Preliminary Notes and Information for Upcoming Task B.3.8 – *Summary of Analyses and Assessment of Conditions*

B.3.8 Summary of Analyses and Assessment of Conditions

Prior to initiating this task, CH2M HILL will meet with County staff to provide draft findings and discuss results of Tasks B.3.1 through B.3.7. The meeting length is anticipated to be approximately 4 hours and will include key County and CH2M HILL staff familiar with and knowledgeable of the data and analyses from Tasks B.3.1 through B.3.7 and the proposed approach for Task B.3.8. The County will provide the meeting venue and arrange for the logistics.

CH2M HILL will summarize and integrate the results of the analyses in Tasks B.3.2 through B.3.7 and use water budget and other hydrologic/hydrogeologic concepts and methods to assess the conditions of the quantity and quality of the surface water and groundwater in the county. The summary will include a discussion of the qualitative and, if possible, quantitative hydrologic relationships between the various monitored resources. Also, trends in water quantity and quality will be identified and discussed as will issues or areas of concern. Tables, graphs, and maps will be used as needed to present the summary of conditions.

The water budget will be comprised of mean values under current conditions of the surface and groundwater components (usage, discharges, withdrawals and sources) summarized on the 16 major watersheds and will be limited to the County boundary. The budget shall be developed within a GIS framework composed of point values (e.g., community and private well average pumpage, surface water intakes), line values (e.g. groundwater transfer between counties, direct discharge to Potomac River) and area values (e.g., subwatershed precipitation and net recharge based on streamflow records). Water budget components lacking quantitative data shall be estimated as needed. The water balance need not detail the stormshed hydraulics or the stormwater infrastructure.

Recommend additional data or modifications to existing data sets necessary to support recommended future analyses and identify areas or issues that warrant further study.

Impervious Surface - LC versus USGS (example map)

Impervious Surface and Population (example map)

Parcels History (example graphic)

Community Groundwater Supply Wells (memo)

Community Groundwater Supply Wells (example map)

Contributing Area (memo)

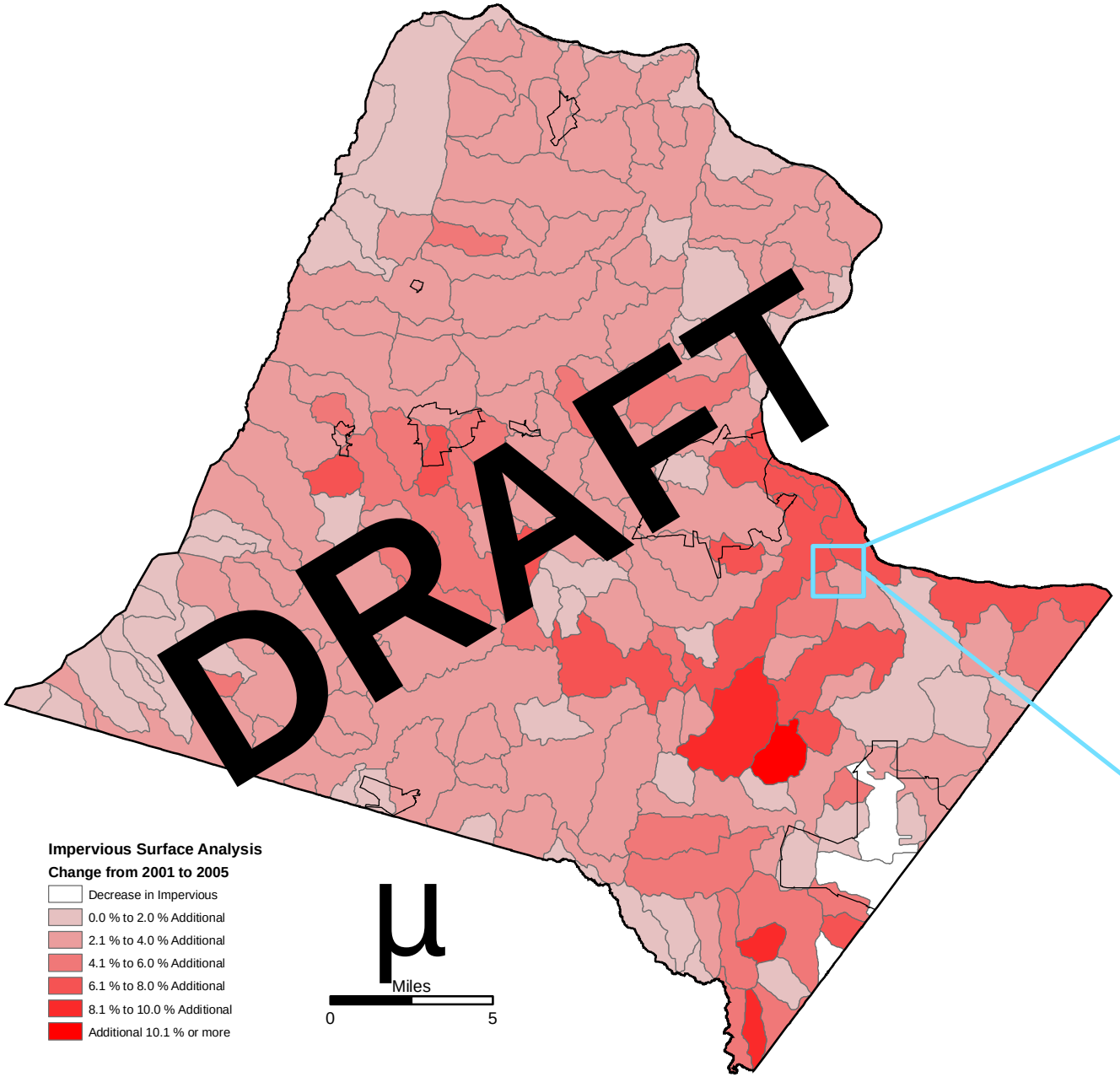
Population Methodology (memo)

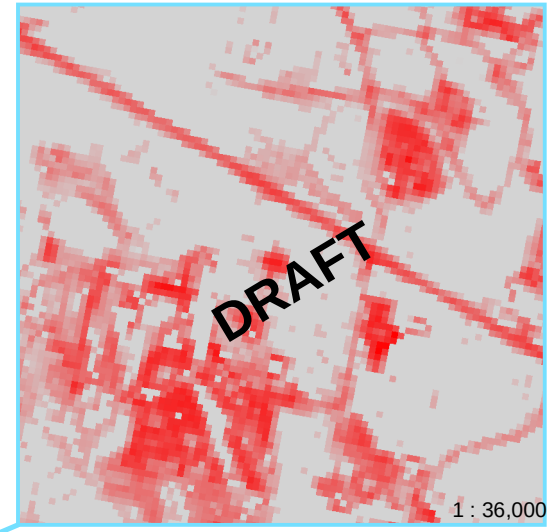
LCSA Service Area (memo)

Surface Water Intakes (example map)

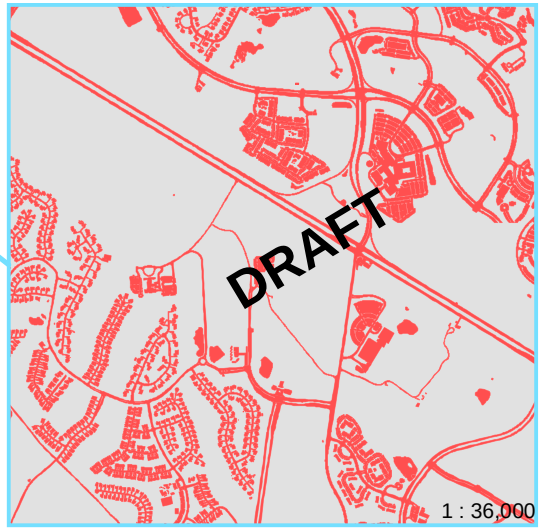
Loudoun County, Virginia

Impervious Surface Analysis



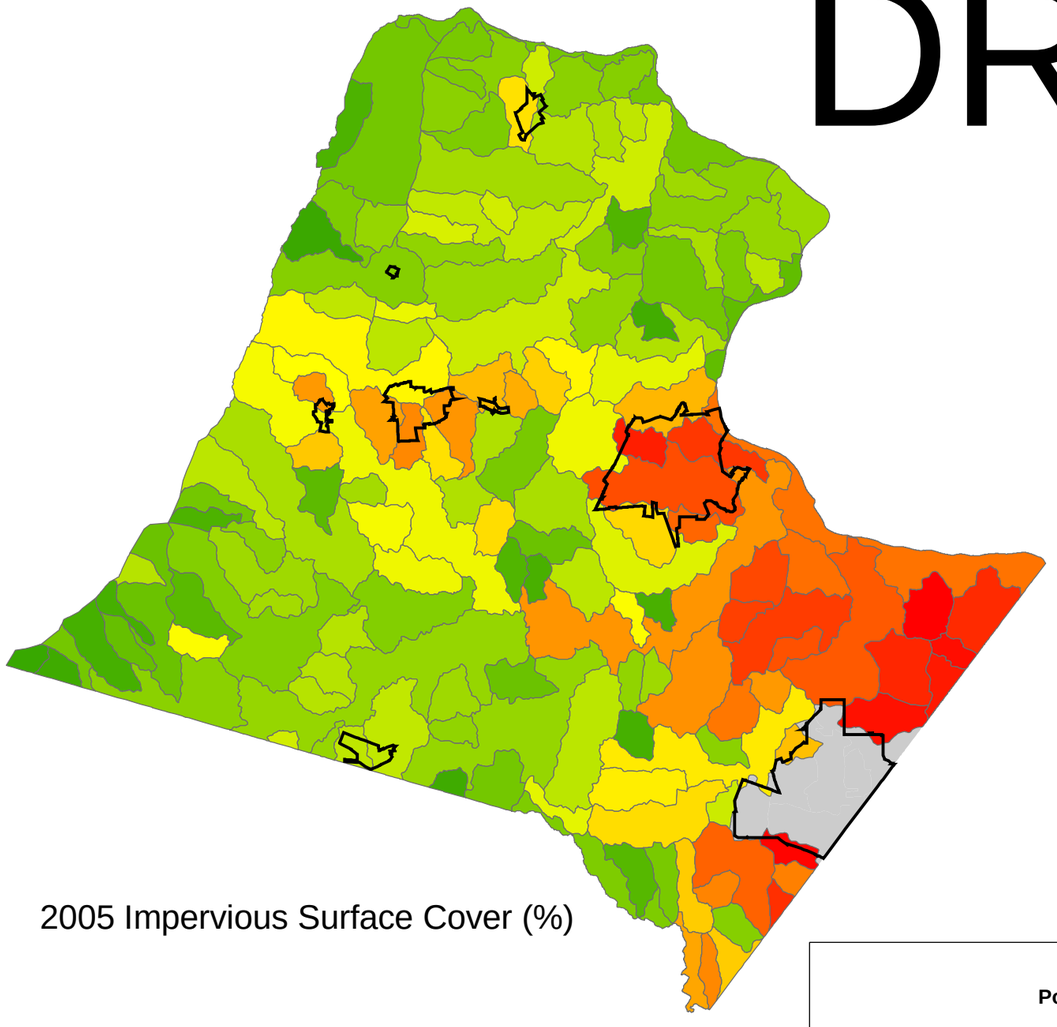


2001 USGS NLCD Impervious Surface

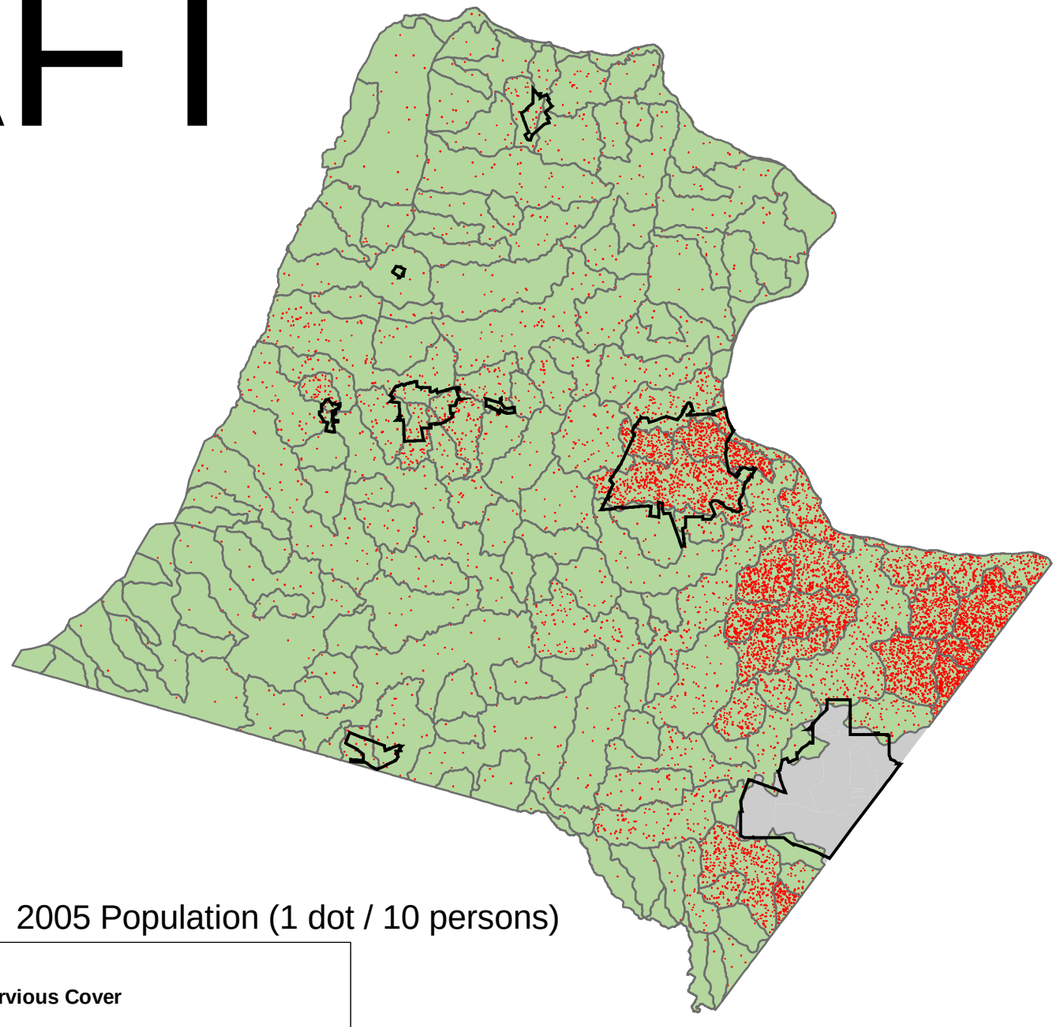


2005 Loudoun County Impervious Surface

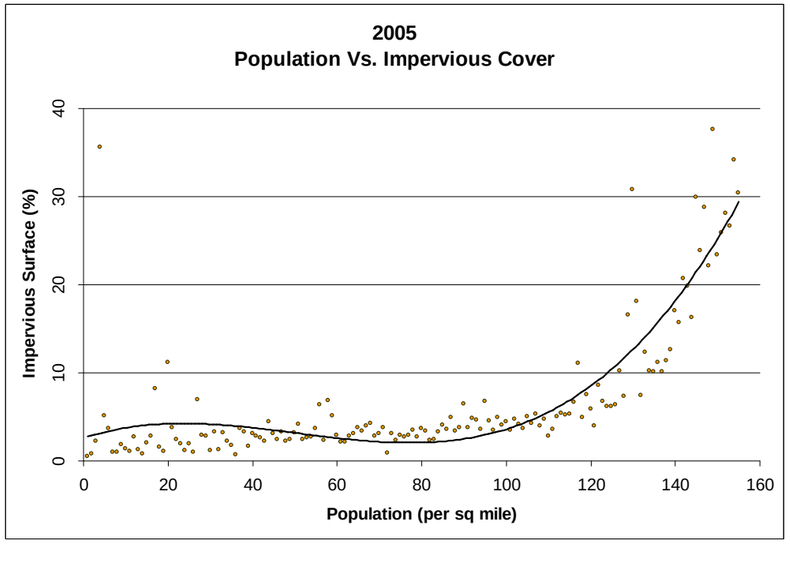
DRAFT



2005 Impervious Surface Cover (%)



2005 Population (1 dot / 10 persons)



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Community Groundwater Supply Wells

Background: There are several sources of data for public water supply wells. These data need to be reviewed and merged.

Objective: To create a GIS of community groundwater usage rates to support subsequent analysis, such as water budget.

Summary of Available Data:

There are several sources of information on community water supply wells as described below. These data are summarized, compared and consolidated into GIS.

1) The **Virginia Dept of Health** maintains data of community water supply wells. We received data in 2003 and again in 2006. These are restricted data, providing well location, owners and population serves. A comparison between 2003 and 2006 showed:

- The number of water supply wells decreased from 128 to 117. Net change is 11 wells.
- Ten news wells were added while 22 were dropped.
- Coordinate mapping was revised.

Reference: E:\D\VDH_Community_Wells\VDH_Changes_2003_2006.xls

2) The **EPA** maintains data on safe water as part of their **Safe Drinking Water Information System (SDWIS)** program. The SWDIS web site may be queried from EPA SDWIS (http://www.epa.gov/enviro/html/sdwis/sdwis_ov.html)

```
http://oaspub.epa.gov/enviro/sdw_query_v2.get_list?wsys_name=&fac_search=fac_beginning&fac_county=LOUDOUN&
pop_serv=500&pop_serv=3300&pop_serv=10000&pop_serv=100000&pop_serv=100001&sys_status=active&pop_serv=&wsys
_id=&fac_state=VA&last_fac_name=&page=1&query_results=&total_rows_found=
```

The resulting table with 73 records is similar to VDH although the data are more limited. Both data sources indicate the population served. The VDH also provide average daily production in GPS as per metadata received with the shapefiles.

- There are a few more records in EPA's SDWIS compared to VDH and visa versa. For those listed in SDWIS, some may be incorrect records, such as POTOMIA and Grandale Farm. EPA provides what appear to be correct addresses in Loudoun, but data can not be located in LMIS.

  The SDWIS provides 5 more records as compared to VDH (BRIAR PATCH B&B, GRANDALE FARM, LOUDOUN COUNTY SANITATION AUTH, POTOMIA, RESERVE AT ROKEBY FARM)

  Conversely, VDH provides 3 more records as compared to SDWIS (LUCKETTS COMMUNITY CENTER, NATIONAL RECREATION & PARK ASSOC. HQ, CHURCH OF THE NAZARENE). The difference is likely due to age of EPA data.

- The population served reported by EPA is sometimes larger, presumably more current than VDH.

- EPA SDWIS also includes LCSA serving 150,000 persons from "Purch_surface_water".

- EPA SDWIS does not include well locations, but VDH file provides latitude and longitude for each well at the facility in separate records.

- EPA typically only reports one record for each facility. Therefore, to match with VDH, EPA records were duplicated. In other words, the population served is for the group of wells and only be tallied once.

- There is some disagreement between the two data source for some of the water supply sources (ground versus surface water).

It is generally recommended that future water resource analysis use VDH files as the spatial data source. The EPA data confirms that population serves needs to be distributed among all wells in a community wellfield.

From this point forward, only VHD data will be used as this is the most complete and current information available.

The VDH files was expanded to include the average per capita use in gal/day/person as calculated based on rate (GPD) and population served. The rates were then allocated between multiple site facilities and converted to gallons per minute (GPM). During the review it was found that data for Lovettsville needs to be corrected by a factor of 30 (presumably a reporting error of days and months).

Reference: G:\BLDG_DEV\Engineering\H2O Team\Programs & Projects\EPA_SDWDIS_Safe_Drinking_Water

3. The **County Wellpoll GIS**

The **wellpoll** file include both water wells and disposal systems (i.e. septic fields). There are no names, population serves of water usage rates, just point location and type of well. The WE_SITE_ID contains the following selections (as per metadata) for wells:

WWCO	**Community well**
WWCS	Community spring
WWDH	Dry well
WWDU	Dug well
WWHP	Heat pump well
WWID	Industrial well
WWIN	Individual well
WWIR	Irrigation well
WWMN	Monitor well
WWNC	**Non-community well**
WWOB	Observation well
WWQM	Water quality monitoring well
WWSP	Spring
WWTS	Test well
WWUN	Unknown well

O:\data\Metadata\SDE_Source\Environment\HTM\wellpoll_point.htm

Presumably the spatial location data is fairly accurate. In review of **VDH** and **wellpoll**, it appears that **wellpoll** is always the more accurate location, based on several factors.

The **VDH community wells** were assigned what spatially appeared to be the corresponding **wellpoll** site_ID. Of the 117 sites, all but 8 locations had a corresponding **wellpoll** location. The **VDH** wells are assigned latitude/longitude using different mapping accuracy as per table. The **wellpoll** sites have been mapped over time at the parcel-accuracy level.

