounded by the boundary of the St. Louis Missouri North Stake. As such, re-assignment of census blocks from the St. Louis Missouri North Stake to adjacent stakes in order to meet all redistricting criteria or the needs outlined in section 3.3.2.4 was limited. Areas that might have been better transferred from one stake to another, such as small slivers of a ward that are the only part of one school district, could not be moved and had to remain in the stake. Additionally, the LDS Church will tend to err on the side of "non-distrubance", meaning that unless there is a compelling reason for moving people between wards, they

tend to leave them as assigned. Thus, according to the current LDS redistricting process, swapping census blocks or neighborhoods from one ward to another simply to align better with county or school district boundaries is generally not a compelling enough reason to make such a change. Further, school district boundaries frequently did not coincide with census blocks, which made it difficult to achieve a close match between ward boundaries and school district boundaries in the attempt to reduce the number of school districts for each ward. This led to limited improvements in reducing the numbers of school districts and counties for each ward, as outlined in section 5.3.

6.3 Future Research Suggestions

Throughout the course of the research, many additional ideas and areas for improvement became apparent, but would have been outside the scope of the research. However, many of these ideas provide excellent suggestions for future research or continuation of this research. The data was all downloaded to a local computer and redistricting was done on the local computer. Because of the LDS Church's data privacy policy, the redistricting process should be attempted by utilizing data that is hosted on a server, notably, the LDS Church's current GIS servers. In addition, the processing could be done on those servers' scratch workspace. Both of these would allow the Church to keep all the data, process the data, and then only return the new redistricting plans to the end-user, without releasing any of the data.

In addition to the movement of the data to a server, the tools and scripts could also be moved to a server. This would allow the scripts and tools to be converted to ArcGIS Server-based tools and hosted on the LDS Church's current GIS servers. Alternatively,

research into using an Open Geospatial Consortium (OGC) Web Processing Service (WPS) for the models and scripts could be researched, to allow the LDS Church to utilize GIS processing standards for handling the data preparation and summarization processes.

The LDS Church has also transitioned to using a Single-Sign-On (SSO) account, known as an "LDS Account". In addition to providing access to several LDS websites and data repositories, the account is role-based and grants further access to local ward and stake leaders. By tying the LDS Account to the GIS servers, and specifically the redistricting scripts and tools, only those with the appropriate authentication and authorization would get access to the redistricting capability.

During the course of the research, in addition to the Districting for ArcGIS extension for the desktop-based ArcGIS software, Esri released a new Software-as-a-Service (SaaS) known as "Esri Redistricting". This is a completely web-based redistricting application that uses data hosted on Esri's servers and keeps all processing done on web-accessible servers (a.k.a. "the cloud"). By researching this software, the LDS Church might be able to utilize the redistricting capability with a very low cost-of-ownership, by leveraging the SaaS instead of the ArcGIS desktop software and the Districting for ArcGIS extension.

An additional area for further research would be the application of the research from a stake, or inter-ward, level to an intra-ward level. LDS wards are often divided into zones, which are then divided into districts, for emergency preparedness purposes. Extension of this research to sub-divide a ward into zones, and then sub-dividing zones into districts

could be undertaken to show the flexibility of the research and application of the criteria for balancing demographics and achieving geographic compactness.

Assessment of each and every parameter, individually as well as combined together, would also be beneficial. Research could be undertaken to evaluate which parameters could be 100% honored, or if not possible, to what degree, which could help to establish suggested weightings for all the parameters, geographic and demographic. Lastly, changing the study area for future research may alleviate some of the limitations noted in Section 6.2, such as school district boundaries not aligning with census blocks, but it might also introduce new, previously unobserved limitations to the research. Evaluation of any of the previous suggestions poses several promising challenges and opportunities for future research.

Appendix A: "SummarizeLDSMembers" VBA Code

```
Public Sub SummarizeLDSMembers()
    Dim pAge As Single
    Dim pGender As Integer
    Dim pPriesthood As Integer

    Dim pLDS_Total_Val As Integer
    Dim pLDS_Male_Val, pLDS_Female_Val As Integer
    Dim pLDS_Men_Val, pLDS_Women_Val As Integer

    Dim pLDS_Eligible_Priesthood_Val, pLDS_Melchizedek_Val,
pLDS_Aaronic_Val, pLDS_Aaronic_Men_Val, pLDS_Aaronic_Youth_Val As
Integer
    Dim pLDS_Unordained_Val, pLDS_Unordained_Men_Val,
pLDS_Unordained_Youth_Val As Integer

    Dim pLDS_MP_Elders_Val, pLDS_MP_HighPriests_Val, pLDS_MP_Others_Val
As Integer

    Dim pLDS_AP_Priests_Val, pLDS_AP_Teachers_Val, pLDS_AP_Deacons_Val
As Integer
    Dim pLDS_AP_Priests_Youth_Val, pLDS_AP_Teachers_Youth_Val,
pLDS_AP_Deacons_Youth_Val As Integer
    Dim pLDS_AP_Priests_Men_Val, pLDS_AP_Teachers_Men_Val,
pLDS_AP_Deacons_Men_Val As Integer

    Dim pLDS_YM_Val, pLDS_YW_Val, pLDS_Primary_Val,
pLDS_Primary_Boys_Val, pLDS_Primary_Girls_Val As Integer

    Dim pLDS_All_Total_Val As Integer
    Dim pLDS_All_Male_Val, pLDS_All_Female_Val As Integer
    Dim pLDS_All_Men_Val, pLDS_All_Women_Val As Integer

    Dim pLDS_All_Eligible_Priesthood_Val, pLDS_All_Melchizedek_Val,
pLDS_All_Aaronic_Val, pLDS_All_Aaronic_Men_Val,
pLDS_All_Aaronic_Youth_Val As Integer
    Dim pLDS_All_Unordained_Val, pLDS_All_Unordained_Men_Val,
pLDS_All_Unordained_Youth_Val As Integer

    Dim pLDS_All_MP_Elders_Val, pLDS_All_MP_HighPriests_Val,
pLDS_All_MP_Others_Val As Integer

    Dim pLDS_All_AP_Priests_Val, pLDS_All_AP_Teachers_Val,
pLDS_All_AP_Deacons_Val As Integer
    Dim pLDS_All_AP_Priests_Youth_Val, pLDS_All_AP_Teachers_Youth_Val,
pLDS_All_AP_Deacons_Youth_Val As Integer
    Dim pLDS_All_AP_Priests_Men_Val, pLDS_All_AP_Teachers_Men_Val,
pLDS_All_AP_Deacons_Men_Val As Integer

    Dim pLDS_All_YM_Val, pLDS_All_YW_Val, pLDS_All_Primary_Val,
pLDS_All_Primary_Boys_Val, pLDS_All_Primary_Girls_Val As Integer

    Static m_pCensusBlock As String
    m_pCensusBlock = ""
    Dim pCompCensusBlock As String
```

```
pCompCensusBlock = ""

Dim pMxDoc As IMxDocument
Set pMxDoc = ThisDocument

Dim pMap As IMap
Set pMap = pMxDoc.ActiveView

Dim pCursor As ICursor
Dim pRow As IRow
Dim pTableRow As IRow
Dim pTableSort As ITableSort
Dim pQueryFilter As IQueryFilter
Set pQueryFilter = New QueryFilter

Dim pFLayerDef As IFeatureLayerDefinition

'Set up the Ward Members Feature Class
Dim pMembersTable As IDisplayTable
Set pMembersTable = pMap.Layer(0)

Dim pMembersFLayer As IFeatureLayer
Set pMembersFLayer = pMap.Layer(0)

'Set up the Census Blocks Feature Class
Dim pSATblColl As IStandaloneTableCollection
Dim pSATbl As IStandaloneTable
Dim pTbl As ITable
Set pSATblColl = pMxDoc.FocusMap

Set pSATbl = pSATblColl.StandaloneTable(0)
Set pTbl = pSATbl

Dim pCensusTable As IDisplayTable
Set pCensusTable = pTbl

Dim pWS As IWorkspace
Set pWS = pMembersFLayer.FeatureClass.FeatureDataset.Workspace

'StartWorkspaceEditSession pWS

Set pFLayerDef = pMembersTable
pQueryFilter.WhereClause = pFLayerDef.DefinitionExpression

'Sort the table based on the field that you want
Set pTableSort = New TableSort

With pTableSort
  .Fields = "GEOID, Full_Name"
  .Ascending("GEOID") = True
  .Ascending("Full_Name") = True
  .CaseSensitive("GEOID") = False
  .CaseSensitive("Full_Name") = False
  Set .QueryFilter = pQueryFilter
  Set .Table = pMembersTable
End With
```

```
pTableSort.Sort Nothing

'Return the selection
Set pCursor = pTableSort.Rows
'The first row should be the highest number
Set pRow = pCursor.NextRow


'Resetting the counters to zero
pLDS_Total_Val = 0
pLDS_Male_Val = 0
pLDS_Female_Val = 0
pLDS_Men_Val = 0
pLDS_Women_Val = 0

pLDS_Eligible_Priesthood_Val = 0
pLDS_Melchizedek_Val = 0
pLDS_Aaronic_Val = 0
pLDS_Aaronic_Men_Val = 0
pLDS_Aaronic_Youth_Val = 0
pLDS_Unordained_Val = 0
pLDS_Unordained_Men_Val = 0
pLDS_Unordained_Youth_Val = 0
pLDS_MP_Elders_Val = 0
pLDS_MP_HighPriests_Val = 0
pLDS_MP_Others_Val = 0
pLDS_AP_Priests_Val = 0
pLDS_AP_Teachers_Val = 0
pLDS_AP_Deacons_Val = 0
pLDS_AP_Priests_Youth_Val = 0
pLDS_AP_Teachers_Youth_Val = 0
pLDS_AP_Deacons_Youth_Val = 0
pLDS_AP_Priests_Men_Val = 0
pLDS_AP_Teachers_Men_Val = 0
pLDS_AP_Deacons_Men_Val = 0

pLDS_YM_Val = 0
pLDS_YW_Val = 0
pLDS_Primary_Val = 0
pLDS_Primary_Boys_Val = 0
pLDS_Primary_Girls_Val = 0

Static resetValues As Boolean
resetValues = False

Static counter As Integer
counter = 0

Dim pPreCompCensusBlock As String

Do While Not pRow Is Nothing

    If pPreCompCensusBlock <> pCompCensusBlock Then
        resetValues = True
    End If

    If counter = 0 Then
```

```
            m_pCensusBlock = pRow.Value(pRow.Fields.FindField("GEOID"))
            Set pTableRow = pCensusTable.DisplayTable.CreateRow
        End If

        pCompCensusBlock = pRow.Value(pRow.Fields.FindField("GEOID"))

        If pCompCensusBlock = m_pCensusBlock Then
            If resetValues = True Then
                'Resetting the counters to zero
                pLDS_Total_Val = 0
                pLDS_Male_Val = 0
                pLDS_Female_Val = 0
                pLDS_Men_Val = 0
                pLDS_Women_Val = 0

                pLDS_Eligible_Priesthood_Val = 0
                pLDS_Melchizedek_Val = 0
                pLDS_Aaronic_Val = 0
                pLDS_Aaronic_Men_Val = 0
                pLDS_Aaronic_Youth_Val = 0
                pLDS_Unordained_Val = 0
                pLDS_Unordained_Men_Val = 0
                pLDS_Unordained_Youth_Val = 0
                pLDS_MP_Elders_Val = 0
                pLDS_MP_HighPriests_Val = 0
                pLDS_MP_Others_Val = 0
                pLDS_AP_Priests_Val = 0
                pLDS_AP_Teachers_Val = 0
                pLDS_AP_Deacons_Val = 0
                pLDS_AP_Priests_Youth_Val = 0
                pLDS_AP_Teachers_Youth_Val = 0
                pLDS_AP_Deacons_Youth_Val = 0
                pLDS_AP_Priests_Men_Val = 0
                pLDS_AP_Teachers_Men_Val = 0
                pLDS_AP_Deacons_Men_Val = 0

                pLDS_YM_Val = 0
                pLDS_YW_Val = 0
                pLDS_Primary_Val = 0
                pLDS_Primary_Boys_Val = 0
                pLDS_Primary_Girls_Val = 0

                'pGender = Null
                'pAge = Null
                'pPriesthood = Null
            End If

            'Setting up values to compare before deriving counts
            pGender = pRow.Value(pRow.Fields.FindField("SEX"))
            pAge = pRow.Value(pRow.Fields.FindField("AGE"))
            pPriesthood =
pRow.Value(pRow.Fields.FindField("PRIESTHOOD"))
            Dim pName As String
            pName = pRow.Value(pRow.Fields.FindField("FULL_NAME"))

            If pGender = 1 Then 'Male
                pLDS_Total_Val = pLDS_Total_Val + 1
```

```
                pLDS_All_Total_Val = pLDS_All_Total_Val + 1

                pLDS_Male_Val = pLDS_Male_Val + 1
                pLDS_All_Male_Val = pLDS_All_Male_Val + 1
                If ((pAge >= 1.5) And (pAge < 12)) Then 'In Primary
                    pLDS_Primary_Val = pLDS_Primary_Val + 1
                    pLDS_All_Primary_Val = pLDS_All_Primary_Val + 1
                    pLDS_Primary_Boys_Val = pLDS_Primary_Boys_Val + 1
                    pLDS_All_Primary_Boys_Val =
pLDS_All_Primary_Boys_Val + 1
                ElseIf ((pAge >= 12) And (pAge < 18)) Then 'In Young
Mens
                    pLDS_YM_Val = pLDS_YM_Val + 1
                    pLDS_All_YM_Val = pLDS_All_YM_Val + 1