In matching **VDH** and **wellpoll** locations there were numeous occurances where there were several probably wells in wellpoll that corresponded to one site in **VDH** data, even though **VDH** data does include multiple location per production system. For example, the Town of Hamilton has 10 records in **VDH**. In the GIS there may be as many as 16 locations of WWNC and WWCO type wells. In Lovettsville fours well are know to be in operation as reported by **VDH** and there are 6 sites in **wellpoll**.

4. The **B&D Welldatabase**

The **B&D** file is an on-going upgrade to wellpoll. This is MS Access file. The table **tbl_groundwater** has a fairly good and complete relationship from Well ID to Permit ID and the true well status. We need to match up "site_id" (text 25) in "tbl_groudnwater" with WE_SITE_ID" (text 14) assigned manually to "community wells" from **wellpoll** GIS basemap layer.

We can use this in helping to decide how to best assign WE_CODE_ID to the community_well records. Often there are multiple probable wells in wellpoll_GIS to match up with community_wells. Ideally we would have only one **wellpoll** GIS point per community well as the community_well already has separate records with distinct lat/long for the know wells in a well field. The additional points in the GIS may be test wells associated with the community well. They may be where several wells were drilled to find the community and then just one of two or more were selected as the true production wells. The additional wells may or may not have been abandoned.

5. **Water Usage from Annual Reports**

Historical water use for the major towns is typically summarized in terms of equivalent residual units (ERU/ERC) or connections. Data from Consumer Confidence Report (CCR) and Annual reports were compared for consistency and rates converted to million gallons per day (MGD). At the end an estimate for average 2007 use has been added.

Annual Water & Wastewater Reports prepared by by Draper Arden
Rates in MGD were calculated from Equivalent Residential Unit values
http://www.daa.com/news/surveys.htm

	LCSA	Leesburg	Purcellville	Round Hill	Middleburg	Hamilton	Lovettsville	Total MGD
ERU	**250**	**350**	**250**	**250**	**250**	**250**	**250**	
2000	10.400	3.837	0.350	0.139	0.037	no data	no data	14.8
2001	no data	4.831	0.340	no data	no data	no data	0.049	5.2
2002	12.620	5.311	0.374	0.130	no data	0.131	no data	18.6
2003	13.277	5.487	0.373	0.172	0.206	0.130	no data	19.6
2004	13.950	5.704	0.490	0.586	0.062	0.125	no data	20.9
2005	14.237	5.639	0.598	0.293	0.660	0.125	no data	21.6
2006	15.485	5.538	no data	0.142	no data	0.150	no data	21.3

Equivalent Residential User: One equivalent residential water connection equals total water consumption per day divided by 250 gallons per day, except Leesburg is 350 gallons per day.

2007 Estimate	**16.50**	**5.80**	**0.70**	**0.30**	**0.50**	**0.17**	**0.10**	**24.1**

Reference: G:\BLDG_DEV\Engineering\H2O Team\Programs & Projects\Public_Water_Supplies

6. **Water Use by Towns**

Other than LCSA, the Towns are the major water users. To confirm the data and provide additional insight of future water use data was collected at the town level.

Town of Leesburg data were obtained directly. Virtually all water is obtained through an intake on the Potomac River. Using comparable ERU's, the town data is generally consistent with the annual reports.

Town of Purcellville data were obtained through a consultant. While the Town generally produces half of the water from Hirst Reservoir, the data did confirm the annual total usage report mentioned above. At this time the second reservoir (New Centential) will not be developed for at least a decade.

Both the town data and the annual report data were compared with the VDH for overall consistency. This cross check did not reveal any significant data problems.

G:\BLDG_DEV\Engineering\H2O Team\Programs & Projects\Public_Water_Supplies\Purcellville

7. **Wellhead Protection Plans**

Wellhead protection plans have been compiled for: Town of Round Hill, Beacon Hill, Lenah Run, and Raspberry Falls. Plans for Lovettsville are in preparation. It is unknown as to whether plans exist or will be developed for Town of Hamilton. Plans will be forth coming for: Elysian Heights, the Reserve at Rokeby Farm, and Selma in 2007-2008. Thus far there has been no mention of WHP for Town of Purceville, know to have several wells and operates Hirst Reservoir. These reports often include the individual well names, depth, capacity (gpm) and status.

Reference: G:\BLDG_DEV\Engineering\H2O Team\Programs & Projects\Loudoun_Wellhead_Protection_Plans

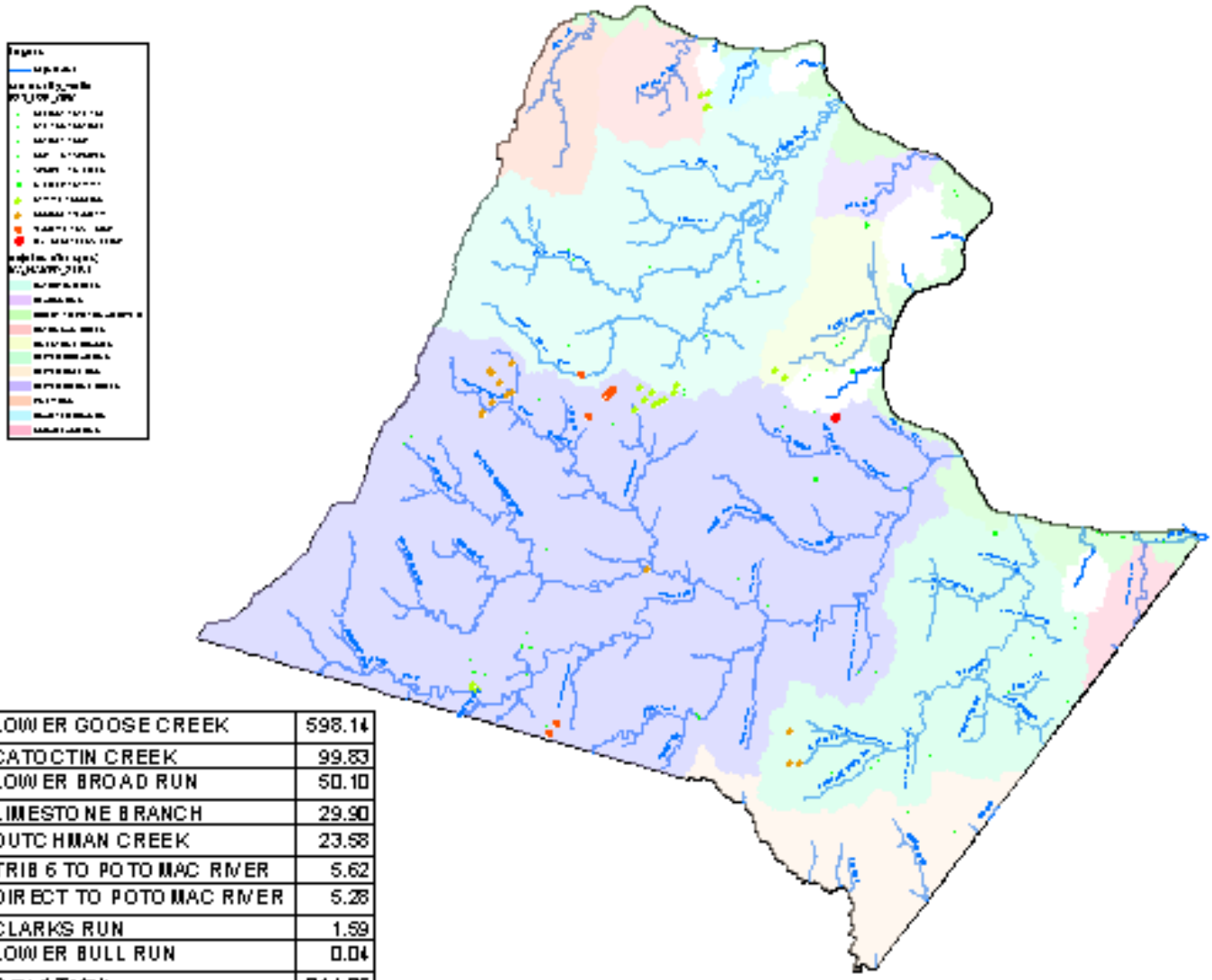
Data Compilation:

Using ArcToolBox Identity, create the feature class "community_wells_identity_majshed" in the pgdb pgdb_groundwater_use.mdb. Now using Crystal Report, summarize the estimated well usage by subwatershed (field MA_NAMED_SUB1). Also, edit the estimated rate and change LCSA surface water value to zero (it was over 2,700). Then rework/reformat the file into Excel file "report1.xls" as:

LOWER GOOSE CREEK	598.14
CATOCTIN CREEK	99.83
LOWER BROAD RUN	50.10
LIMESTONE BRANCH	29.90
DUTCHMAN CREEK	23.58
TRIB 6 TO POTOMAC RIVER	5.62
DIRECT TO POTOMAC RIVER	5.28
CLARKS RUN	1.59
LOWER BULL RUN	0.04
Grand Total:	814.06

The highest community well usage is in Goose Creek at over 600 gpm. *(Need to check to see if this includes Hirst Reservoir)*

The below image can more easily be seen on screen or large plot



LOWER GOOSE CREEK	598.14
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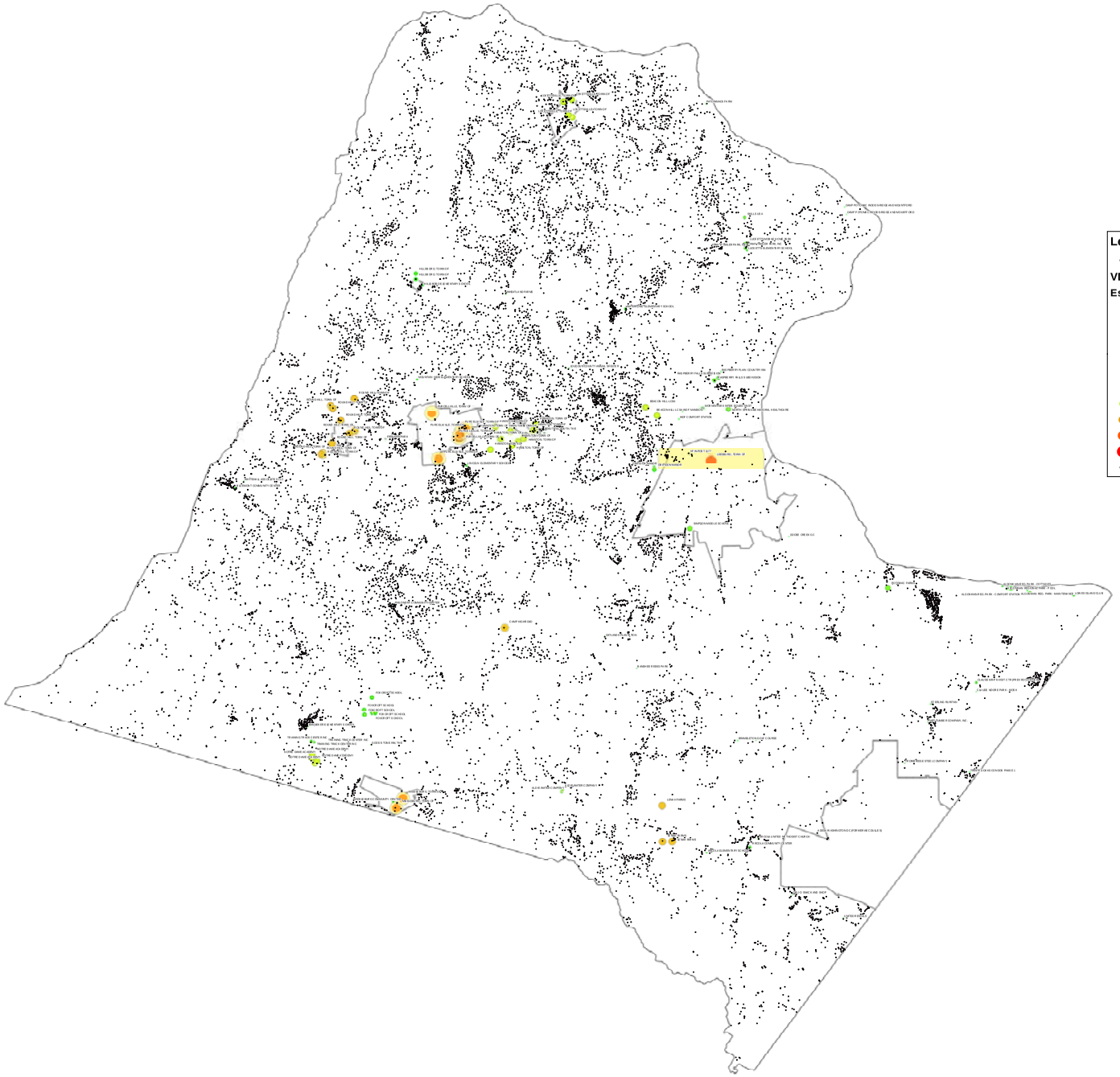
DIRECT TO POTOMAC RIVER	5.28
CLARKS RUN	1.59
LOWER BULL RUN	0.04
Grand Total:	814.06

Working folder: O:\project\wrmp\Groundwater_Use

Next Step: Tally up the private water well, eliminating the "imminent" wells that are these are not in operation. Tally up the surface water intakes on Goose Creek/Beaverdam Reservoir. Revisit Purcellville data and separate out wells from Hirst Reservoir.

Need to check on what significant agricultural wells exist that need to be included. Are there any surface water users not reported? Check with VA Extension and LSWCD.

Also, may consider development of additional water demand using "imminent" wells and an analysis of zoning and future "build-out".



Username: DWARD Computer: DWARD-50987C
Printed: Jun 06, 2007
Document: O:\project\wrmp\Groundwater_Use\Groundwater_Use_Map09.mxd

0 1 2 4 6 8 Miles

Groundwater Use (gpm)
Commmunity and Private Wells

Data developed from "wellpoll", VDH and EPA (SWDIS)

Loudoun County, Building & Development

Contributing Area to Groundwater Wells using Volumetric Method

For each public water supply well, we can compute the average contributing area in several ways. In a separate memo, the "contributing area" is based on a calculated net recharge to groundwater. In the volumetric method, we calculate the pore volume pumped for a certain time period using a simple displacement using assumed values for aquifer porosity, thickness and time of pumping. EPA WHP refers to this as the "volumetric method".

The approach is to calculate a simple radius of circle based on the pumping and aquifer characteristics. This is a very simple first-order approximation. These values depend on the assumed time of interpretation and should probably not be extended too many years as the cone of depression would naturally hit recharge boundaries. The approach neglects regional groundwater gradient. This approach neglects non-steady pumpage. The approach does not allow for interference between wells. The approach does not include the effects of dispersion. In fractured bedrock in western Loudoun, pollution transport can be substantially greater than the average travel distance. Therefore, this method is not conservative and should be interpreted in light of minimal distances of wellhead protection.

The formula is:

```
radius_ft = sqrt(Time_days*Pumping_Rate_gpm*1440/7.48/* /
                 (Porosity*Aquifer_Thickness_ft*PI())
```

To apply this formula, we can assume aquifer porosity of 0.01 (1%) and an aquifer thickness of 300 feet. For rate and time, let's choose several values to cover the range of reasonably possibilities.

Time	Rate	Rate	Radius	Well Type
days	gpm	gpd	feet	
100	0.188	270	20	Small Residential
365	0.188	270	37	Small Residential
1,000	0.188	270	62	Small Residential
3,650	0.188	270	118	Small Residential
100	0.5	720	32	Large Residential
365	0.5	720	61	Large Residential
1,000	0.5	720	101	Large Residential
3,650	0.5	720	193	Large Residential
100	5	7,200	101	Small Community
365	5	7,200	193	Small Community
1,000	5	7,200	320	Small Community
3,650	5	7,200	611	Small Community
100	50	72,000	320	Large Community
365	50	72,000	611	Large Community
1,000	50	72,000	1011	Large Community
3,650	50	72,000	1931	Large Community

It is interesting to note that using the "recharge method", a residential household well pumping at 270 gpd (0.188 gpm) requires a 71 ft radius which compares with 3 to 4 years of comparable pumpage using the "volumetric method".

Due to groundwater gradients and regional groundwater flow patterns typical of western Loudoun County, caution should be used for times greater than a few years.

How does this compare to the administrative wellhead protection limits?

- Zone 1 is a 1000-foot radius around the well and is a priority zone for managing potential sources of contamination; and
- Zone 2 is a one-mile (5,280-feet) radius which represents an estimate of the total recharge zone for the well.

It is somewhat difficult to reasonably compare the two approaches as the "volumetric method" depends on the value of time. Nonetheless, the method is generally consistent with the Zone 1 distance of 1,000 feet for several years of pumpage. Because the method does not include fracture contaminant transport or dispersion, the approach is generally consistent with Zone 2 administrative boundary of one mile distance from the well.

Contributing Recharge Area to Groundwater Wells

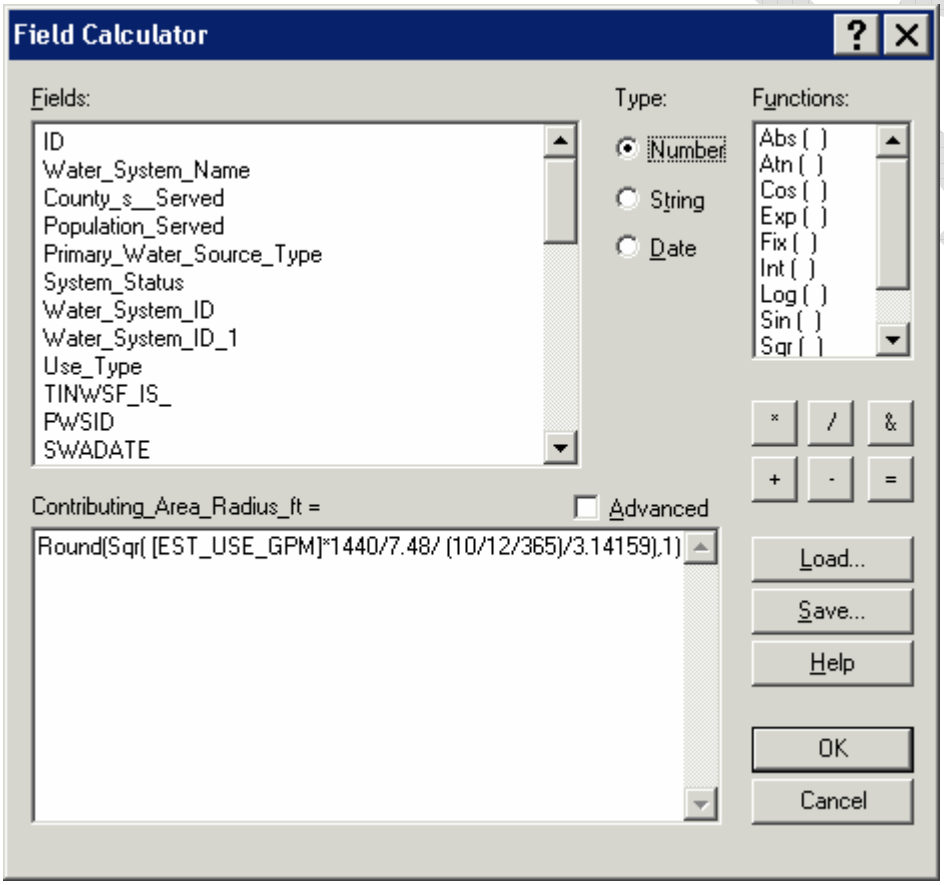
For each public water supply well, we can compute the average contributing area, based on a calculated net recharge to groundwater. The approach is to calculate a simple radius of circle in which the recharge equals the average pumping rate. This is a very simple first-order approximation. These values are much less than conservative estimates used in the wellhead protection strategy. The approach neglects regional groundwater gradient. This approach neglects non-steady pumpage. The approach does not allow for interference between wells.