                    pLDS_Eligible_Priesthood_Val =
pLDS_Eligible_Priesthood_Val + 1
                    pLDS_All_Eligible_Priesthood_Val =
pLDS_All_Eligible_Priesthood_Val + 1
                ElseIf pAge >= 18 Then 'Count as Man, not child or
young man
                    pLDS_Men_Val = pLDS_Men_Val + 1
                    pLDS_All_Men_Val = pLDS_All_Men_Val + 1
                    pLDS_Eligible_Priesthood_Val =
pLDS_Eligible_Priesthood_Val + 1
                    pLDS_All_Eligible_Priesthood_Val =
pLDS_All_Eligible_Priesthood_Val + 1
                End If

                If pPriesthood = 0 Then 'Unordained
                    If ((pAge >= 12) And (pAge < 18)) Then 'Unordained
Young Man
                        pLDS_Unordained_Youth_Val =
pLDS_Unordained_Youth_Val + 1 'Increment number of unordained youth in
this census block
                        pLDS_All_Unordained_Youth_Val =
pLDS_All_Unordained_Youth_Val + 1 'Increment number of total unordained
youth
                        pLDS_Unordained_Val = pLDS_Unordained_Val + 1
'Increment number of total unordained in this census block
                        pLDS_All_Unordained_Val =
pLDS_All_Unordained_Val + 1 'Increment number of total unordained
                    ElseIf pAge >= 18 Then 'Unordained Adult Man
                        pLDS_Unordained_Men_Val =
pLDS_Unordained_Men_Val + 1 'Increment number of unordained men in this
census block
                        pLDS_All_Unordained_Men_Val =
pLDS_All_Unordained_Men_Val + 1 'Increment number of total unordained
men
                        pLDS_Unordained_Val = pLDS_Unordained_Val + 1
'Increment number of total unordained in this census block
                        pLDS_All_Unordained_Val =
pLDS_All_Unordained_Val + 1 'Increment number of total unordained
                    End If
                ElseIf pPriesthood = 1 Then 'Deacon
                    If ((pAge >= 12) And (pAge < 18)) Then 'Deacon is a
Young Man
                        pLDS_Aaronic_Val = pLDS_Aaronic_Val + 1
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                        pLDS_All_Aaronic_Val = pLDS_All_Aaronic_Val + 1
                        pLDS_AP_Deacons_Youth_Val =
pLDS_AP_Deacons_Youth_Val + 1
                        pLDS_All_AP_Deacons_Youth_Val =
pLDS_All_AP_Deacons_Youth_Val + 1
                        pLDS_AP_Deacons_Val = pLDS_AP_Deacons_Youth_Val
+ 1
                        pLDS_All_AP_Deacons_Val =
pLDS_All_AP_Deacons_Val + 1
                    ElseIf pAge >= 18 Then 'Deacon is an Adult Man
                        pLDS_Aaronic_Val = pLDS_Aaronic_Val + 1
                        pLDS_All_Aaronic_Val = pLDS_All_Aaronic_Val + 1
                        pLDS_AP_Deacons_Men_Val =
pLDS_AP_Deacons_Men_Val + 1
                        pLDS_All_AP_Deacons_Men_Val =
pLDS_All_AP_Deacons_Men_Val + 1
                        pLDS_AP_Deacons_Val = pLDS_AP_Deacons_Youth_Val
+ 1
                        pLDS_All_AP_Deacons_Val =
pLDS_All_AP_Deacons_Val + 1
                    End If
                ElseIf pPriesthood = 2 Then 'Teacher
                    If ((pAge >= 12) And (pAge < 18)) Then 'Deacon is a
Young Man
                        pLDS_Aaronic_Val = pLDS_Aaronic_Val + 1
                        pLDS_All_Aaronic_Val = pLDS_All_Aaronic_Val + 1
                        pLDS_AP_Teachers_Youth_Val =
pLDS_AP_Teachers_Youth_Val + 1
                        pLDS_All_AP_Teachers_Youth_Val =
pLDS_All_AP_Teachers_Youth_Val + 1
                        pLDS_AP_Teachers_Val =
pLDS_AP_Teachers_Youth_Val + 1
                        pLDS_All_AP_Teachers_Val =
pLDS_All_AP_Teachers_Val + 1
                    ElseIf pAge >= 18 Then 'Deacon is an Adult Man
                        pLDS_Aaronic_Val = pLDS_Aaronic_Val + 1
                        pLDS_All_Aaronic_Val = pLDS_All_Aaronic_Val + 1
                        pLDS_AP_Teachers_Men_Val =
pLDS_AP_Teachers_Men_Val + 1
                        pLDS_All_AP_Teachers_Men_Val =
pLDS_All_AP_Teachers_Men_Val + 1
                        pLDS_AP_Teachers_Val =
pLDS_AP_Teachers_Youth_Val + 1
                        pLDS_All_AP_Teachers_Val =
pLDS_All_AP_Teachers_Val + 1
                    End If
                ElseIf pPriesthood = 3 Then 'Priest
                    If ((pAge >= 12) And (pAge < 18)) Then 'Deacon is a
Young Man
                        pLDS_Aaronic_Val = pLDS_Aaronic_Val + 1
                        pLDS_All_Aaronic_Val = pLDS_All_Aaronic_Val + 1
                        pLDS_AP_Priests_Youth_Val =
pLDS_AP_Priests_Youth_Val + 1
                        pLDS_All_AP_Priests_Youth_Val =
pLDS_All_AP_Priests_Youth_Val + 1
                        pLDS_AP_Priests_Val = pLDS_AP_Priests_Youth_Val
+ 1
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                        pLDS_All_AP_Priests_Val =
pLDS_All_AP_Priests_Val + 1
                    ElseIf pAge >= 18 Then 'Deacon is an Adult Man
                        pLDS_Aaronic_Val = pLDS_Aaronic_Val + 1
                        pLDS_All_Aaronic_Val = pLDS_All_Aaronic_Val + 1
                        pLDS_AP_Priests_Men_Val =
pLDS_AP_Priests_Men_Val + 1
                        pLDS_All_AP_Priests_Men_Val =
pLDS_All_AP_Priests_Men_Val + 1
                        pLDS_AP_Priests_Val = pLDS_AP_Priests_Youth_Val
+ 1
                        pLDS_All_AP_Priests_Val =
pLDS_All_AP_Priests_Val + 1
                    End If
                ElseIf pPriesthood = 4 Then 'Elder
                    pLDS_Melchizedek_Val = pLDS_Melchizedek_Val + 1
                    pLDS_All_Melchizedek_Val = pLDS_All_Melchizedek_Val
+ 1
                    pLDS_MP_Elders_Val = pLDS_MP_Elders_Val + 1
                    pLDS_All_MP_Elders_Val = pLDS_All_MP_Elders_Val + 1
                ElseIf pPriesthood = 5 Then 'High Priest
                    pLDS_Melchizedek_Val = pLDS_Melchizedek_Val + 1
                    pLDS_All_Melchizedek_Val = pLDS_All_Melchizedek_Val
+ 1
                    pLDS_MP_HighPriests_Val = pLDS_MP_HighPriests_Val +
1
                    pLDS_All_MP_HighPriests_Val =
pLDS_All_MP_HighPriests_Val + 1
                ElseIf ((pPriesthood = 6) Or (pPriesthood = 7)) Then
'Seventy or Apostle
                    pLDS_Melchizedek_Val = pLDS_Melchizedek_Val + 1
                    pLDS_All_Melchizedek_Val = pLDS_All_Melchizedek_Val
+ 1
                    pLDS_MP_Others_Val = pLDS_MP_Others_Val + 1
                    pLDS_All_MP_Others_Val = pLDS_All_MP_Others_Val + 1
                End If

            ElseIf pGender = 2 Then 'Female
                pLDS_Total_Val = pLDS_Total_Val + 1
                pLDS_All_Total_Val = pLDS_All_Total_Val + 1
                pLDS_Female_Val = pLDS_Female_Val + 1
                pLDS_All_Female_Val = pLDS_All_Female_Val + 1
                If ((pAge >= 1.5) And (pAge < 12)) Then 'In Primary
                    pLDS_Primary_Val = pLDS_Primary_Val + 1
                    pLDS_All_Primary_Val = pLDS_All_Primary_Val + 1
                    pLDS_Primary_Girls_Val = pLDS_Primary_Girls_Val + 1
                    pLDS_All_Primary_Girls_Val =
pLDS_All_Primary_Girls_Val + 1
                ElseIf ((pAge >= 12) And (pAge < 18)) Then 'In Young
Womens
                    pLDS_YW_Val = pLDS_YW_Val + 1
                    pLDS_All_YW_Val = pLDS_All_YW_Val + 1
                Else 'Count as Man, not child or young man
                    pLDS_Women_Val = pLDS_Women_Val + 1
                    pLDS_All_Women_Val = pLDS_All_Women_Val + 1
                End If
            End If
```

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            counter = counter + 1

            pTableRow.Value(pTableRow.Fields.FindField("GEOID")) =
pCompCensusBlock
            pTableRow.Value(pTableRow.Fields.FindField("LDS_Total")) =
pLDS_Total_Val
            pTableRow.Value(pTableRow.Fields.FindField("LDS_Male")) =
pLDS_Male_Val
            pTableRow.Value(pTableRow.Fields.FindField("LDS_Female")) =
pLDS_Female_Val
            pTableRow.Value(pTableRow.Fields.FindField("LDS_Men")) =
pLDS_Men_Val
            pTableRow.Value(pTableRow.Fields.FindField("LDS_Women")) =
pLDS_Women_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_Melchizedek")) =
pLDS_Melchizedek_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_MP_Elders")) =
pLDS_MP_Elders_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_MP_HighPriests")) =
pLDS_MP_HighPriests_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_MP_Others")) =
pLDS_MP_Others_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_Eligible_Priesthood"))
= pLDS_Eligible_Priesthood_Val
            pTableRow.Value(pTableRow.Fields.FindField("LDS_Aaronic"))
= pLDS_Aaronic_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_Aaronic_Men")) =
pLDS_Aaronic_Men_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_Aaronic_Youth")) =
pLDS_Aaronic_Youth_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Priests")) =
pLDS_AP_Priests_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Priests_Men")) =
pLDS_AP_Priests_Men_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Priests_Youth")) =
pLDS_AP_Priests_Youth_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Teachers")) =
pLDS_AP_Teachers_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Teachers_Men")) =
pLDS_AP_Teachers_Men_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Teachers_Youth")) =
pLDS_AP_Teachers_Youth_Val
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pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Deacons")) =
pLDS_AP_Deacons_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Deacons_Men")) =
pLDS_AP_Deacons_Men_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Deacons_Youth")) =
pLDS_AP_Deacons_Youth_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_Unordained")) =
pLDS_Unordained_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_Unordained_Men")) =
pLDS_Unordained_Men_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_Unordained_Youth")) =
pLDS_Unordained_Youth_Val
            pTableRow.Value(pTableRow.Fields.FindField("LDS_YM")) =
pLDS_YM_Val
            pTableRow.Value(pTableRow.Fields.FindField("LDS_YW")) =
pLDS_YW_Val
            pTableRow.Value(pTableRow.Fields.FindField("LDS_Primary"))
= pLDS_Primary_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_Primary_Boys")) =
pLDS_Primary_Boys_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_Primary_Girls")) =
pLDS_Primary_Girls_Val

            pTableRow.Store

            'pCursor.UpdateRow pRow
            'pRow.Store
        Else
            'Before Resetting Values and moving on to next census
block, set values on census blocks equal to calculated values

            Set pTableRow = pCensusTable.DisplayTable.CreateRow

            m_pCensusBlock = pRow.Value(pRow.Fields.FindField("GEOID"))

            'Setting up values to compare before deriving counts
            pGender = pRow.Value(pRow.Fields.FindField("SEX"))
            pAge = pRow.Value(pRow.Fields.FindField("AGE"))
            pPriesthood =
pRow.Value(pRow.Fields.FindField("PRIESTHOOD"))