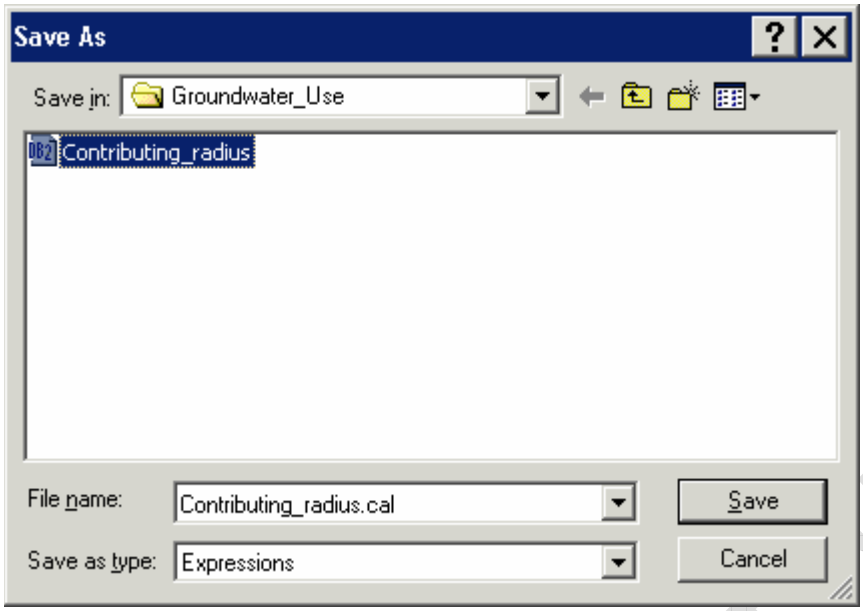
The formula is:

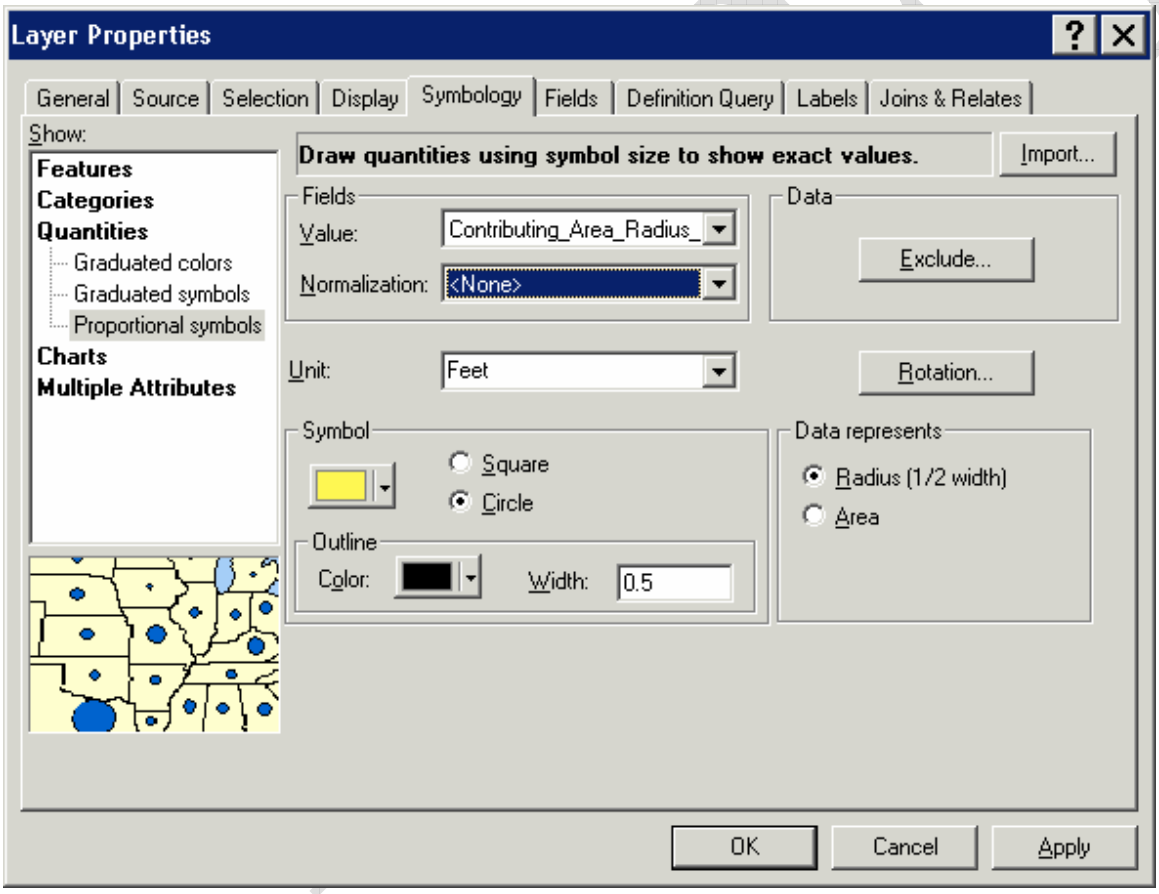
```
radius_ft = sqrt(rate_gpm*1440/7.48/(Recharge_in_per_year/12/365)/PI())
```

For example, a 1 gpm well requires recharge over a circle with a radius of 163.5 feet assuming 10 inches per year of recharge.

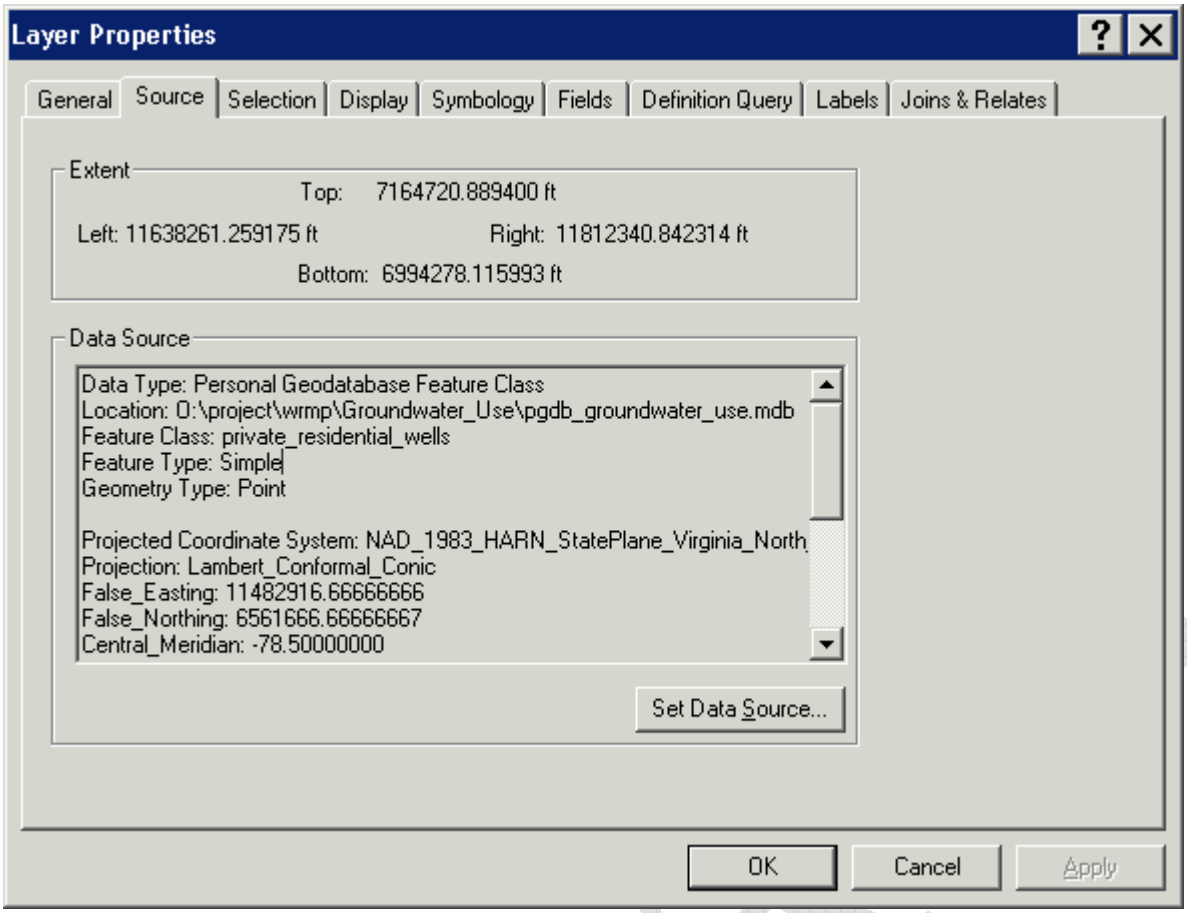
In geodatabase, add a field and calculate:







Now for private wells, lets assume about 270 gallons per day per well (per household). We add a field to the feature class “private residence wells” and set value to 71 feet. (See Excel file).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Feature Type: Simple
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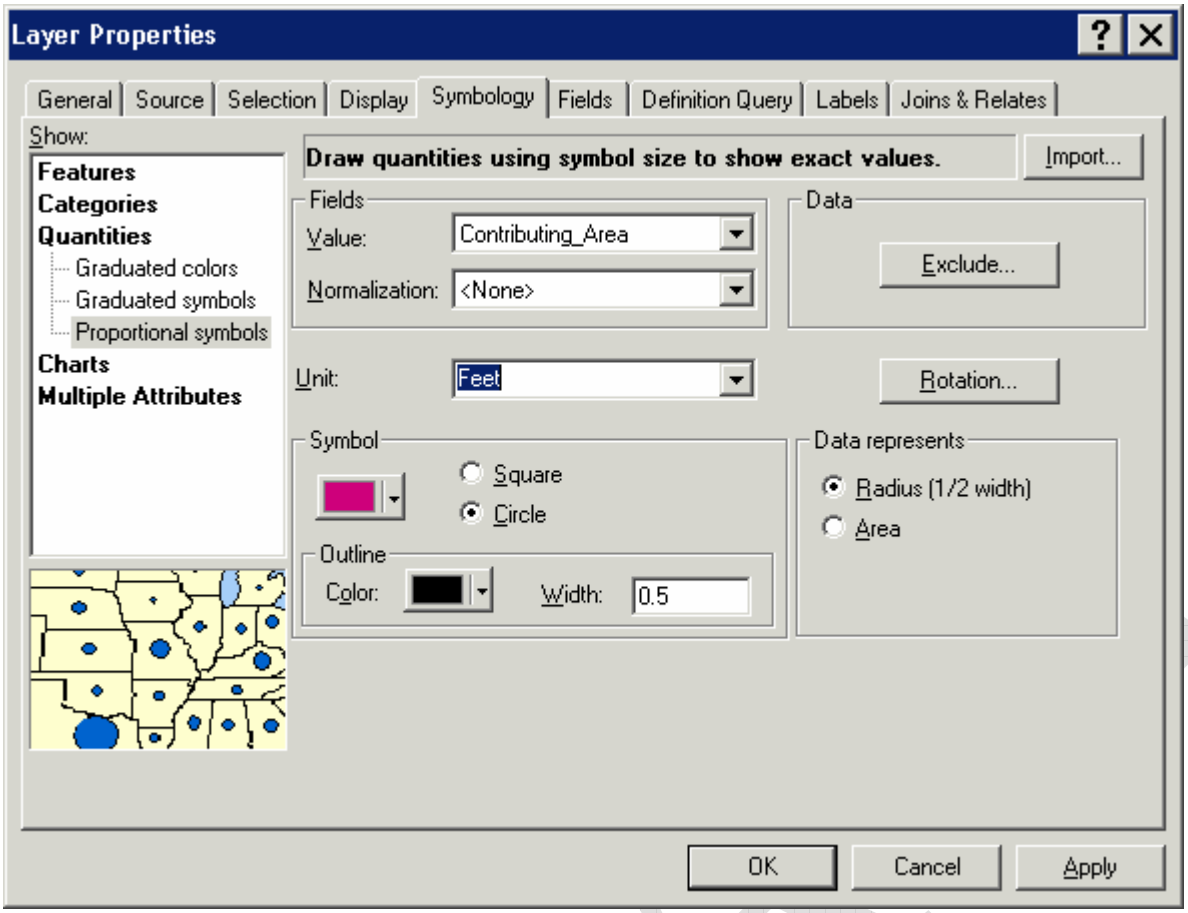
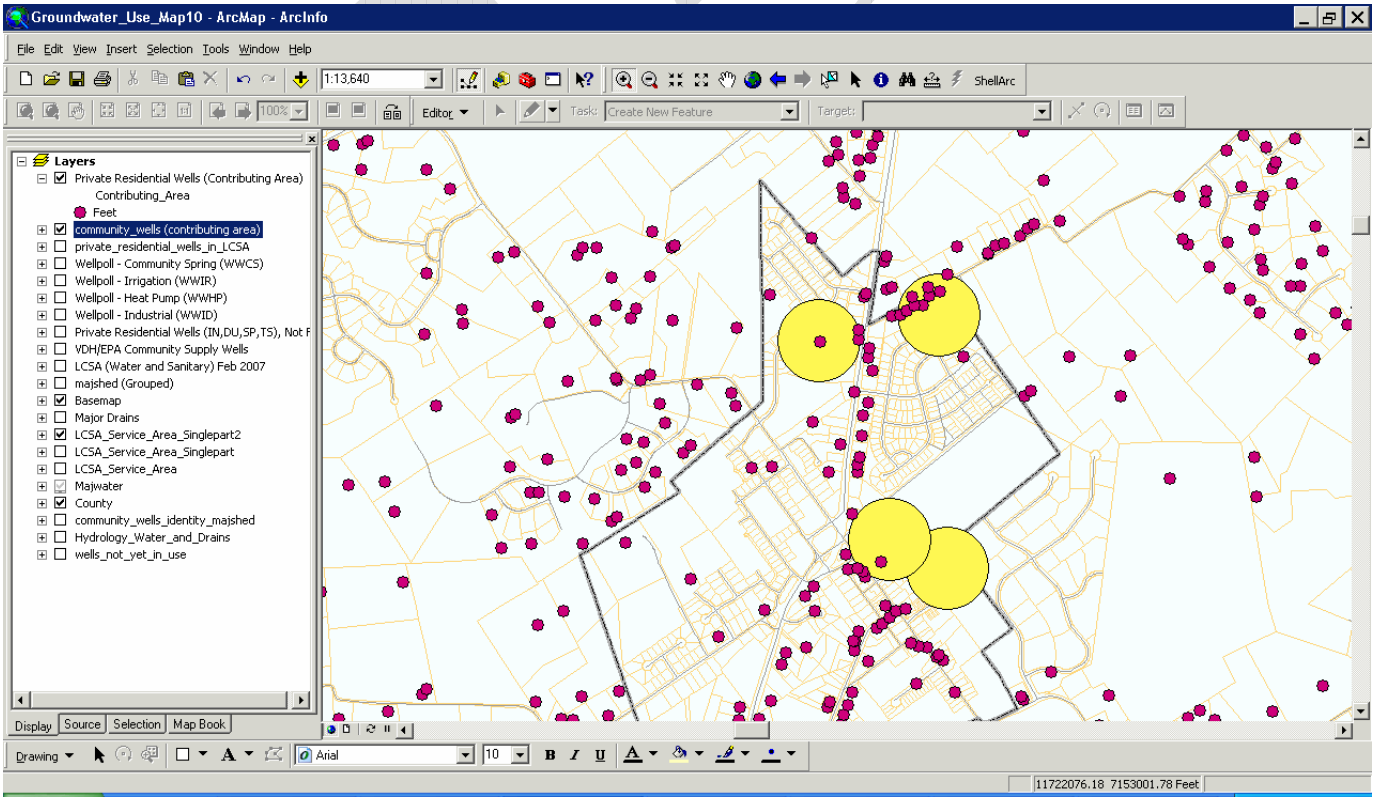
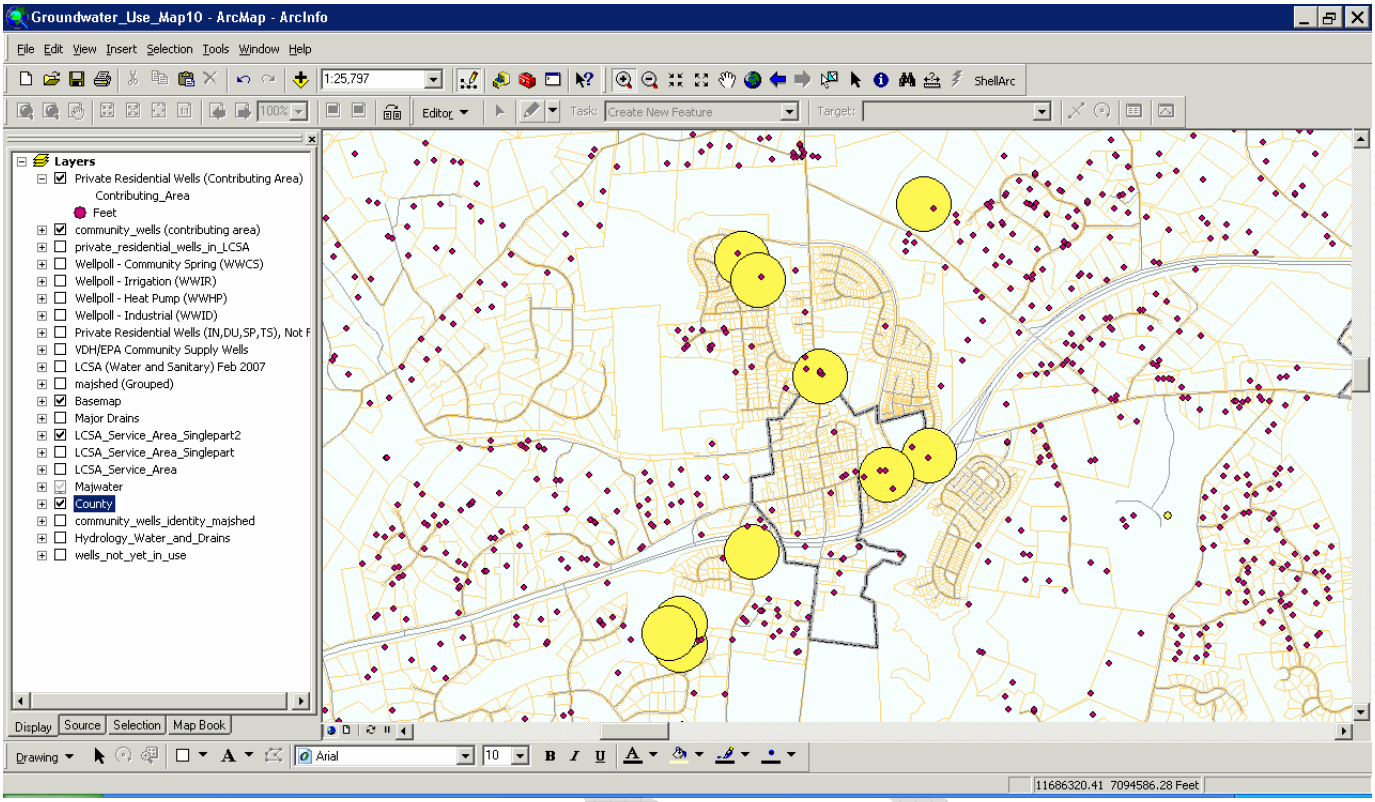


In Lovettsville:



In Round Hill:


Groundwater_Use_Map10 - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
1:25,797
Editor
Task: Create New Feature
Target:
ShellArc
Layers
Private Residential Wells (Contributing Area)
Contributing_Area
Feet
community_wells (contributing area)
private_residential_wells_in_LCSA
Wellpoll - Community Spring (WWCS)
Wellpoll - Irrigation (WWIR)
Wellpoll - Heat Pump (WWHP)
Wellpoll - Industrial (WWID)
Private Residential Wells (IN,DU,SP,TS), Not F
VDH/EPA Community Supply Wells
LCSA (Water and Sanitary) Feb 2007
majshed (Grouped)
Basemap
Major Drains
LCSA_Service_Area_Singlepart2
LCSA_Service_Area_Singlepart
LCSA_Service_Area
Majwater
County
community_wells_identity_majshed
Hydrology_Water_and_Drains
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Display Source Selection Map Book
Drawing
Arial
10
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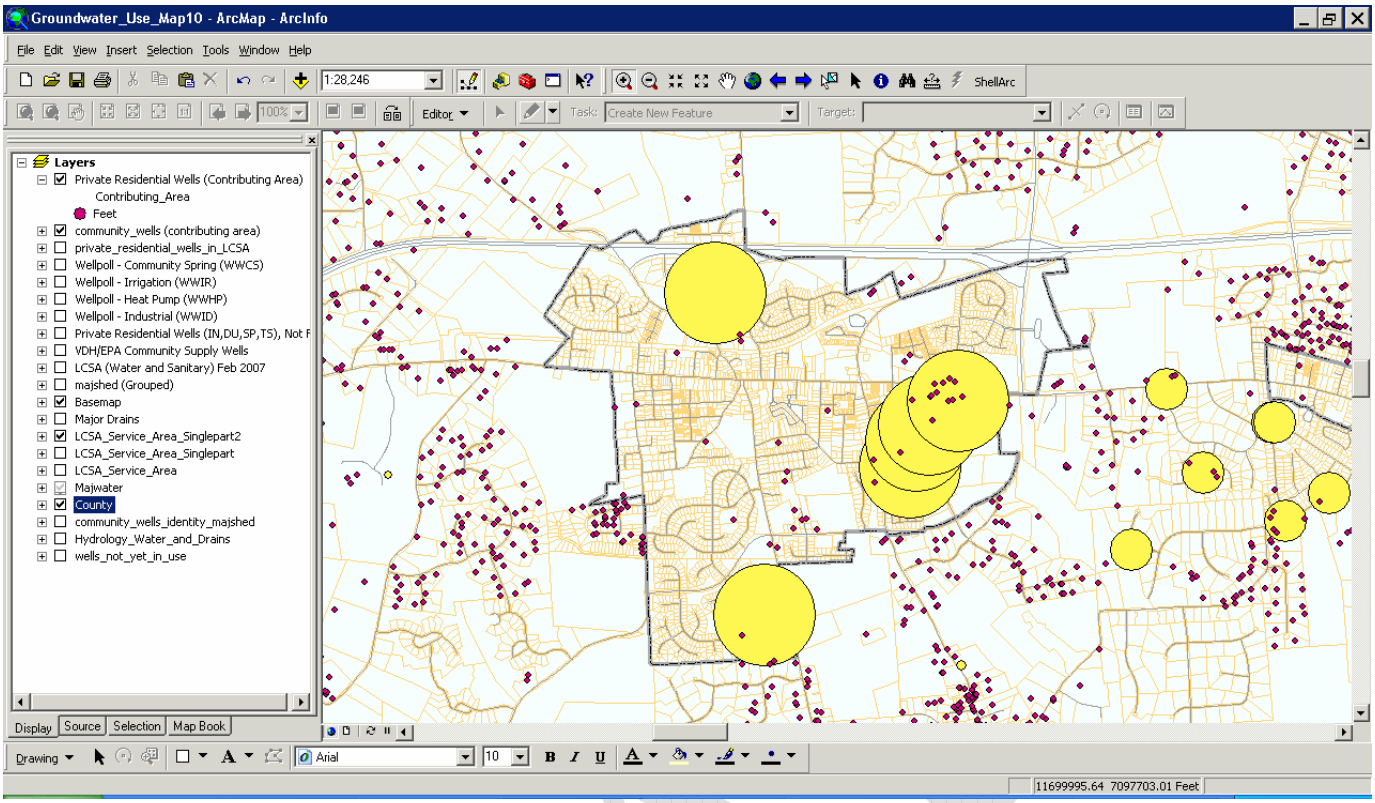
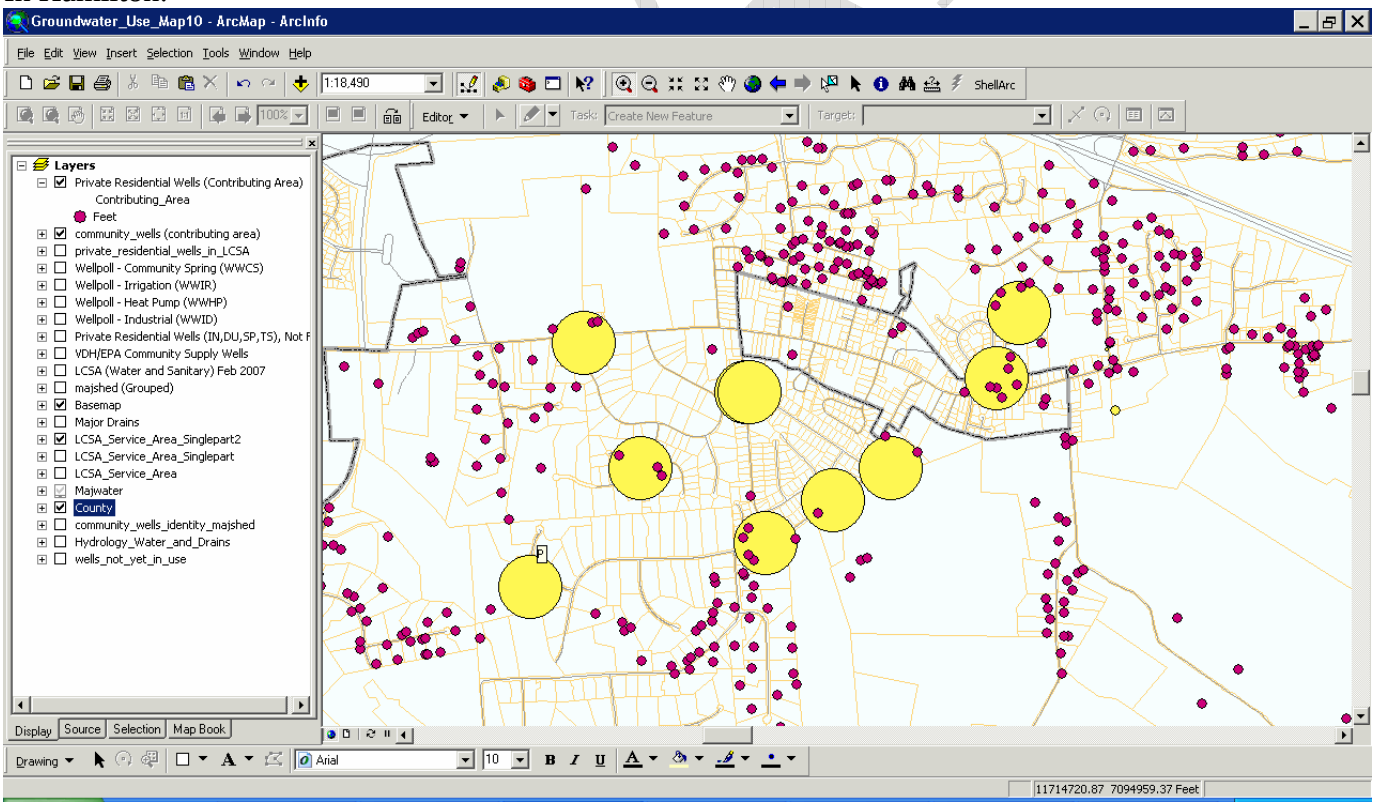
In Purcellville:



In Hamilton:



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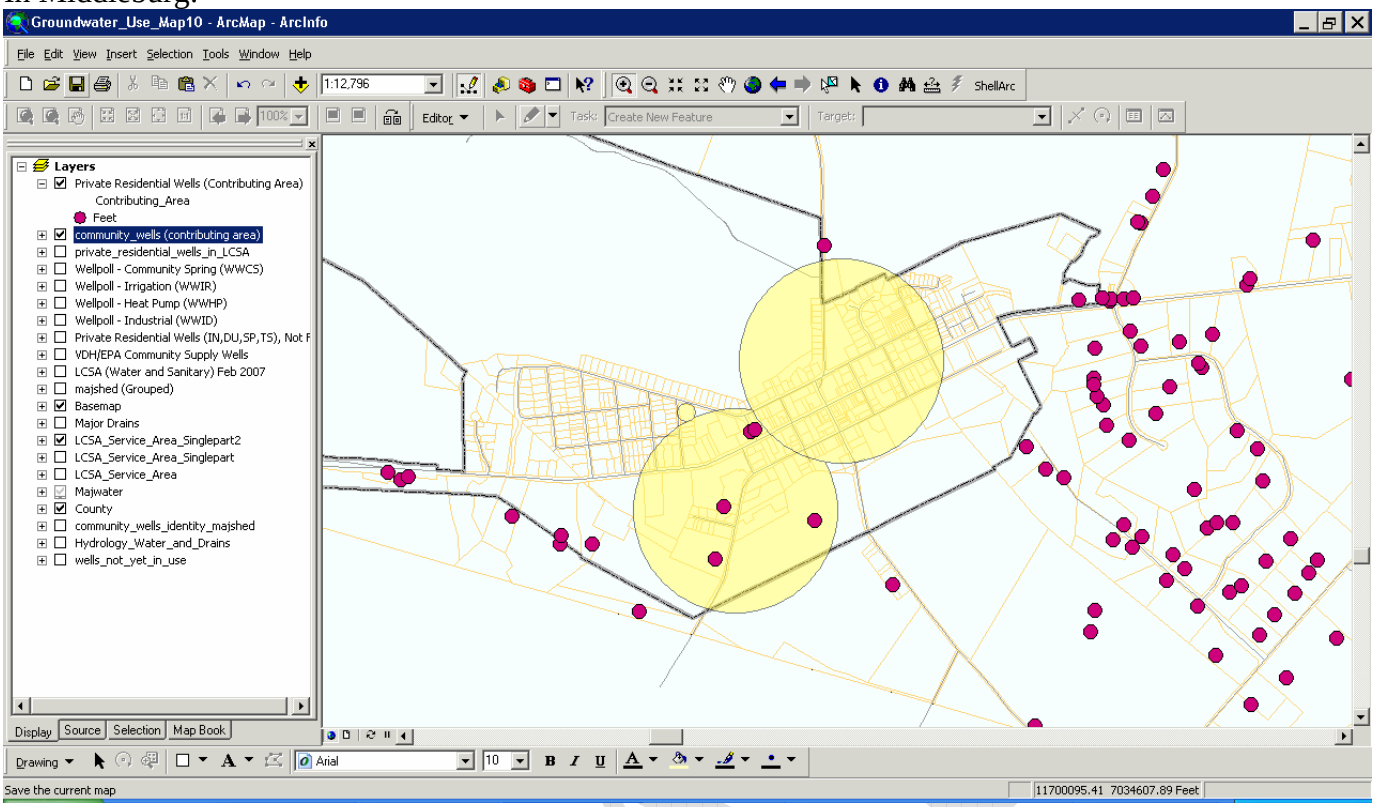
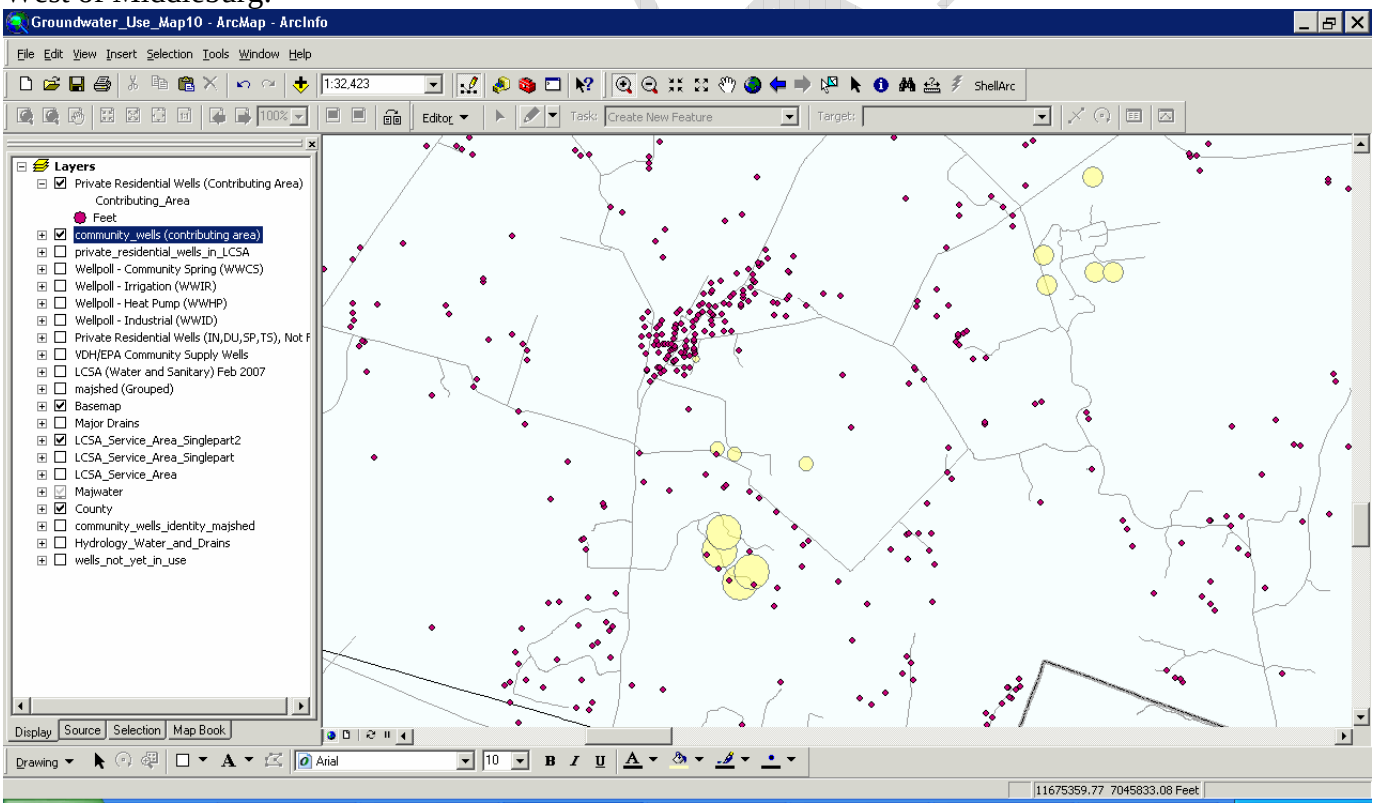
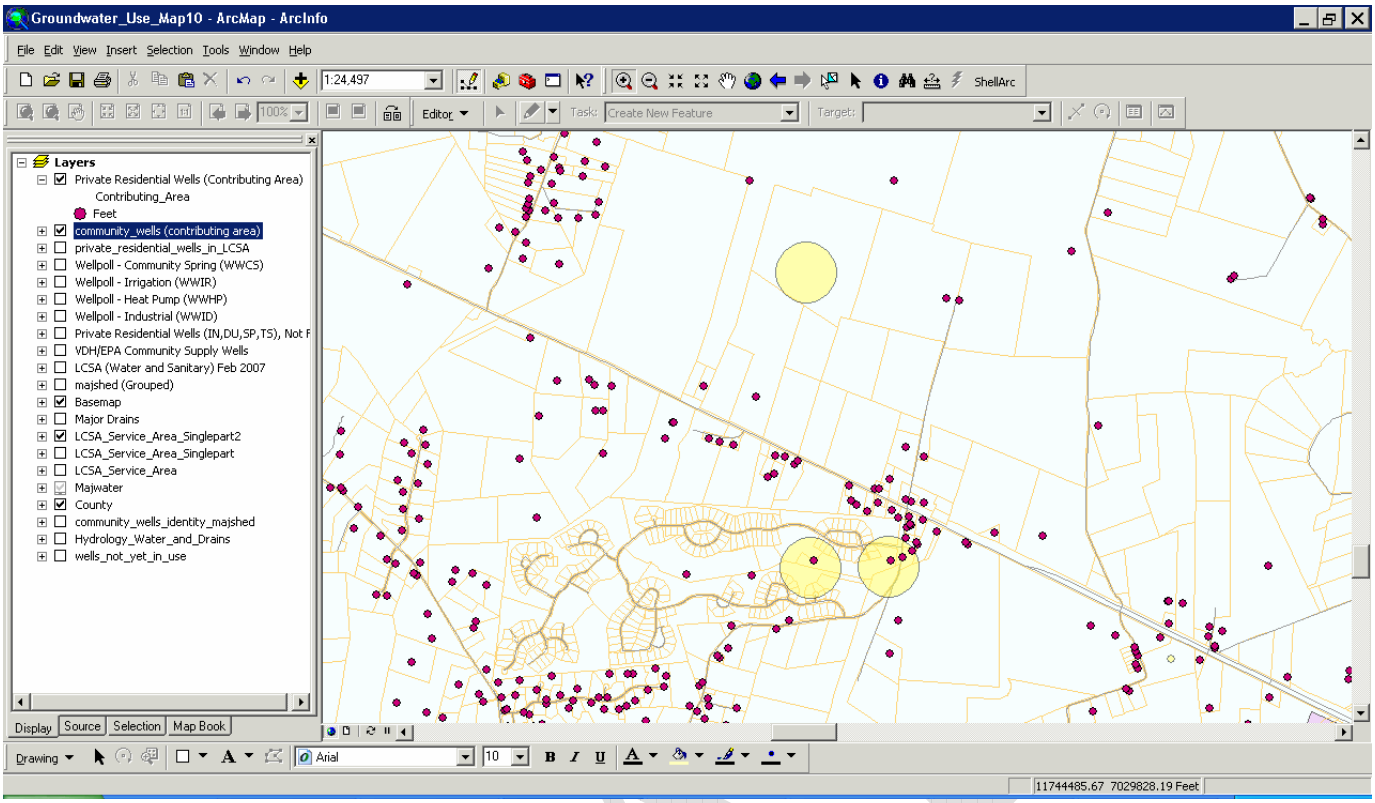


West of Middleburg:



In Lenah Run:



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- Zone 2 is a one-mile (5,280-feet) radius which represents an estimate of the total recharge zone for the well.

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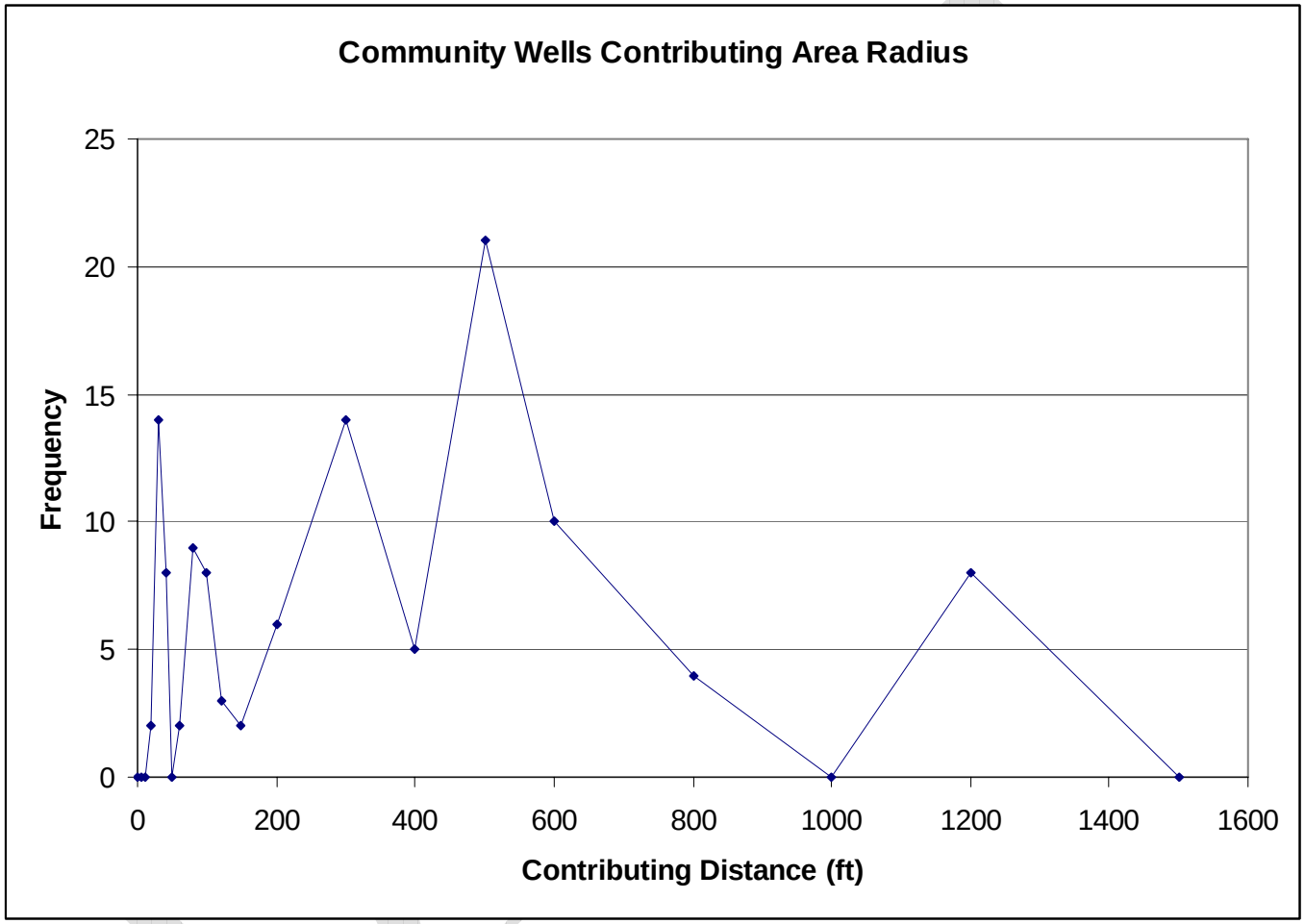


Water System Name	County(s) Served	Population Served	Primary Water Source Type	System Status	Water System ID
ALDIE WATER COMPANY	LOUDOUN	70	Groundwater	Active	VA6107010
BEACON HILL-LCSA	LOUDOUN	320	Groundwater	Active	VA6107037
FOXCROFT SCHOOL	LOUDOUN	290	Groundwater	Active	VA6107100
GRAYDON MANOR	LOUDOUN	33	Groundwater	Active	VA6107470
HAMILTON, TOWN OF	LOUDOUN	2000	Groundwater	Active	VA6107150
HILLSBORO, TOWN OF	LOUDOUN	90	Groundwater_under_infl_of_surface_water	Active	VA6107200
HIWAY TRAILER PARK, INC	LOUDOUN	72	Groundwater	Active	VA6107075
LEESBURG, TOWN OF	LOUDOUN	37000	Surface_water	Active	VA6107300
LENAH FARMS	LOUDOUN	800	Groundwater	Active	VA6107221
LOUDOUN COUNTY SANITATION AUTH	LOUDOUN	154589	Purch_surface_water	Active	VA6107350
LOVETTSVILLE, TOWN OF	LOUDOUN	1280	Groundwater	Active	VA6107400
LUCKETTS MOBILE HOME PARK	LOUDOUN	60	Groundwater	Active	VA6107420
MIDDLEBURG, TOWN OF	LOUDOUN	590	Groundwater	Active	VA6107450
NORTH SPRING BEHAVIORAL HEALTHCARE	LOUDOUN	77	Groundwater	Active	VA6107725
POTOMAC FARMS	LOUDOUN	100	Groundwater	Active	VA6107550
POTOMIA	LOUDOUN	50	Groundwater	Active	VA6107555
PURCELLVILLE, TOWN OF	LOUDOUN	6300	Surface_water	Active	VA6107600
RASPBERRY FALLS SUBDIVISION	LOUDOUN	650	Groundwater	Active	VA6107601
RESERVE AT ROKEBY FARM	LOUDOUN	25	Groundwater	Active	VA6107651
ROUND HILL, TOWN OF	LOUDOUN	3156	Groundwater	Active	VA6107650