            'Resetting the counters to zero
            pLDS_Total_Val = 0
            pLDS_Male_Val = 0
            pLDS_Female_Val = 0
            pLDS_Men_Val = 0
            pLDS_Women_Val = 0

            pLDS_Eligible_Priesthood_Val = 0
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```
            pLDS_Melchizedek_Val = 0
            pLDS_Aaronic_Val = 0
            pLDS_Aaronic_Men_Val = 0
            pLDS_Aaronic_Youth_Val = 0
            pLDS_Unordained_Val = 0
            pLDS_Unordained_Men_Val = 0
            pLDS_Unordained_Youth_Val = 0
            pLDS_MP_Elders_Val = 0
            pLDS_MP_HighPriests_Val = 0
            pLDS_MP_Others_Val = 0
            pLDS_AP_Priests_Val = 0
            pLDS_AP_Teachers_Val = 0
            pLDS_AP_Deacons_Val = 0
            pLDS_AP_Priests_Youth_Val = 0
            pLDS_AP_Teachers_Youth_Val = 0
            pLDS_AP_Deacons_Youth_Val = 0
            pLDS_AP_Priests_Men_Val = 0
            pLDS_AP_Teachers_Men_Val = 0
            pLDS_AP_Deacons_Men_Val = 0

            pLDS_YM_Val = 0
            pLDS_YW_Val = 0
            pLDS_Primary_Val = 0
            pLDS_Primary_Boys_Val = 0
            pLDS_Primary_Girls_Val = 0

            If pGender = 1 Then 'Male
                pLDS_Total_Val = pLDS_Total_Val + 1
                pLDS_All_Total_Val = pLDS_All_Total_Val + 1

                pLDS_Male_Val = pLDS_Male_Val + 1
                pLDS_All_Male_Val = pLDS_All_Male_Val + 1
                If ((pAge >= 1.5) And (pAge < 12)) Then 'In Primary
                    pLDS_Primary_Val = pLDS_Primary_Val + 1
                    pLDS_All_Primary_Val = pLDS_All_Primary_Val + 1
                    pLDS_Primary_Boys_Val = pLDS_Primary_Boys_Val + 1
                    pLDS_All_Primary_Boys_Val =
pLDS_All_Primary_Boys_Val + 1
                ElseIf ((pAge >= 12) And (pAge < 18)) Then 'In Young
Mens
                    pLDS_YM_Val = pLDS_YM_Val + 1
                    pLDS_All_YM_Val = pLDS_All_YM_Val + 1
                    pLDS_Eligible_Priesthood_Val =
pLDS_Eligible_Priesthood_Val + 1
                    pLDS_All_Eligible_Priesthood_Val =
pLDS_All_Eligible_Priesthood_Val + 1
                Else 'Count as Man, not child or young man
                    pLDS_Men_Val = pLDS_Men_Val + 1
                    pLDS_All_Men_Val = pLDS_All_Men_Val + 1
                    pLDS_Eligible_Priesthood_Val =
pLDS_Eligible_Priesthood_Val + 1
                    pLDS_All_Eligible_Priesthood_Val =
pLDS_All_Eligible_Priesthood_Val + 1
                End If

                If pPriesthood = 0 Then 'Unordained
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                    If ((pAge >= 12) And (pAge < 18)) Then 'Unordained
Young Man
                        pLDS_Unordained_Youth_Val =
pLDS_Unordained_Youth_Val + 1 'Increment number of unordained youth in
this census block
                        pLDS_All_Unordained_Youth_Val =
pLDS_All_Unordained_Youth_Val + 1 'Increment number of total unordained
youth
                        pLDS_Unordained_Val = pLDS_Unordained_Val + 1
'Increment number of total unordained in this census block
                        pLDS_All_Unordained_Val =
pLDS_All_Unordained_Val + 1 'Increment number of total unordained
                    ElseIf pAge >= 18 Then 'Unordained Man
                        pLDS_Unordained_Men_Val =
pLDS_Unordained_Men_Val + 1 'Increment number of unordained men in this
census block
                        pLDS_All_Unordained_Men_Val =
pLDS_All_Unordained_Men_Val + 1 'Increment number of total unordained
men
                        pLDS_Unordained_Val = pLDS_Unordained_Val + 1
'Increment number of total unordained in this census block
                        pLDS_All_Unordained_Val =
pLDS_All_Unordained_Val + 1 'Increment number of total unordained
                    End If
                ElseIf pPriesthood = 1 Then 'Deacon
                    If ((pAge >= 12) And (pAge < 18)) Then 'Deacon is a
Young Man
                        pLDS_Aaronic_Val = pLDS_Aaronic_Val + 1
                        pLDS_All_Aaronic_Val = pLDS_All_Aaronic_Val + 1
                        pLDS_AP_Deacons_Youth_Val =
pLDS_AP_Deacons_Youth_Val + 1
                        pLDS_All_AP_Deacons_Youth_Val =
pLDS_All_AP_Deacons_Youth_Val + 1
                        pLDS_AP_Deacons_Val = pLDS_AP_Deacons_Youth_Val
+ 1
                        pLDS_All_AP_Deacons_Val =
pLDS_All_AP_Deacons_Val + 1
                    ElseIf pAge >= 18 Then 'Deacon is an Adult Man
                        pLDS_Aaronic_Val = pLDS_Aaronic_Val + 1
                        pLDS_All_Aaronic_Val = pLDS_All_Aaronic_Val + 1
                        pLDS_AP_Deacons_Men_Val =
pLDS_AP_Deacons_Men_Val + 1
                        pLDS_All_AP_Deacons_Men_Val =
pLDS_All_AP_Deacons_Men_Val + 1
                        pLDS_AP_Deacons_Val = pLDS_AP_Deacons_Youth_Val
+ 1
                        pLDS_All_AP_Deacons_Val =
pLDS_All_AP_Deacons_Val + 1
                    End If
                ElseIf pPriesthood = 2 Then 'Teacher
                    If ((pAge >= 12) And (pAge < 18)) Then 'Deacon is a
Young Man
                        pLDS_Aaronic_Val = pLDS_Aaronic_Val + 1
                        pLDS_All_Aaronic_Val = pLDS_All_Aaronic_Val + 1
                        pLDS_AP_Teachers_Youth_Val =
pLDS_AP_Teachers_Youth_Val + 1
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                        pLDS_All_AP_Teachers_Youth_Val =
pLDS_All_AP_Teachers_Youth_Val + 1
                        pLDS_AP_Teachers_Val =
pLDS_AP_Teachers_Youth_Val + 1
                        pLDS_All_AP_Teachers_Val =
pLDS_All_AP_Teachers_Val + 1
                    ElseIf pAge >= 18 Then 'Deacon is an Adult Man
                        pLDS_Aaronic_Val = pLDS_Aaronic_Val + 1
                        pLDS_All_Aaronic_Val = pLDS_All_Aaronic_Val + 1
                        pLDS_AP_Teachers_Men_Val =
pLDS_AP_Teachers_Men_Val + 1
                        pLDS_All_AP_Teachers_Men_Val =
pLDS_All_AP_Teachers_Men_Val + 1
                        pLDS_AP_Teachers_Val =
pLDS_AP_Teachers_Youth_Val + 1
                        pLDS_All_AP_Teachers_Val =
pLDS_All_AP_Teachers_Val + 1
                    End If
                ElseIf pPriesthood = 3 Then 'Priest
                    If ((pAge >= 12) And (pAge < 18)) Then 'Deacon is a
Young Man
                        pLDS_Aaronic_Val = pLDS_Aaronic_Val + 1
                        pLDS_All_Aaronic_Val = pLDS_All_Aaronic_Val + 1
                        pLDS_AP_Priests_Youth_Val =
pLDS_AP_Priests_Youth_Val + 1
                        pLDS_All_AP_Priests_Youth_Val =
pLDS_All_AP_Priests_Youth_Val + 1
                        pLDS_AP_Priests_Val = pLDS_AP_Priests_Youth_Val
+ 1
                        pLDS_All_AP_Priests_Val =
pLDS_All_AP_Priests_Val + 1
                    ElseIf pAge >= 18 Then 'Deacon is an Adult Man
                        pLDS_Aaronic_Val = pLDS_Aaronic_Val + 1
                        pLDS_All_Aaronic_Val = pLDS_All_Aaronic_Val + 1
                        pLDS_AP_Priests_Men_Val =
pLDS_AP_Priests_Men_Val + 1
                        pLDS_All_AP_Priests_Men_Val =
pLDS_All_AP_Priests_Men_Val + 1
                        pLDS_AP_Priests_Val = pLDS_AP_Priests_Youth_Val
+ 1
                        pLDS_All_AP_Priests_Val =
pLDS_All_AP_Priests_Val + 1
                    End If
                ElseIf pPriesthood = 4 Then 'Elder
                    pLDS_Melchizedek_Val = pLDS_Melchizedek_Val + 1
                    pLDS_All_Melchizedek_Val = pLDS_All_Melchizedek_Val
+ 1
                    pLDS_MP_Elders_Val = pLDS_MP_Elders_Val + 1
                    pLDS_All_MP_Elders_Val = pLDS_All_MP_Elders_Val + 1
                ElseIf pPriesthood = 5 Then 'High Priest
                    pLDS_Melchizedek_Val = pLDS_Melchizedek_Val + 1
                    pLDS_All_Melchizedek_Val = pLDS_All_Melchizedek_Val
+ 1
                    pLDS_MP_HighPriests_Val = pLDS_MP_HighPriests_Val +
1
                    pLDS_All_MP_HighPriests_Val =
pLDS_All_MP_HighPriests_Val + 1
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                ElseIf ((pPriesthood = 6) Or (pPriesthood = 7)) Then
'Seventy or Apostle
                    pLDS_Melchizedek_Val = pLDS_Melchizedek_Val + 1
                    pLDS_All_Melchizedek_Val = pLDS_All_Melchizedek_Val
+ 1
                    pLDS_MP_Others_Val = pLDS_MP_Others_Val + 1
                    pLDS_All_MP_Others_Val = pLDS_All_MP_Others_Val + 1
                End If

            ElseIf pGender = 2 Then 'Female
                pLDS_Total_Val = pLDS_Total_Val + 1
                pLDS_All_Total_Val = pLDS_All_Total_Val + 1
                pLDS_Female_Val = pLDS_Female_Val + 1
                pLDS_All_Female_Val = pLDS_All_Female_Val + 1
                If ((pAge >= 1.5) And (pAge < 12)) Then 'In Primary
                    pLDS_Primary_Val = pLDS_Primary_Val + 1
                    pLDS_All_Primary_Val = pLDS_All_Primary_Val + 1
                    pLDS_Primary_Girls_Val = pLDS_Primary_Girls_Val + 1
                    pLDS_All_Primary_Girls_Val =
pLDS_All_Primary_Girls_Val + 1
                ElseIf ((pAge >= 12) And (pAge < 18)) Then 'In Young
Womens
                    pLDS_YW_Val = pLDS_YW_Val + 1
                    pLDS_All_YW_Val = pLDS_All_YW_Val + 1
                Else 'Count as Man, not child or young man
                    pLDS_Women_Val = pLDS_Women_Val + 1
                    pLDS_All_Women_Val = pLDS_All_Women_Val + 1
                End If
            End If

            counter = counter + 1

            pTableRow.Value(pTableRow.Fields.FindField("GEOID")) =
pCompCensusBlock
            pTableRow.Value(pTableRow.Fields.FindField("LDS_Total")) =
pLDS_Total_Val
            pTableRow.Value(pTableRow.Fields.FindField("LDS_Male")) =
pLDS_Male_Val
            pTableRow.Value(pTableRow.Fields.FindField("LDS_Female")) =
pLDS_Female_Val
            pTableRow.Value(pTableRow.Fields.FindField("LDS_Men")) =
pLDS_Men_Val
            pTableRow.Value(pTableRow.Fields.FindField("LDS_Women")) =
pLDS_Women_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_Melchizedek")) =
pLDS_Melchizedek_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_MP_Elders")) =
pLDS_MP_Elders_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_MP_HighPriests")) =
pLDS_MP_HighPriests_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_MP_Others")) =
pLDS_MP_Others_Val
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pTableRow.Value(pTableRow.Fields.FindField("LDS_Eligible_Priesthood"))
= pLDS_Eligible_Priesthood_Val
            pTableRow.Value(pTableRow.Fields.FindField("LDS_Aaronic"))
= pLDS_Aaronic_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_Aaronic_Men")) =
pLDS_Aaronic_Men_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_Aaronic_Youth")) =
pLDS_Aaronic_Youth_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Priests")) =
pLDS_AP_Priests_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Priests_Men")) =
pLDS_AP_Priests_Men_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Priests_Youth")) =
pLDS_AP_Priests_Youth_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Teachers")) =
pLDS_AP_Teachers_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Teachers_Men")) =
pLDS_AP_Teachers_Men_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Teachers_Youth")) =
pLDS_AP_Teachers_Youth_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Deacons")) =
pLDS_AP_Deacons_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Deacons_Men")) =
pLDS_AP_Deacons_Men_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_AP_Deacons_Youth")) =
pLDS_AP_Deacons_Youth_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_Unordained")) =
pLDS_Unordained_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_Unordained_Men")) =
pLDS_Unordained_Men_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_Unordained_Youth")) =
pLDS_Unordained_Youth_Val
            pTableRow.Value(pTableRow.Fields.FindField("LDS_YM")) =
pLDS_YM_Val
            pTableRow.Value(pTableRow.Fields.FindField("LDS_YW")) =
pLDS_YW_Val
            pTableRow.Value(pTableRow.Fields.FindField("LDS_Primary"))
= pLDS_Primary_Val

pTableRow.Value(pTableRow.Fields.FindField("LDS_Primary_Boys")) =
pLDS_Primary_Boys_Val
```