Non-Transient Non-Community Water Systems: Water Systems that serve the same people, but not year-round (e.g. schools that have their own water system)

Water System Name	County(s) Served	Population Served	Primary Water Source Type	System Status	Water System ID
ADESA WASHINGTON DC (FORMER ABC DULLES)	LOUDOUN	80	Groundwater	Active	VA6107175
ALDIE ELEMENTARY SCHOOL	LOUDOUN	106	Groundwater	Active	VA6107011
ARCOLA COMMUNITY CENTER	LOUDOUN	200	Groundwater	Active	VA6107025
ARCOLA ELEMENTARY SCHOOL	LOUDOUN	430	Groundwater	Active	VA6107024
ARCOLA UNITED METHODIST CHURCH	LOUDOUN	200	Groundwater	Active	VA6107026
BANNEKER ELEMENTARY SCHOOL	LOUDOUN	171	Groundwater	Active	VA6107033
BLUEMONT COMMUNITY CENTER	LOUDOUN	100	Groundwater	Active	VA6107038
HILLSBORO ELEMENTARY SCHOOL	LOUDOUN	127	Groundwater	Active	VA6107205
LINCOLN ELEMENTARY SCHOOL	LOUDOUN	148	Groundwater	Active	VA6107325
LUCKETTS ELEMENTARY SCHOOL	LOUDOUN	269	Groundwater	Active	VA6107417
MOUNTAIN VIEW ELEMENTARY SCHOOL	LOUDOUN	800	Groundwater	Active	VA6107465

NOTRE DAME ACADEMY	LOUDOUN	200	Groundwater	Active	VA6107500
PHILOMONT COMMUNITY CENTER	LOUDOUN	75	Groundwater	Active	VA6107549
SIMPSON MIDDLE SCHOOL	LOUDOUN	1701	Groundwater	Active	VA6107675
TART LUMBER COMPANY, INC.	LOUDOUN	49	Groundwater	Active	VA6107623
TRAINING TRACK CENTER INC	LOUDOUN	100	Groundwater	Active	VA6107710
TROWBRIDGE STEEL COMPANY,	LOUDOUN	32	Groundwater	Active	VA6107715
TWISTED OAKS CONDOS PHASE 1	LOUDOUN	25	Groundwater	Active	VA6107520
UNITED RENTALS	LOUDOUN	26	Groundwater	Active	VA6107062
WATERFORD ELEMENTARY SCHOOL	LOUDOUN	161	Groundwater	Active	VA6107775

Transient Non-Community Water Systems: Water Systems that do not consistently serve the same people (e.g. rest stops, campgrounds, gas stations).

Water System Name	County(s) Served	Population Served	Primary Water Source Type	System Status	Water System ID
ALGONKIAN REG. PARK - COMFORT STATION	LOUDOUN	150	Groundwater	Active	VA6107018
ALGONKIAN REG. PARK - CONFERENCE CENTER	LOUDOUN	250	Groundwater	Active	VA6107015
ALGONKIAN REG. PARK - COTTAGES	LOUDOUN	200	Groundwater	Active	VA6107017
ALGONKIAN REG. PARK - MAINTENANCE	LOUDOUN	200	Groundwater	Active	VA6107019
ALGONKIAN REGIONAL PARK - POOL	LOUDOUN	200	Groundwater	Active	VA6107016
BANSHEE REEKS PARK	LOUDOUN	50	Groundwater	Active	VA6107045
BEAUTIFUL SOUTH, THE	LOUDOUN	25	Groundwater	Active	VA6107240
BRAMBLETON GOLF COURSE	LOUDOUN	25	Groundwater	Active	VA6107034
BRIAR PATCH B&B	LOUDOUN	50	Groundwater	Active	VA6107041
CAMP HIGHROAD	LOUDOUN	150	Groundwater	Active	VA6107052
CAMP POTOMAC WOODS-RIDGE AND MOUNTFORD	LOUDOUN	25	Groundwater	Active	VA6107120
CLAUDE MOORE PARK - KIOSK	LOUDOUN	25	Groundwater	Active	VA6107051
CLAUDE MR PK-VISIT CTR (PREV ROY GEIGER)	LOUDOUN	800	Groundwater	Active	VA6107030
DELI-O SNACK AND SHOP	LOUDOUN	25	Groundwater	Active	VA6107093
FRANKLIN PARK	LOUDOUN	400	Groundwater	Active	VA6107101
GOOD STONE INN, THE	LOUDOUN	25	Groundwater	Active	VA6107144
GOOSE CREEK GC	LOUDOUN	25	Groundwater	Active	VA6107148
GRANDALE FARM	LOUDOUN	30	Groundwater	Active	VA6107043
HAMILTON SAFETY CENTER/HARMONY HALL	LOUDOUN	250	Groundwater	Active	VA6107198
LOUDOUN COUNTY ANIMAL SHELTER	LOUDOUN	25	Groundwater	Active	VA6107349
LOWES ISLAND CLUB	LOUDOUN	725	Groundwater	Active	VA6107811
MIDDLEBURG COMMUNITY CENTER	LOUDOUN	150	Groundwater	Active	VA6107453
MORVEN PARK INTER EQUEST INST	LOUDOUN	50	Groundwater	Active	VA6107460

OATLANDS PLANTATION	LOUDOUN	30	Groundwater	Active	VA6107530
PATOWMACK FARM	LOUDOUN	50	Groundwater	Active	VA6107535
RASPBERRY PLAIN COUNTRY INN	LOUDOUN	25	Groundwater	Active	VA6107630
SKILLS USA	LOUDOUN	50	Groundwater	Active	VA6107012
STERLING RURITAN	LOUDOUN	50	Groundwater	Active	VA6107624
VFW-POST 1177	LOUDOUN	50	Groundwater	Active	VA6107760
WDF COMFORT STATION	LOUDOUN	25	Groundwater	Active	VA6107461
WDF MANSION	LOUDOUN	26	Groundwater	Active	VA6107462
WHEATLAND FARMS	LOUDOUN	50	Groundwater	Active	VA6107796
WHITEHALL ASSOCIATES LLC	LOUDOUN	25	Groundwater	Active	VA6107797

http://oaspub.epa.gov/enviro/sdw_query_v2.get_list?wsys_name=&fac_search=fac_beginning&fac_county=LOUDOUN&pop_serv=500&pop_serv=3300&pop_serv=10000&pop_serv=100000&pop_serv=100001&sys_status=active&pop_serv=&wsys_id=&fac_state=VA&last_fac_name=&page=1&query_results=&total_rows_found=

Contributing Recharge Area to Groundwater Wells

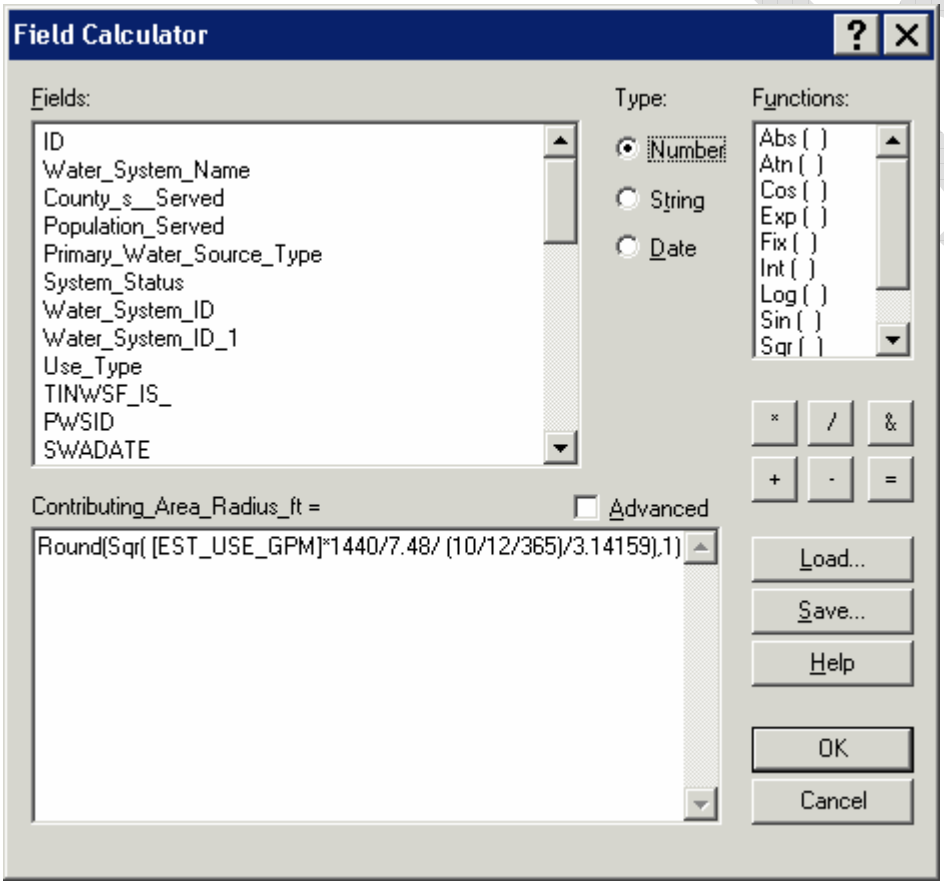
For each public water supply well, we can compute the average contributing area, based on a calculated net recharge to groundwater. The approach is to calculate a simple radius of circle in which the recharge equals the average pumping rate. This is a very simple first-order approximation. These values are much less than conservative estimates used in the wellhead protection strategy. The approach neglects regional groundwater gradient. This approach neglects non-steady pumpage. The approach does not allow for interference between wells.

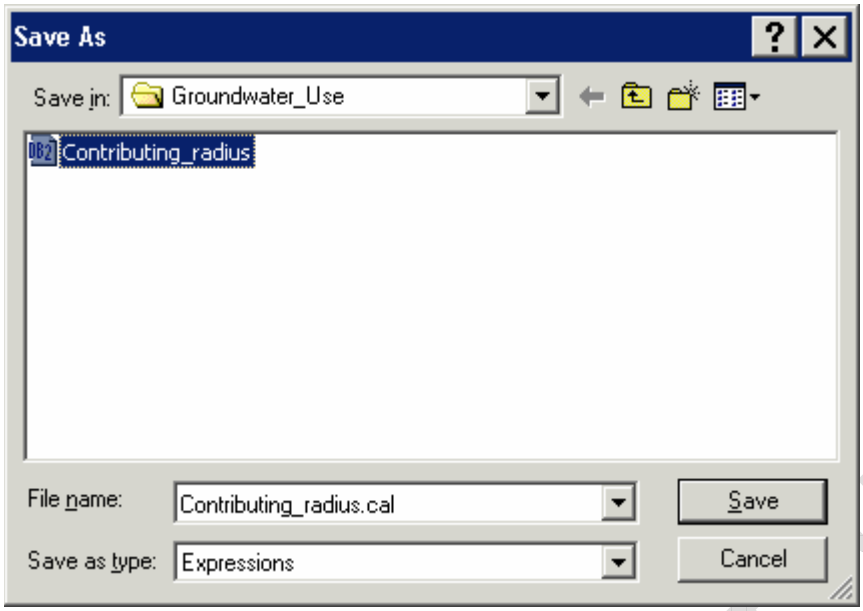
The formula is:

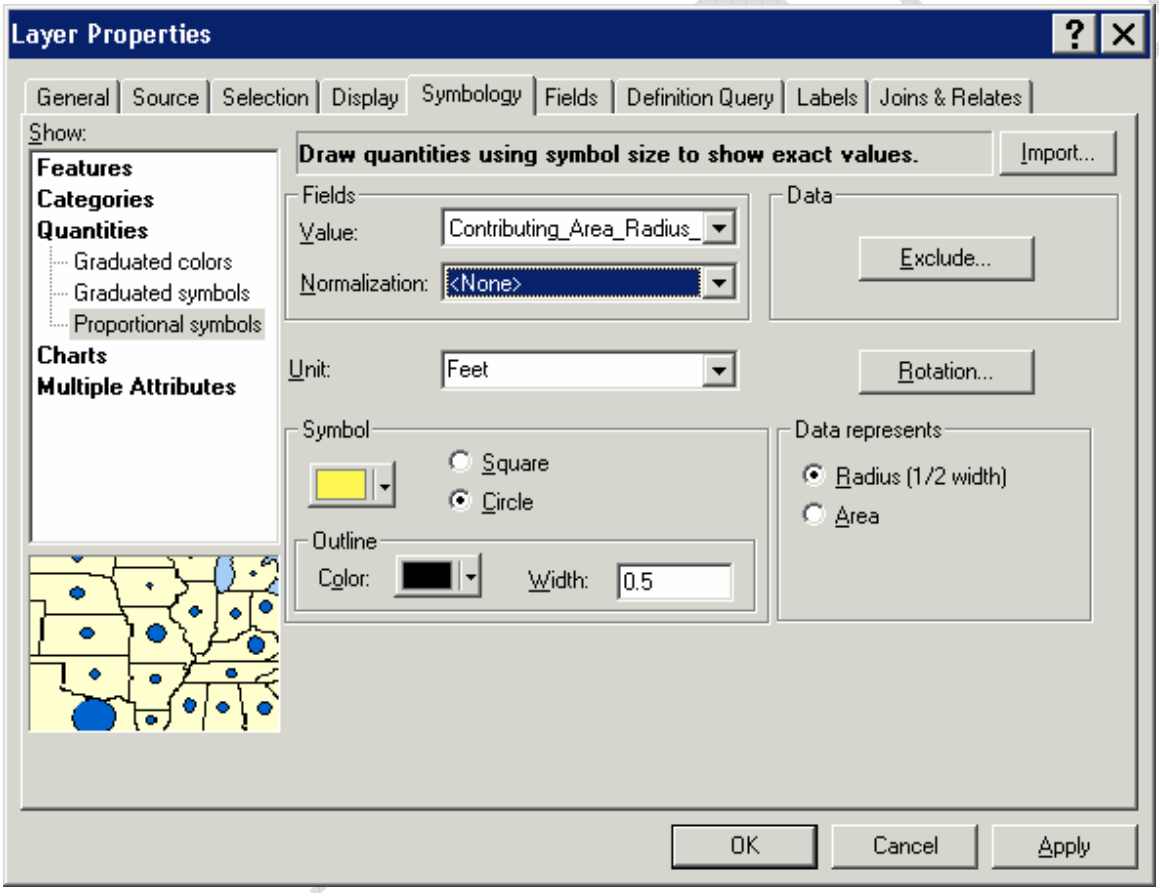
```
radius_ft = sqrt(rate_gpm*1440/7.48/(Recharge_in_per_year/12/365)/PI())
```

For example, a 1 gpm well requires recharge over a circle with a radius of 163.5 feet assuming 10 inches per year of recharge.

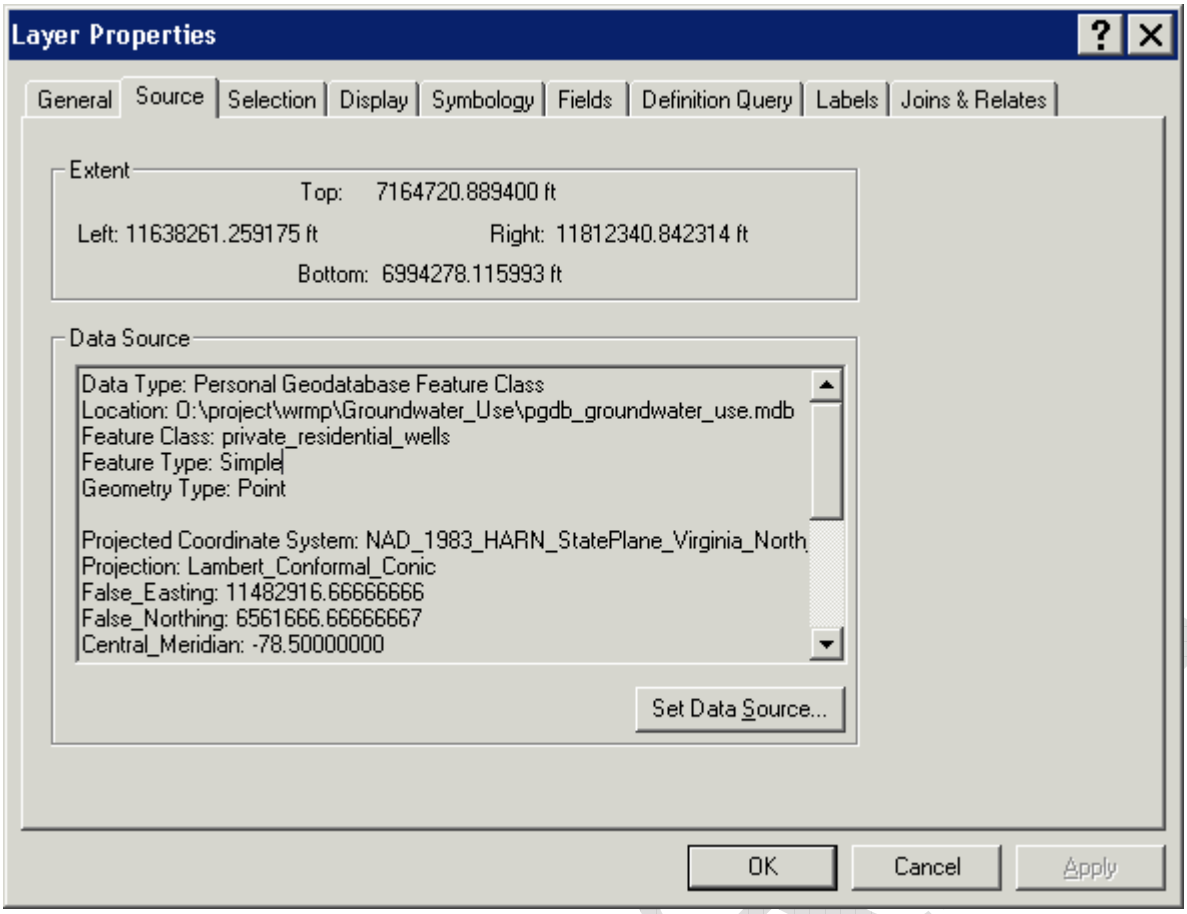
In geodatabase, add a field and calculate:

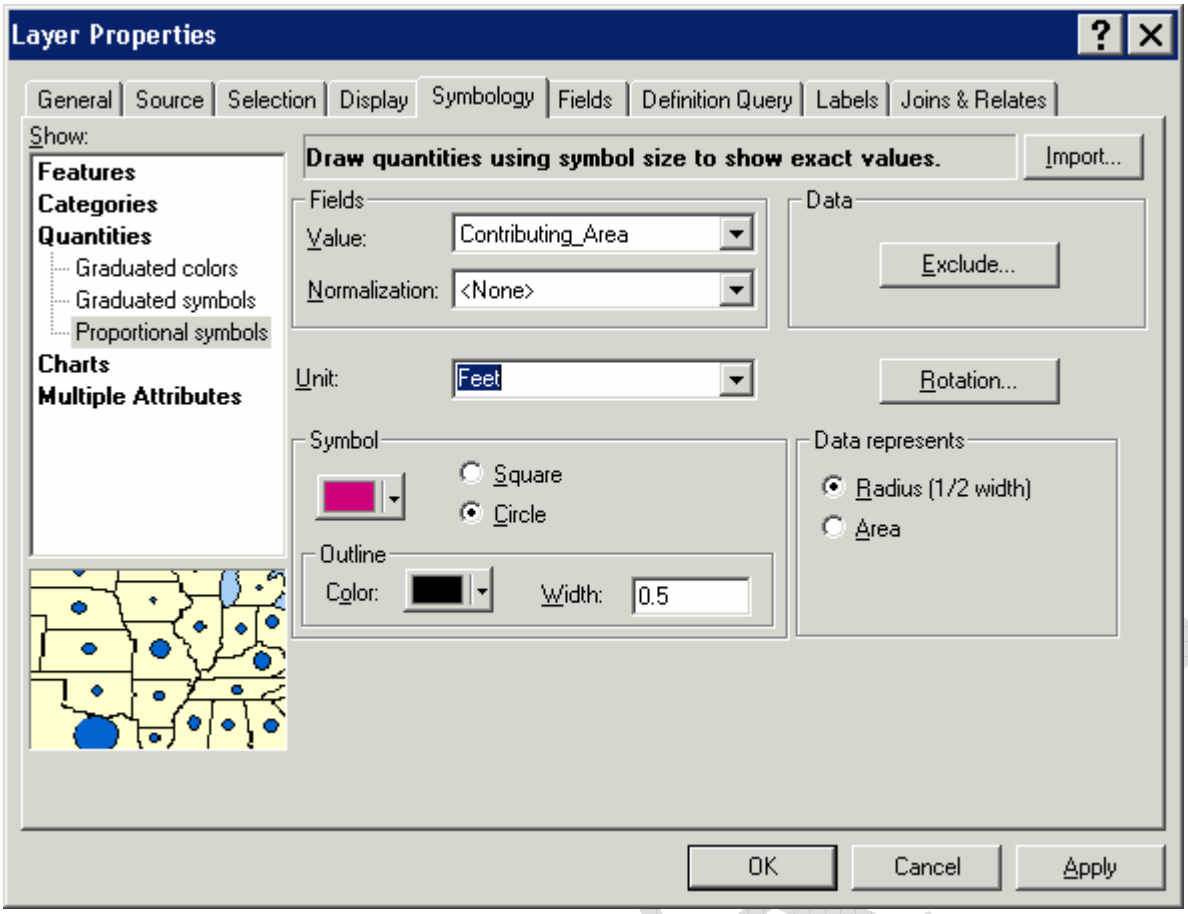




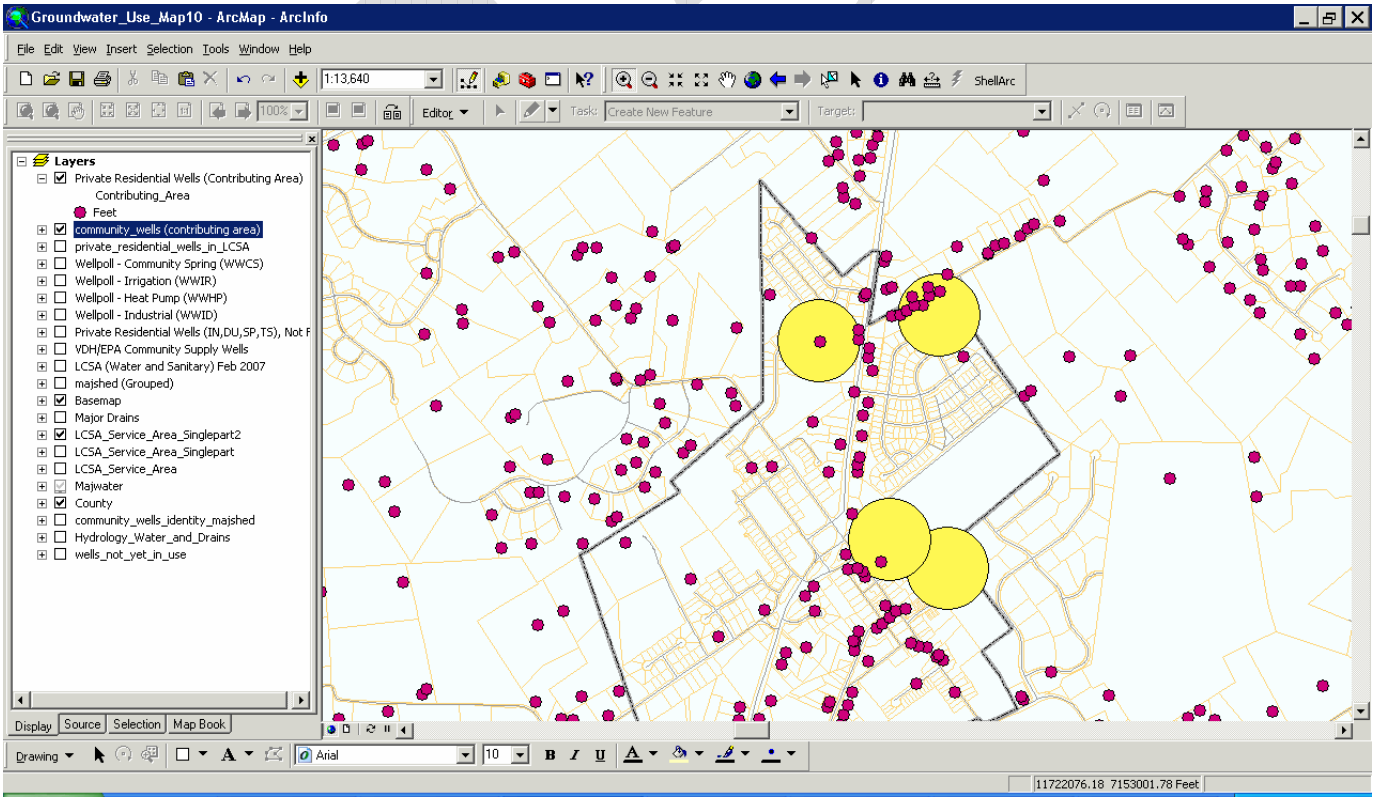


Now for private wells, lets assume about 270 gallons per day per well (per household). We add a field to the feature class “private residence wells” and set value to 71 feet. (See Excel file).

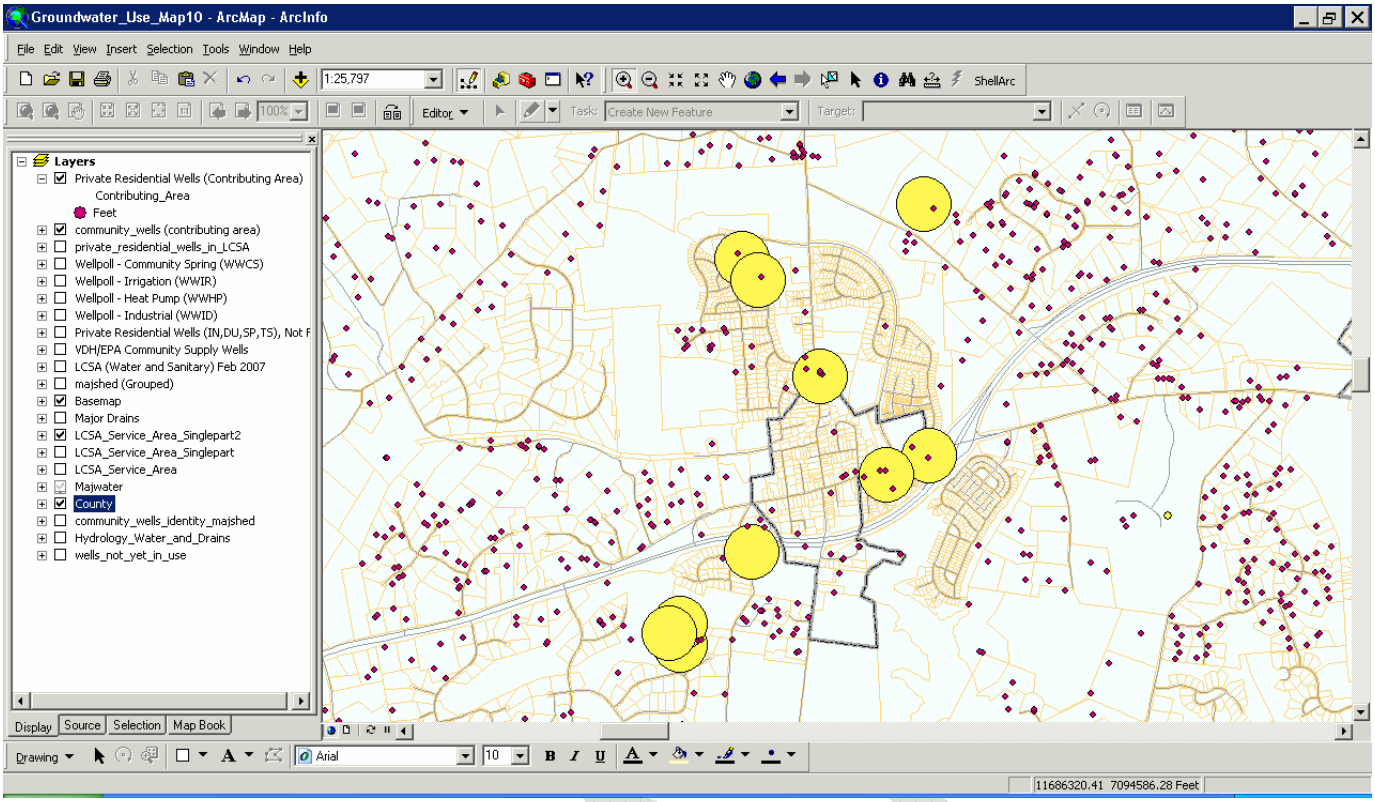

Layer Properties
General
Source
Selection
Display
Symbology
Fields
Definition Query
Labels
Joins & Relates
Extent
Top: 7164720.889400 ft
Left: 11638261.259175 ft
Right: 11812340.842314 ft
Bottom: 6994278.115993 ft
Data Source
Data Type: Personal Geodatabase Feature Class
Location: O:\project\wrmp\Groundwater_Use\pgdb_groundwater_use.mdb
Feature Class: private_residential_wells
Feature Type: Simple
Geometry Type: Point
Projected Coordinate System: NAD_1983_HARN_StatePlane_Virginia_North
Projection: Lambert_Conformal_Conic
False_Easting: 11482916.66666666
False_Northing: 6561666.66666667
Central_Meridian: -78.50000000
Set Data Source...
OK
Cancel
Apply



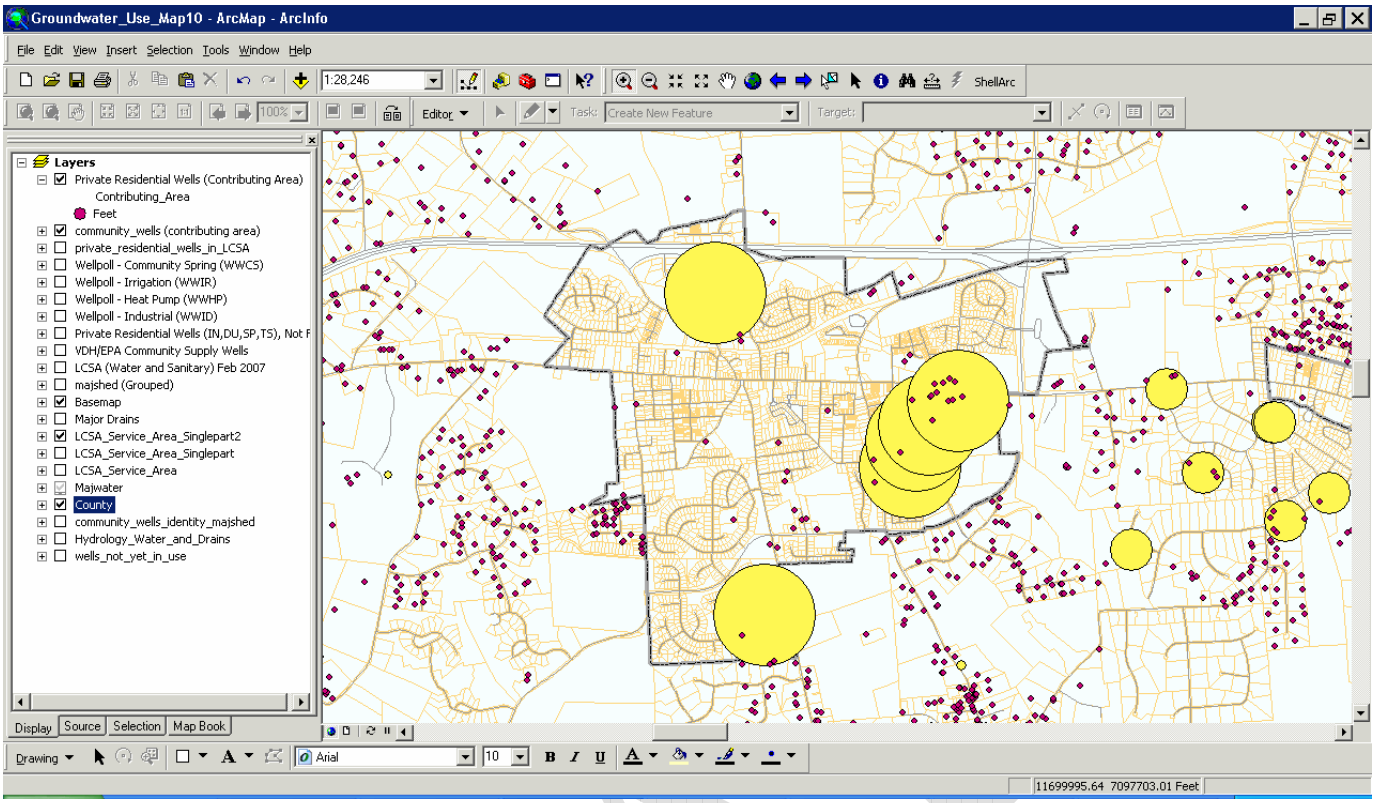
In Lovettsville:



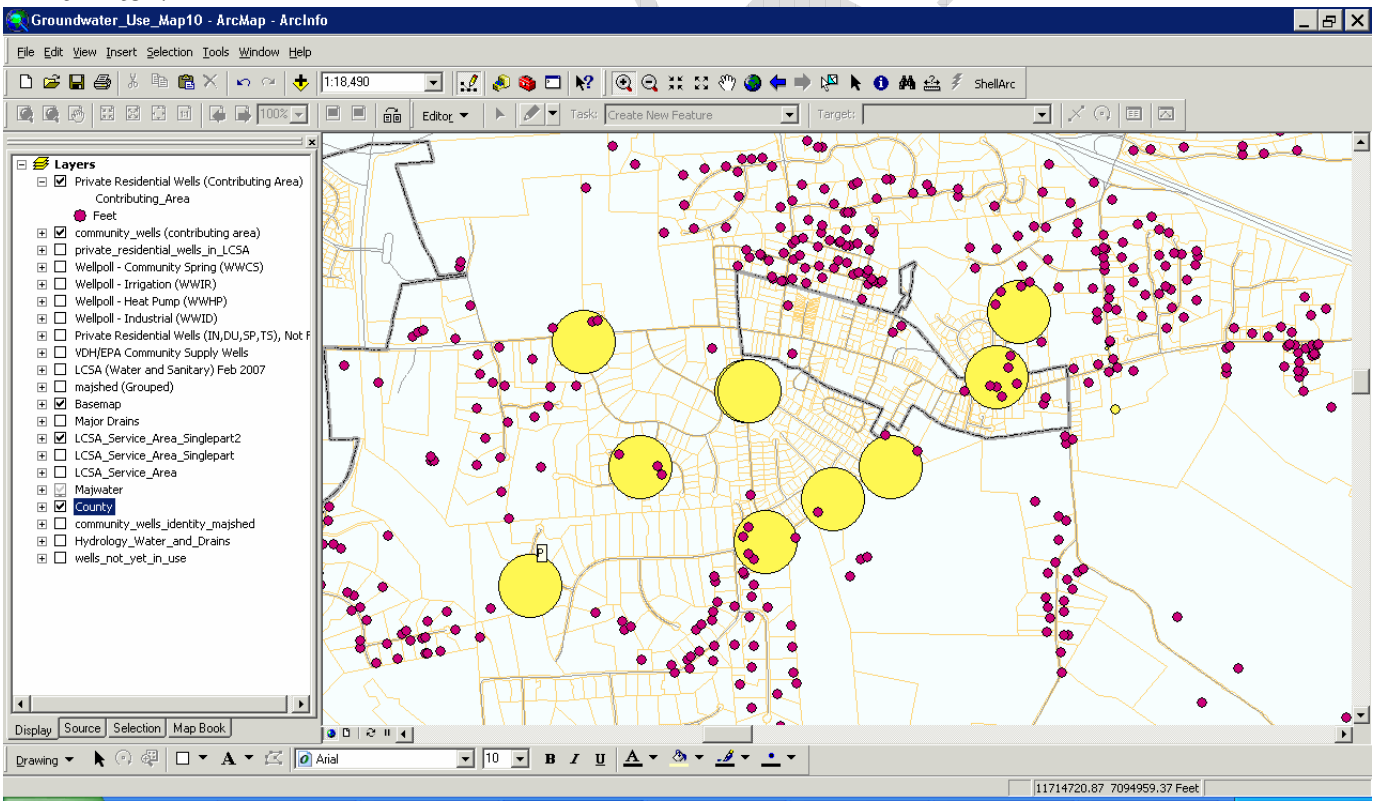
In Round Hill:


Groundwater_Use_Map10 - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
1:25,797
Editor
Task: Create New Feature
Target:
ShellArc
Layers
Private Residential Wells (Contributing Area)
Contributing_Area
Feet
community_wells (contributing area)
private_residential_wells_in_LCSA
Wellpoll - Community Spring (WWCS)
Wellpoll - Irrigation (WWIR)
Wellpoll - Heat Pump (WWHP)
Wellpoll - Industrial (WWID)
Private Residential Wells (IN,DU,SP,TS), Not F
VDH/EPA Community Supply Wells
LCSA (Water and Sanitary) Feb 2007
majshed (Grouped)
Basemap
Major Drains
LCSA_Service_Area_Singlepart2
LCSA_Service_Area_Singlepart
LCSA_Service_Area
Majwater
County
community_wells_identity_majshed
Hydrology_Water_and_Drains
wells_not_yet_in_use
Display Source Selection Map Book
Drawing
Arial
10
11686320.41 7094586.28 Feet

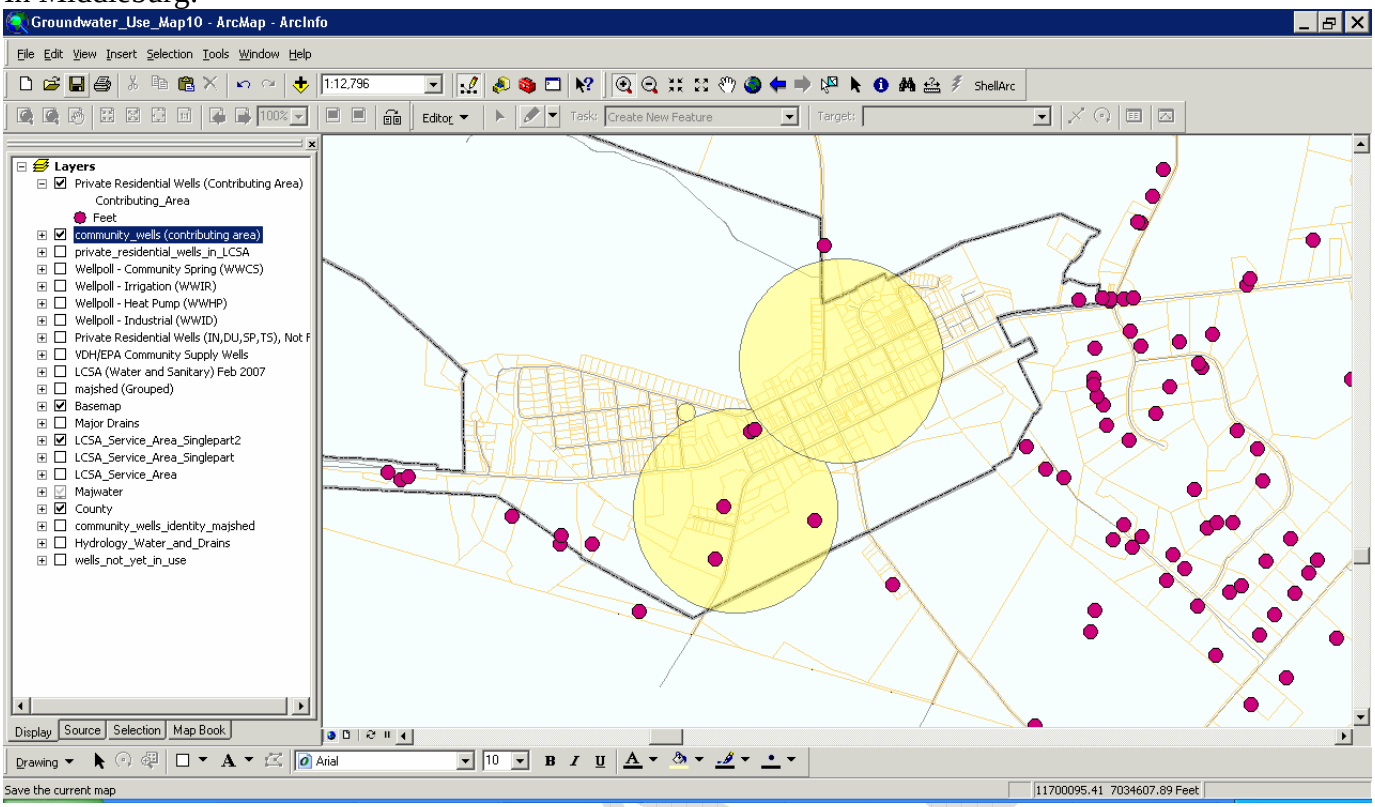
In Purcellville:



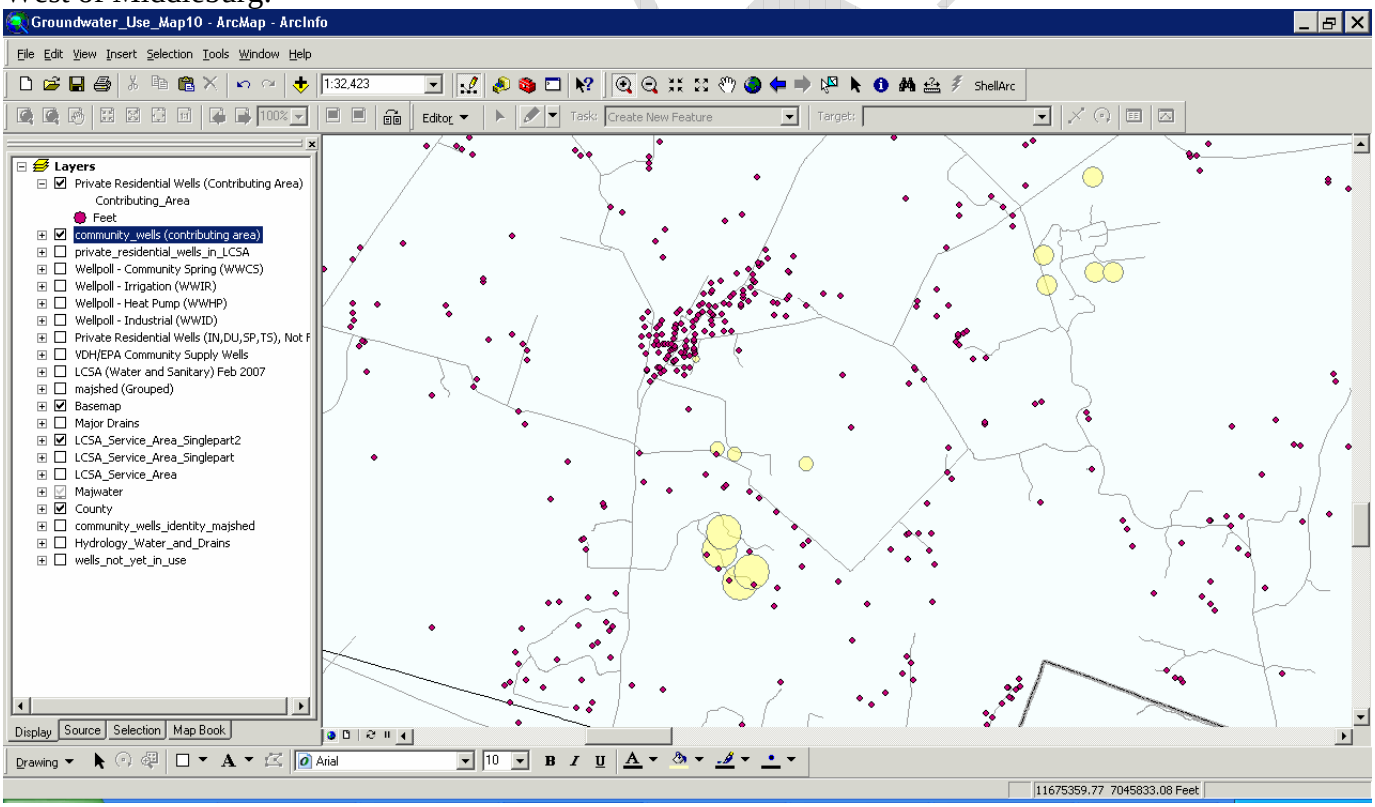
In Hamilton:



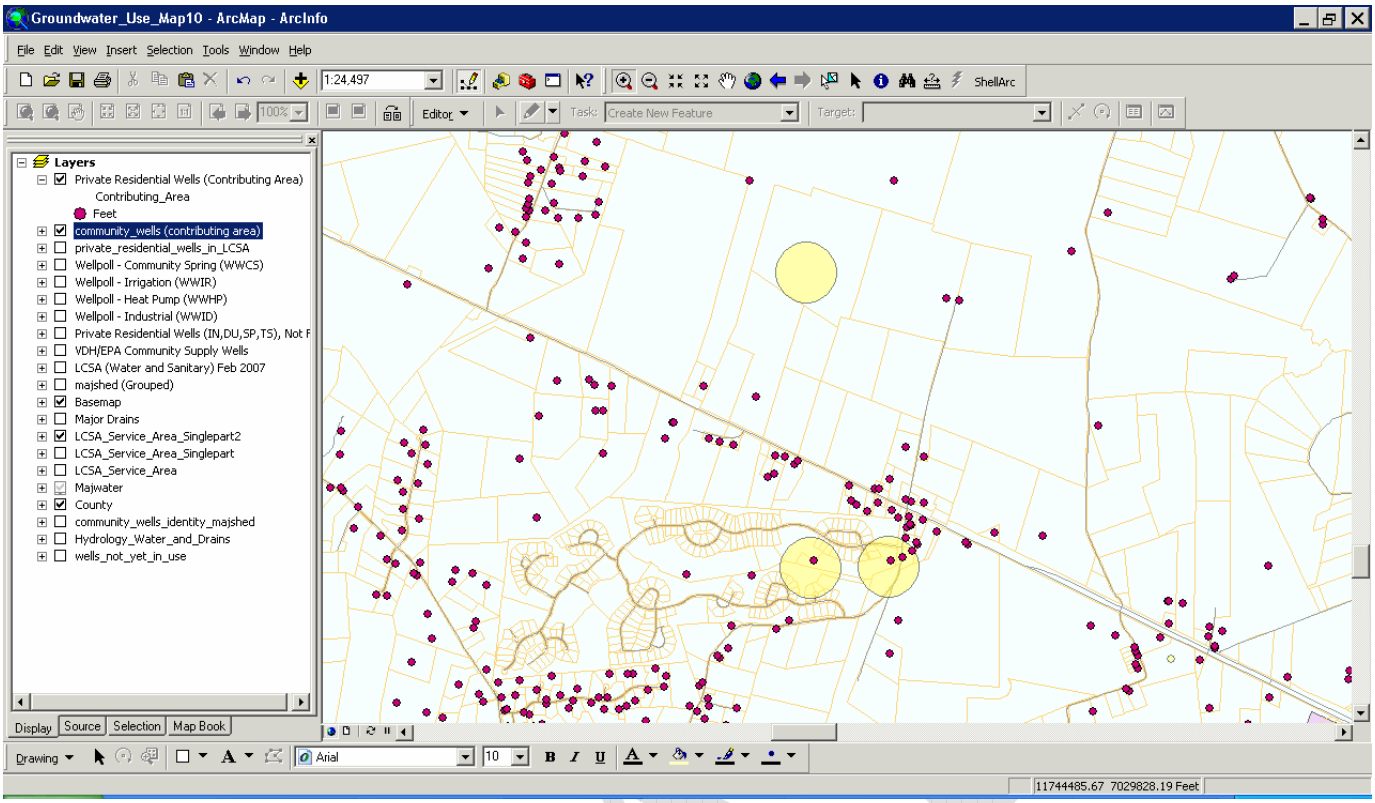
In Middleburg:



West of Middleburg:



In Lenah Run:



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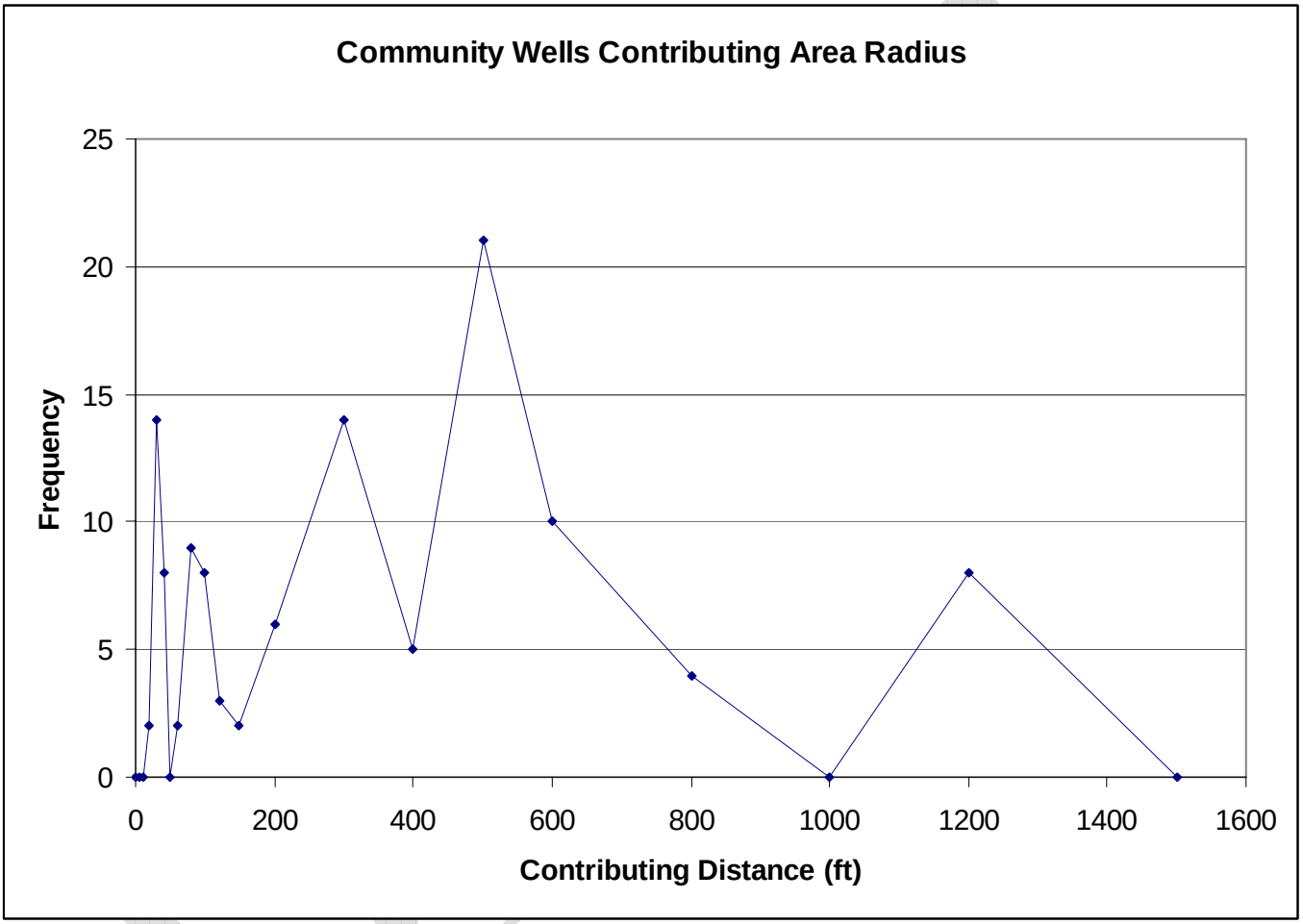


CWMP Population Methodology

Data Sources

- U.S. Census Bureau, *Census 2000* block data
- Loudoun County Department of Management and Financial Services population estimates through 2007.
- Loudoun County's Round 7.1 Cooperative Forecasts submitted to the Metropolitan Washington Council of Governments in June 2007.

Methodology

2000 Population

The Census 2000 census block populations are the building blocks for all estimates and forecasts post census. There are 2318 census blocks and 161 watersheds in Loudoun County. The watersheds do not follow the census block boundaries. Therefore, estimates of the 2000 population by watershed needed to be calculated. Due to time and resource limitations, the 2000 population estimates by watershed were calculated under the assumption that the population is evenly distributed throughout the census block.

2005 and 2007 Population

The 2005 and 2007 watershed populations were calculated by summing the population growth with the 2000 population. The County Demographer, whom is within the Department of Management and Financial Services, maintains a GIS database of the residential building permits issued from 2000 to the present and the estimated population associated with each of these new residential units. The factors that are used to calculate the estimated population within each new residential unit were adopted by the Fiscal Impact Committee and the Loudoun County Board of Supervisors in February 2007 and are documented in the Fiscal Impact Committee *2006 Annual Update* report. The watershed that each new residence is within was determined by performing a GIS overlay of the Demographer's residential permit database with the watersheds. A summary of the growth from 2000 to 2005 and from 2000 to 2007 by watershed was then achieved using this overlay data.

2010 to 2030 Population

The forecasted population growth from 2007 to 2030 was calculated using the Demographer's traffic analysis zone population growth data 2007 to 2030. The 2010, 2020, and 2030 traffic analysis zone figures were part of Loudoun County's Round 7.1 Cooperative Forecasts submission to the Metropolitan Council of Governments. The sum of the watershed 2010, 2020, and 2030 populations will equal the sum of the 2010, 2020, and 2030 traffic analysis zone populations.

The Route 7 traffic analysis zone forecasts were produced using a variety of different data sources. Approved residential projects, planned land uses according to the County's Revised General Plan, vacant land, and past growth trends were used to derive the traffic analysis zone data. Due to time and resources this level of analysis was not performed for the watersheds. There are 126 traffic analysis zones and 161 watersheds in Loudoun County. The watersheds do not follow the traffic analysis boundaries. Therefore, estimates of the growth from 2007 to 2010, 2010 to 2020, and 2020 to 2030 were calculated under the assumption that the forecasted population growth is evenly distributed throughout the census block.

LCSA Service Area Exclusion

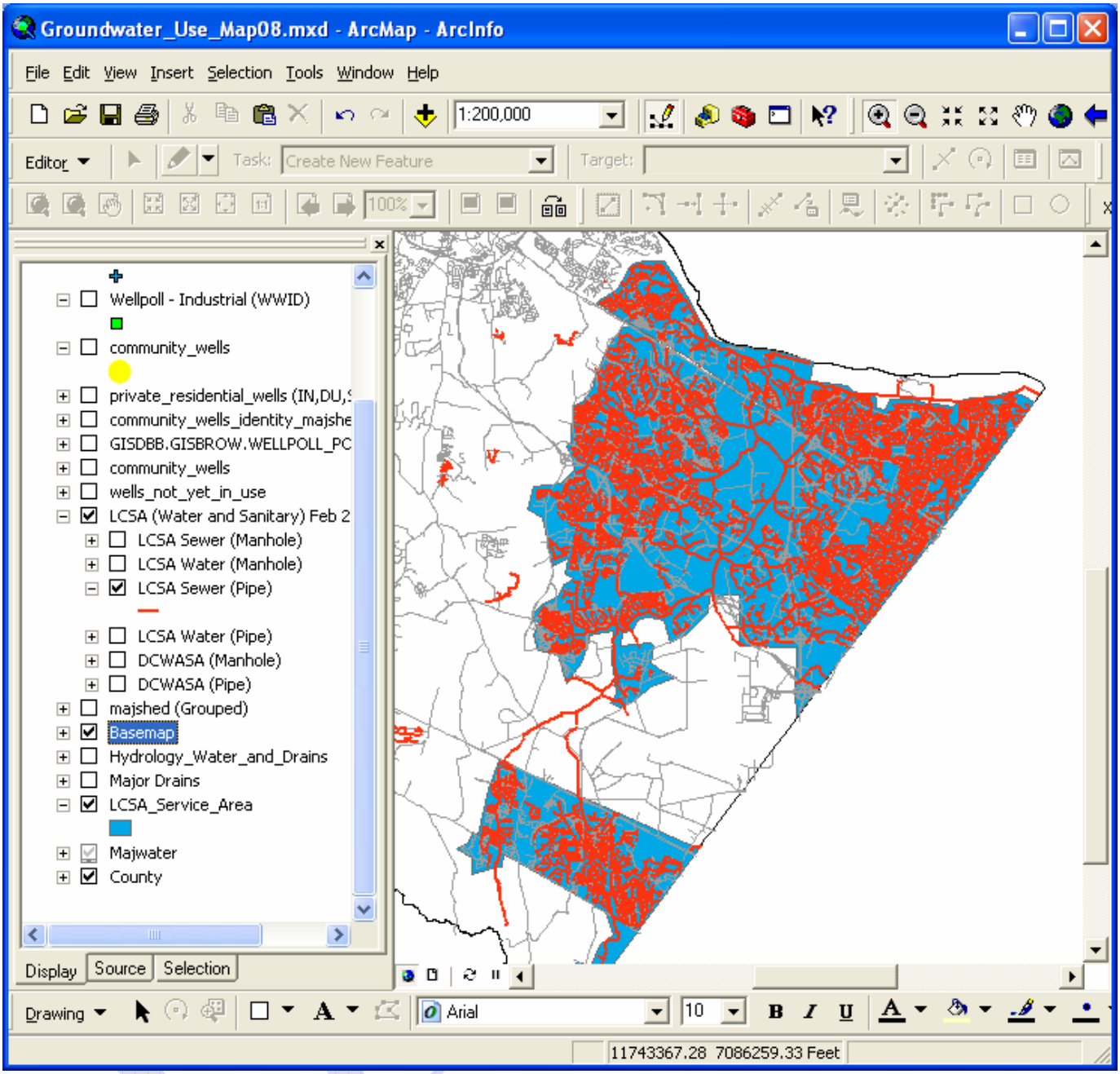
Background: Many of the legacy groundwater wells are no longer used as the area is now served by Loudoun County Sanitation Authority (LCSA) water distribution system. In these areas, we need to exclude legacy private water wells that are no longer in use.

Approach: First, develop a LCSA Service area based on the latest GIS files for water distribution pipes.

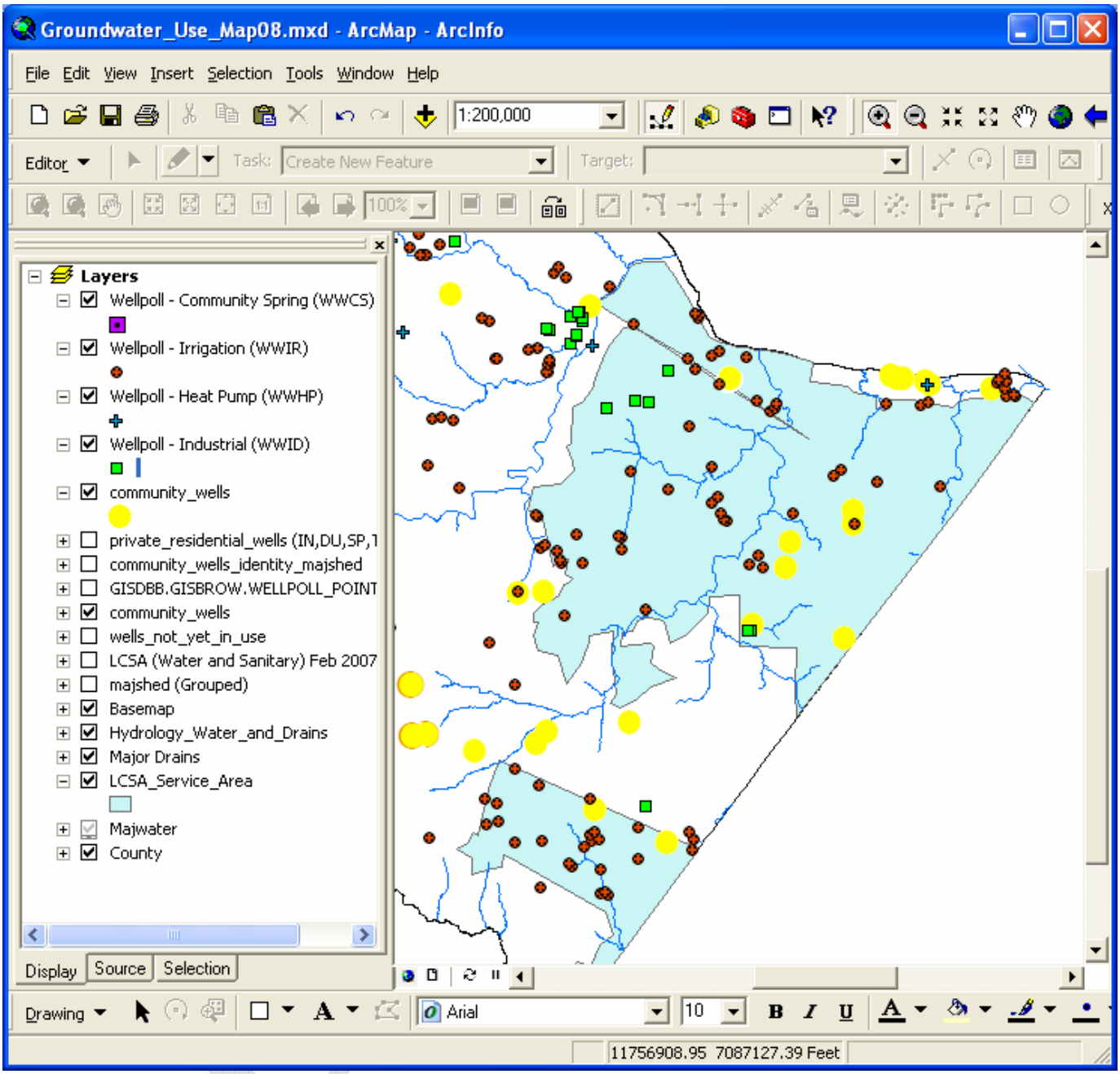
Next, review wells in the service area and selectively exclude those wells that are presumed to no longer be in service.