```
pTableRow.Value(pTableRow.Fields.FindField("LDS_Primary_Girls")) =
pLDS_Primary_Girls_Val

            pTableRow.Store

        End If
        pPreCompCensusBlock =
pRow.Value(pRow.Fields.FindField("GEOID"))
        Set pRow = pCursor.NextRow
    Loop

    pCursor.Flush

End Sub
```

Appendix B: "SummarizeLDSMembers" Python Code

```
import arcpy, sys, os, traceback, math
from arcpy import env

def ResetCounters(paramsList, paramDict):
    for item in paramsList:
        paramDict[item] = 0

def IncreaseCounters(paramsList, paramsDict):
    for item in paramsList:
        paramsDict[item] = paramsDict[item] + 1

def TallyMemberStatistics(ageVal,genderVal,priesthoodVal):
    age = ageVal
    gender = genderVal
    priesthood = priesthoodVal

    if gender == 1:     #Male
        IncreaseCounters(totalList,varDict)
        IncreaseCounters(maleList,varDict)

        if age >= 1.5 and age < 12:     #Primary age boy
            IncreaseCounters(primaryList,varDict)
            IncreaseCounters(primaryBoysList,varDict)
        elif age >= 12 and age < 18:    #In Young Mens Program
            IncreaseCounters(youngmenList,varDict)
            IncreaseCounters(eligPHList,varDict)
        elif age >= 18: #Count as a man, not a child or young man
            IncreaseCounters(menList,varDict)
            IncreaseCounters(eligPHList,varDict)

        if priesthood == 0:     #Unordained male
            if age >= 12 and age < 18:  #Unordained young man
                IncreaseCounters(unordainedYMList,varDict)
                IncreaseCounters(unordainedList,varDict)
            elif age >= 18:     #Unordained adult man
                IncreaseCounters(unordainedMenList,varDict)
                IncreaseCounters(unordainedList,varDict)
        elif priesthood == 1:   #Deacon
            if age >= 12 and age < 18:  #Deacon is a young man
                IncreaseCounters(aaronicList,varDict)
                IncreaseCounters(deaconsList,varDict)
                IncreaseCounters(deaconsYMList,varDict)
            elif age >= 18:     #Deacon is an adult man
                IncreaseCounters(aaronicList,varDict)
                IncreaseCounters(deaconsList,varDict)
                IncreaseCounters(deaconsMenList,varDict)
        elif priesthood == 2:   #Teacher
            if age >= 12 and age < 18:  #Teacher is a young man
                IncreaseCounters(aaronicList,varDict)
                IncreaseCounters(teachersList,varDict)
                IncreaseCounters(teachersYMList,varDict)
            elif age >= 18:     #Teacher is an adult man
                IncreaseCounters(aaronicList,varDict)
                IncreaseCounters(teachersList,varDict)
```

```
                IncreaseCounters(teachersMenList,varDict)
        elif priesthood == 3:   #Priest
            if age >= 12 and age < 18:  #Priest is a young man
                IncreaseCounters(aaronicList,varDict)
                IncreaseCounters(priestsList,varDict)
                IncreaseCounters(priestsYMList,varDict)
            elif age >= 18:     #Teacher is an adult man
                IncreaseCounters(aaronicList,varDict)
                IncreaseCounters(priestsList,varDict)
                IncreaseCounters(priestsMenList,varDict)
        elif priesthood == 4:   #Elder
            IncreaseCounters(melchizedekList,varDict)
            IncreaseCounters(eldersList,varDict)
        elif priesthood == 5:   #High Priest
            IncreaseCounters(melchizedekList,varDict)
            IncreaseCounters(highpriestList,varDict)
        elif priesthood == 6 or priesthood == 7:    #Seventy or Apostle
            IncreaseCounters(melchizedekList,varDict)
            IncreaseCounters(mpothersList,varDict)
    elif gender == 2:    #Female
        IncreaseCounters(totalList,varDict)
        IncreaseCounters(femaleList,varDict)
        if age >= 1.5 and age < 12:     #Primary age girl
            IncreaseCounters(primaryList,varDict)
            IncreaseCounters(primaryGirlsList,varDict)
        elif age >=12 and age < 18:     #In Young Womens Program
            IncreaseCounters(youngwomenList,varDict)
        elif age > 18:      #Count as a woman, not a child or young
woman
            IncreaseCounters(womenList,varDict)


# MAIN SECTION OF CODE
# Set overwrite option
env.overwriteOutput = True

# Get and set inputs
inPoints = arcpy.GetParameterAsText(0)  # Input point feature layer of
Members, with a point for every member (not per family)
inPointsHDQ = arcpy.GetParameterAsText(1) # Flag to honor definition
query or not on Points
nameField = arcpy.GetParameterAsText(2) # Field containing unique name
field for Census Polygons (i.e. GEOID)
inSumTable = arcpy.GetParameterAsText(3)    # Input Summary Table

try:
    mxd = arcpy.mapping.MapDocument("CURRENT")
    df = arcpy.mapping.ListDataFrames(mxd)[0]
    memberLayer = arcpy.mapping.ListLayers(mxd,inPoints)[0]

    if inPointsHDQ == True:
        memberLayerWQ = str(memberLayer.definitionQuery)
    else:
        memberLayerWQ = ""

    sortFields = nameField + " A; FULL_NAME A"
    tblCur = arcpy.InsertCursor(inSumTable)
```

```
    sCur = arcpy.SearchCursor(memberLayer, memberLayerWQ, "", "",
sortFields)