Definition of LCSA Service Area:

Currently LCSA does not offer a service area polygon. To facilitate the well exclusion, a polygon was created to "mask" the LCSA service area as shown below.

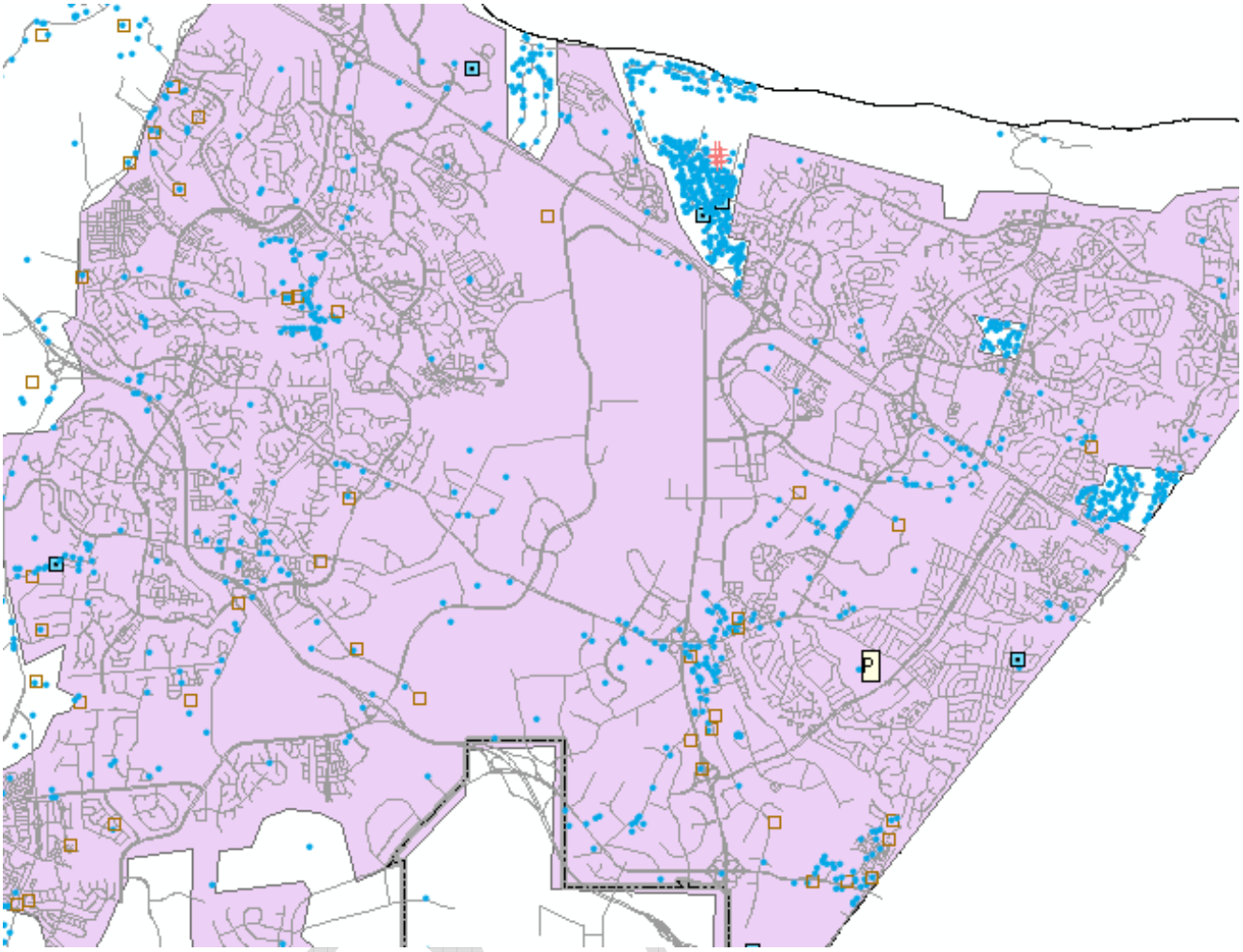

Groundwater_Use_Map08.mxd - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
1:200,000
Editor
Task: Create New Feature
Target:
Wellpoll - Industrial (WWID)
community_wells
private_residential_wells (IN,DU,
community_wells_identity_majshe
GISDBB.GISBROW.WELLPOLL_PC
community_wells
wells_not_yet_in_use
LCSA (Water and Sanitary) Feb 2
LCSA Sewer (Manhole)
LCSA Water (Manhole)
LCSA Sewer (Pipe)
LCSA Water (Pipe)
DCWASA (Manhole)
DCWASA (Pipe)
majshed (Grouped)
Basemap
Hydrology_Water_and_Drains
Major Drains
LCSA_Service_Area
Majwater
County
Display
Source
Selection
Drawing
Arial
10
11743367.28 7086259.33 Feet

Now, examine some of the wells in the service, specifically highlight the irrigation and industrial as well as previously identified “community wells” as per VDH and EPA records.

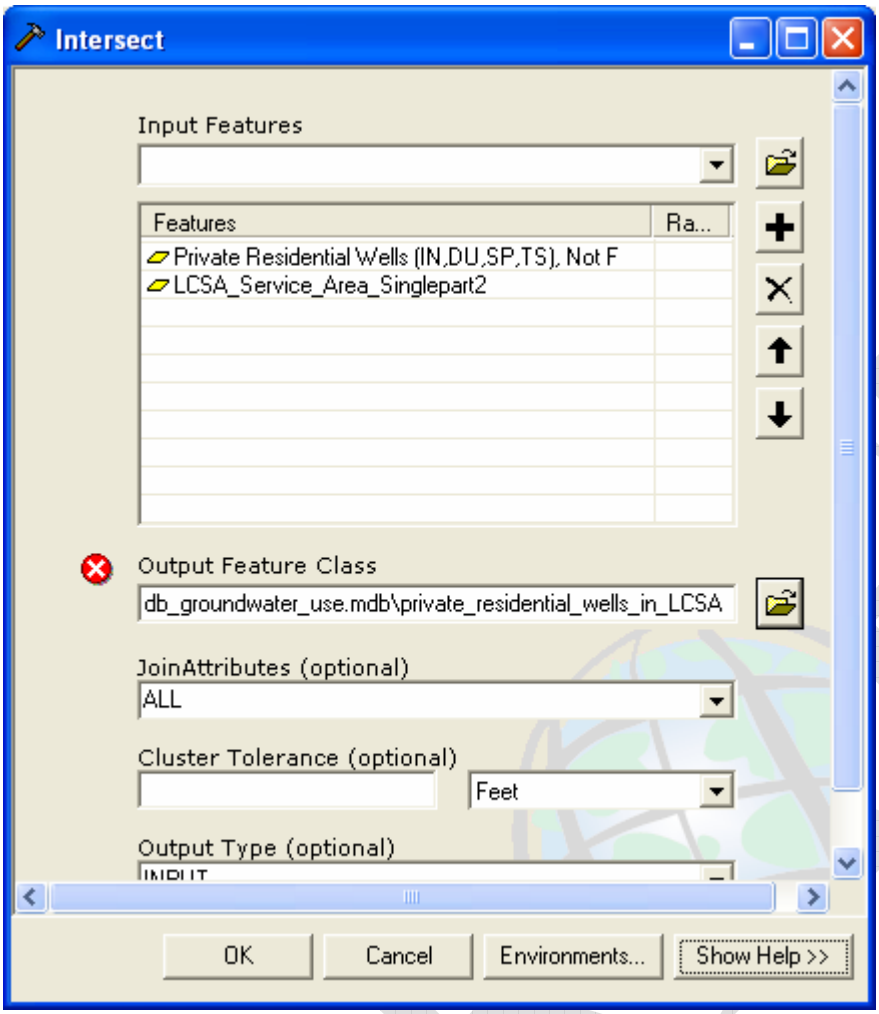


Need to review each of the VDH Community water wells that are within the LCSA services area.

Looking more closely at the data, we need to create a donut to exclude some of the older subdivisions still on well water and septic even though LCSA surrounds the neighborhood. To do this, use “Edit>Cut Polygon” then Sketch tool (read on-line help for more). This will result in a multipart feature. We can clean this up using “Xtools>Feature Conversion>Convert Multipart to SinglePart”. The result looks like

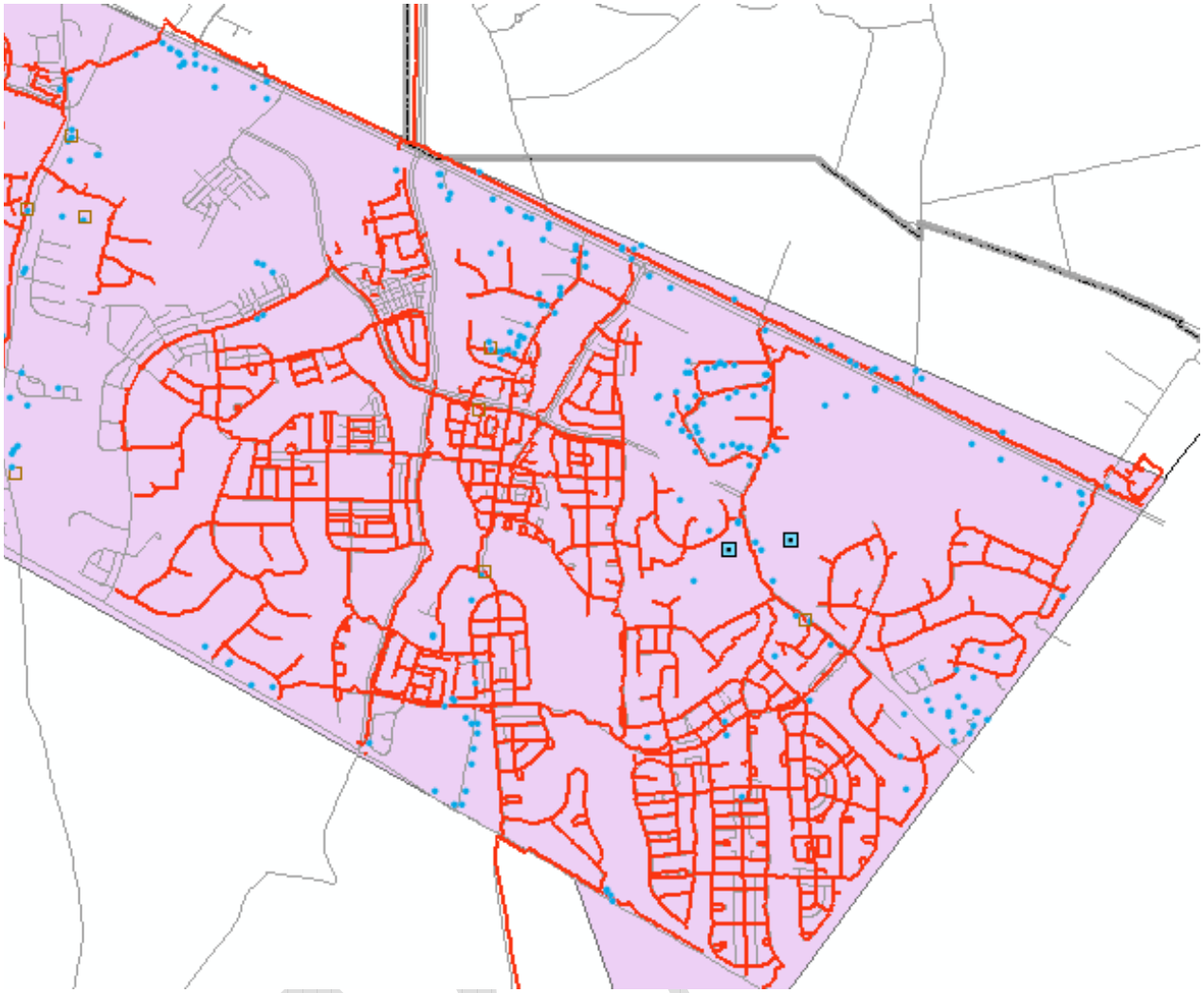


Now we want to select those private wells in the LCSA service area. The standard "Selection>Select by Location" fails to work properly. Instead, use "ArcToolBox>Data Management>Intersect":



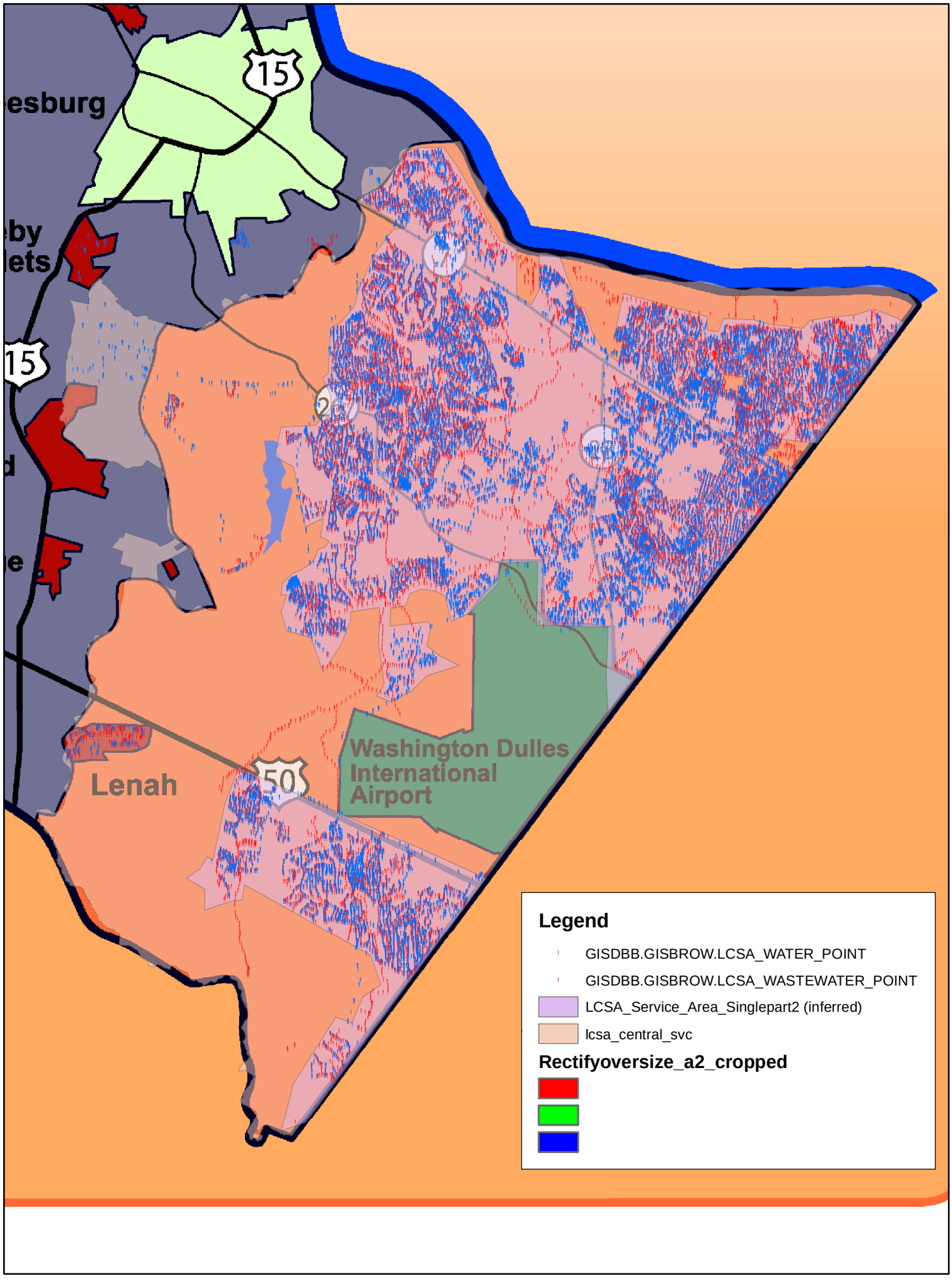
This analysis is first order and there may be a few wells in use in or near the actual LCSA service area. For example wells along Rt. 50 may still be in use, but will be excluded through this analysis. Because the goal is to develop an overall water budget, such errors are probably acceptable in light of lack of detail on actual well-by-well usage.

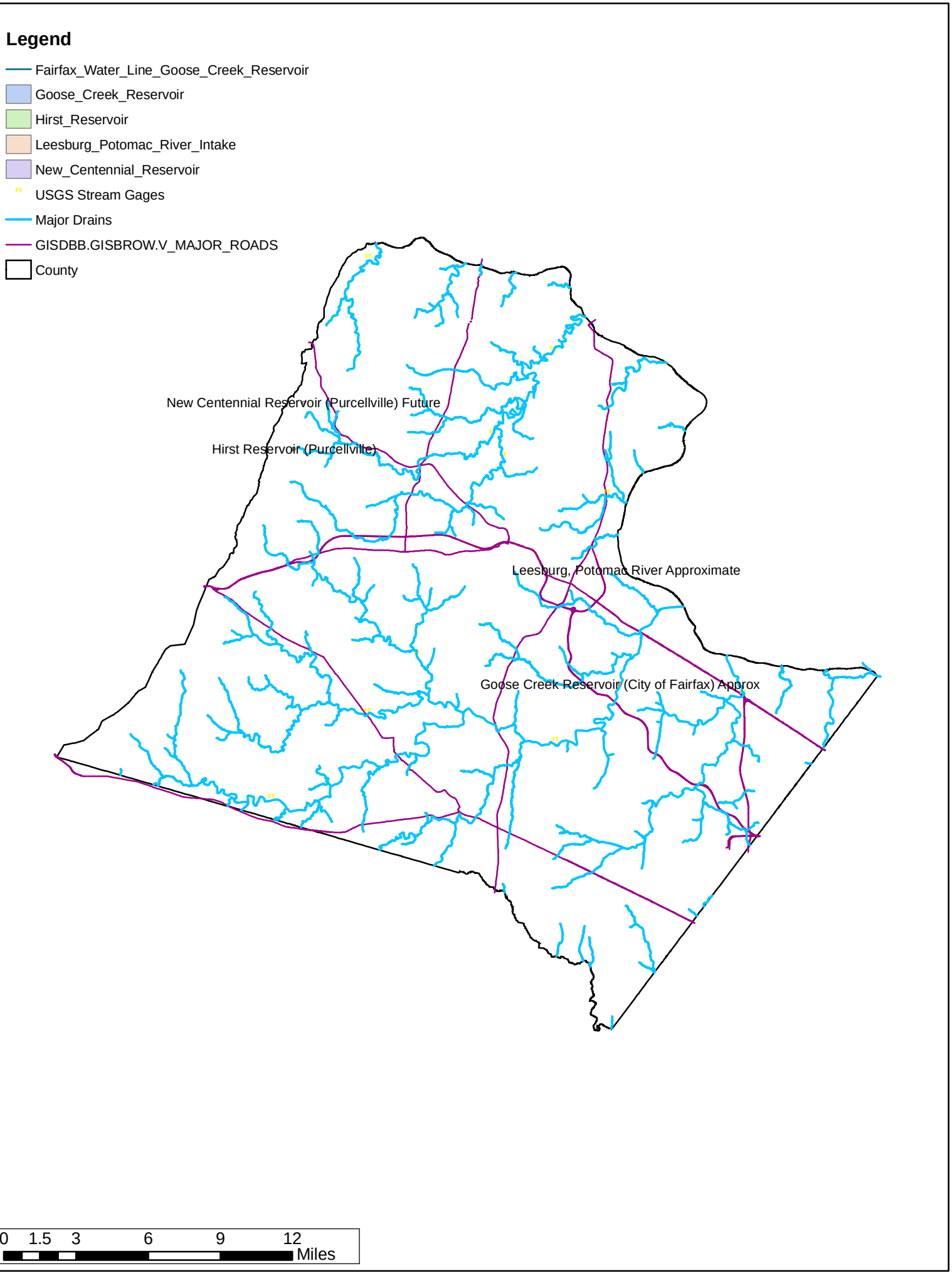
We also need to develop exclusion for all wells in well-poll, not just private wells. ???



Working folder: O:\project\wrmp\Groundwater_Use

Next Step:


15
15
50
Lenah
Washington Dulles
International
Airport
Legend
GISDBB.GISBROW.LCSA_WATER_POINT
GISDBB.GISBROW.LCSA_WASTEWATER_POINT
LCSA_Service_Area_Singlepart2 (inferred)
lcsa_central_svc
Rectifyoversize_a2_cropped


Legend
Fairfax_Water_Line_Goose_Creek_Reservoir
Goose_Creek_Reservoir
Hirst_Reservoir
Leesburg_Potomac_River_Intake
New_Centennial_Reservoir
USGS Stream Gages
Major Drains
GISDBB.GISBROW.V_MAJOR_ROADS
County
New Centennial Reservoir (Purcellville) Future
Hirst Reservoir (Purcellville)
Leesburg, Potomac River Approximate
Goose Creek Reservoir (City of Fairfax) Approx
0 1.5 3 6 9 12
Miles