    # Set up variables and initial values
    totalList = ['LDS_Total','all_LDS_Total']
    maleList = ['LDS_Male','all_LDS_Male']
    femaleList = ['LDS_Female', 'all_LDS_Female']
    primaryList = ['LDS_Primary', 'all_LDS_Primary']
    primaryBoysList = ['LDS_Primary_Boys', 'all_LDS_Primary_Boys']
    primaryGirlsList = ['LDS_Primary_Girls', 'all_LDS_Primary_Girls']
    youngmenList = ['LDS_YM', 'all_LDS_YM']
    youngwomenList = ['LDS_YW', 'all_LDS_YW']
    eligPHList = ['LDS_Eligible_Priesthood',
'all_LDS_Eligible_Priesthood']
    menList = ['LDS_Men', 'all_LDS_Men']
    womenList = ['LDS_Women', 'all_LDS_Women']
    unordainedList = ['LDS_Unordained', 'all_LDS_Unordained']
    unordainedYMList =
['LDS_Unordained_Youth','all_LDS_Unordained_Youth']
    unordainedMenList = ['LDS_Unordained_Men','all_LDS_Unordained_Men']
    aaronicList = ['LDS_Aaronic','all_LDS_Aaronic']
    aaronicMenList = ['LDS_Aaronic_Men', 'all_LDS_Aaronic_Men']
    aaronicYouthList = ['LDS_Aaronic_Youth', 'all_LDS_Aaronic_Youth']
    deaconsList = ['LDS_AP_Deacons', 'all_LDS_AP_Deacons']
    teachersList = ['LDS_AP_Teachers', 'all_LDS_AP_Teachers']
    priestsList = ['LDS_AP_Priests','all_LDS_AP_Priests']
    deaconsYMList = ['LDS_AP_Deacons_Youth',
'all_LDS_AP_Deacons_Youth']
    teachersYMList = ['LDS_AP_Teachers_Youth',
'all_LDS_AP_Teachers_Youth']
    priestsYMList = ['LDS_AP_Priests_Youth',
'all_LDS_AP_Priests_Youth']
    deaconsMenList = ['LDS_AP_Deacons_Men', 'all_LDS_AP_Deacons_Men']
    teachersMenList = ['LDS_AP_Teachers_Men',
'all_LDS_AP_Teachers_Men']
    priestsMenList = ['LDS_AP_Priests_Men', 'all_LDS_AP_Priests_Men']
    melchizedekList = ['LDS_Melchizedek', 'all_LDS_Melchizedek']
    eldersList = ['LDS_MP_Elders', 'all_LDS_MP_Elders']
    highpriestList = ['LDS_MP_HighPriests', 'all_LDS_MP_HighPriests']
    mpothersList = ['LDS_MP_Others','all_LDS_MP_Others']

    fieldsList =
['GEOID','LDS_Total','LDS_Male','LDS_Female','LDS_Men','LDS_Women','LDS
_Melchizedek','LDS_MP_Elders','LDS_MP_HighPriests','LDS_MP_Others',

'LDS_Eligible_Priesthood','LDS_Aaronic','LDS_Aaronic_Men','LDS_Aaronic_
Youth','LDS_AP_Priests','LDS_AP_Priests_Men','LDS_AP_Priests_Youth',

'LDS_AP_Teachers','LDS_AP_Teachers_Men','LDS_AP_Teachers_Youth','LDS_AP
_Deacons','LDS_AP_Deacons_Men','LDS_AP_Deacons_Youth',
'LDS_Unordained',

'LDS_Unordained_Men','LDS_Unordained_Youth','LDS_YM','LDS_YW','LDS_Prim
ary','LDS_Primary_Boys','LDS_Primary_Girls']

    geoidList = ['GEOID']
```

```
    allVarsList = geoidList + totalList + maleList + femaleList +
primaryList + primaryBoysList + primaryGirlsList + youngmenList +
youngwomenList + eligPHList + menList + womenList + unordainedList +
unordainedYMList + unordainedMenList + aaronicList + aaronicMenList +
aaronicYouthList + deaconsList + teachersList + priestsList +
deaconsYMList + teachersYMList + priestsYMList + deaconsMenList +
teachersMenList + priestsMenList + melchizedekList + eldersList +
highpriestList + mpothersList

    varDict = {}
    for var in allVarsList:
        varDict[var] = 0

    curCensusBlockName = ""
    censusBlockName = ""
    preCompCensusBlockName = ""
    resetValues = False
    counter = 0

    blockList = []

    for row in sCur:
        curCensusBlockName = row.getValue(nameField)

        if curCensusBlockName != censusBlockName:   # Different census
block, so new row
            if counter != 0:
                arcpy.AddMessage("Successfully added row...")
                tblCur.insertRow(newRow)
            arcpy.AddMessage("Adding new row to table for " +
str(nameField) + ": " + str(curCensusBlockName))
            newRow = tblCur.newRow()
            censusBlockName = row.getValue(nameField)

            newGender = int(row.getValue("SEX"))
            newAge = float(row.getValue("AGE"))
            newPriesthood = int(row.getValue("PRIESTHOOD"))
            newName = str(row.getValue("FULL_NAME"))

            ResetCounters(fieldsList,varDict)
            varDict['GEOID'] = censusBlockName
            TallyMemberStatistics(newAge,newGender,newPriesthood)

            for field in fieldsList:    #Iterate through fields,
setting the value to the summarized values
                fieldName = "'" + field + "'"
                if field == 'GEOID':
                    value = str(varDict[field])
                    newRow.setValue(field,value)
                else:
                    value = varDict[field]
                    newRow.setValue(field,value)

            counter += 1
        else:
            if resetValues == True:
                ResetCounters(fieldsList,varDict)
```

```
            curGender = int(row.getValue("SEX"))
            curAge = float(row.getValue("AGE"))
            curPriesthood = int(row.getValue("PRIESTHOOD"))
            curName = str(row.getValue("FULL_NAME"))
            censusBlockName = row.getValue(nameField)

            varDict['GEOID'] = curCensusBlockName
            TallyMemberStatistics(curAge,curGender,curPriesthood)

            for field in fieldsList:    #Iterate through fields,
setting the value to the summarized values
                if field == 'GEOID':
                    value = str(varDict[field])
                    newRow.setValue(field,value)
                else:
                    value = int(varDict[field])
                    newRow.setValue(field,value)

    arcpy.AddMessage("Successfully added last row...")
    tblCur.insertRow(newRow)
    del sCur, tblCur
except:

    # Code block to handle errors...
    tb = sys.exc_info()[2]
    tbinfo = traceback.format_tb(tb)[0]
    pymsg = "Python Errors:\nTraceback Info:\n" + tbinfo + "\nError
Info:\n    " + str(sys.exc_type) + ": " + str(sys.exc_value) + "\n"
    arcpy.AddError(pymsg)
    message = message + "\n" + pymsg
    msgs = "Geoprocessing Errors:\n" + arcpy.GetMessages(2) + "\n"
    message = message + "\n" + msgs
    arcpy.AddError(msgs)

finally:
    arcpy.AddMessage("Finished script. There were " + str(counter) + "
unique census tracts with members.")
```

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