Methods for Exploring Micro-Trends in Births and Student Enrollments

Within the Los Angeles Unified School District

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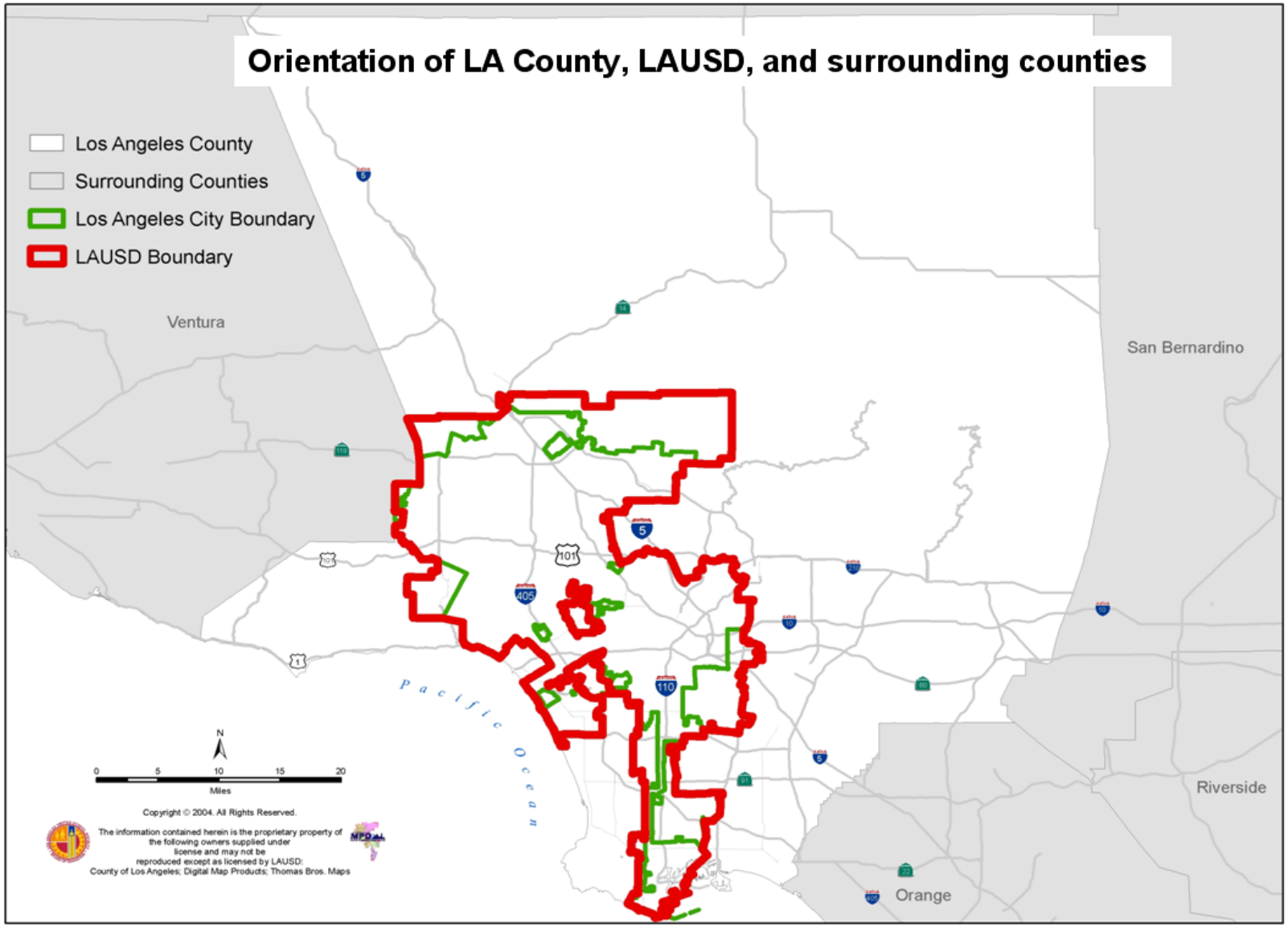
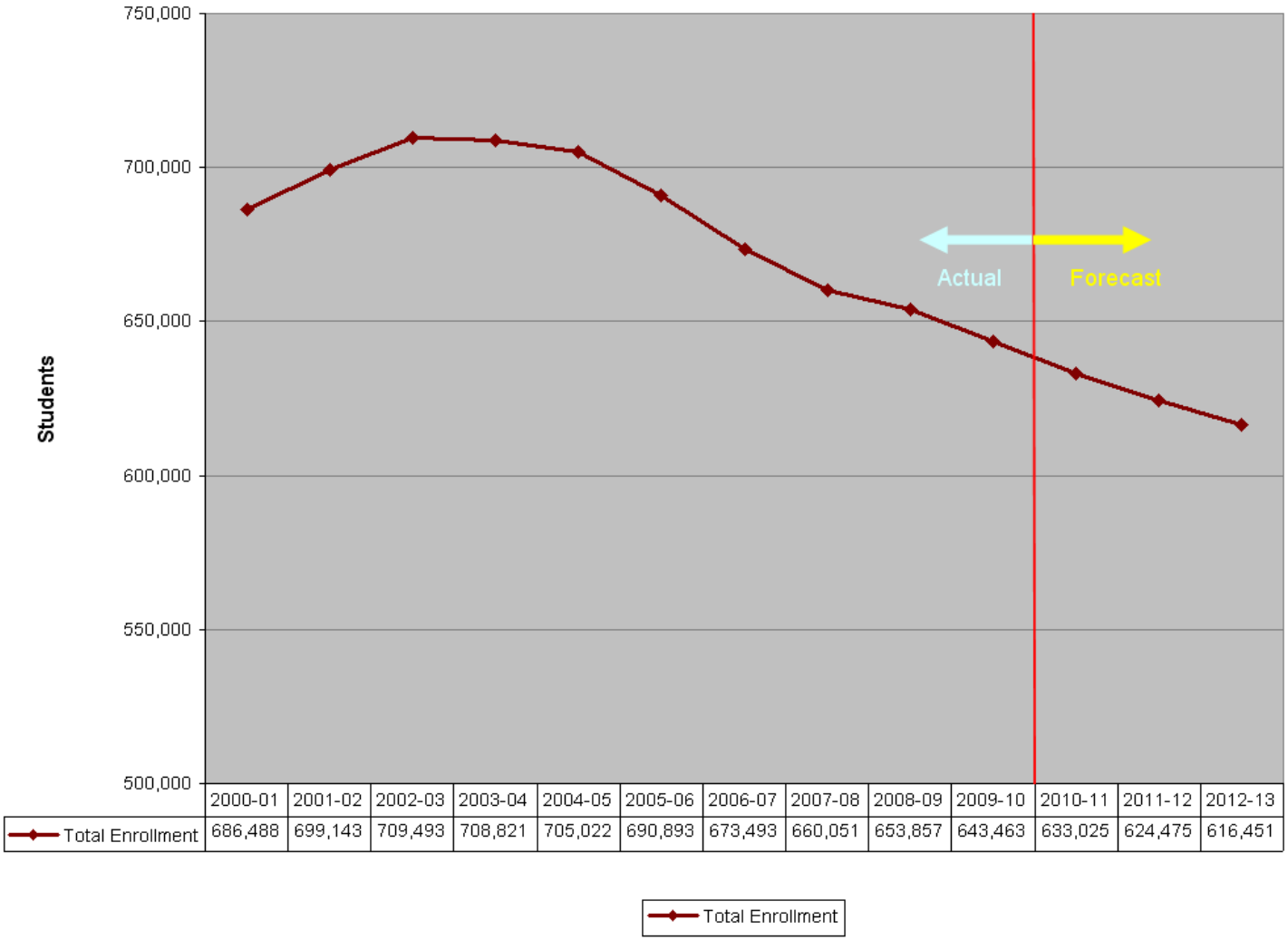
- In LAUSD's Master Planning and Demographic Unit, our job is to make forecasts for approximately 650 schools annually, so we need to understand data and demographic trends at the small-area level.
- We have been exploring methods for better understanding the relationship between data elements at the micro-level.
- Most of an elementary school's forecast depends on births, making the relationship between births and children entering school at kindergarten and first grades very important to the accuracy of enrollment projections.



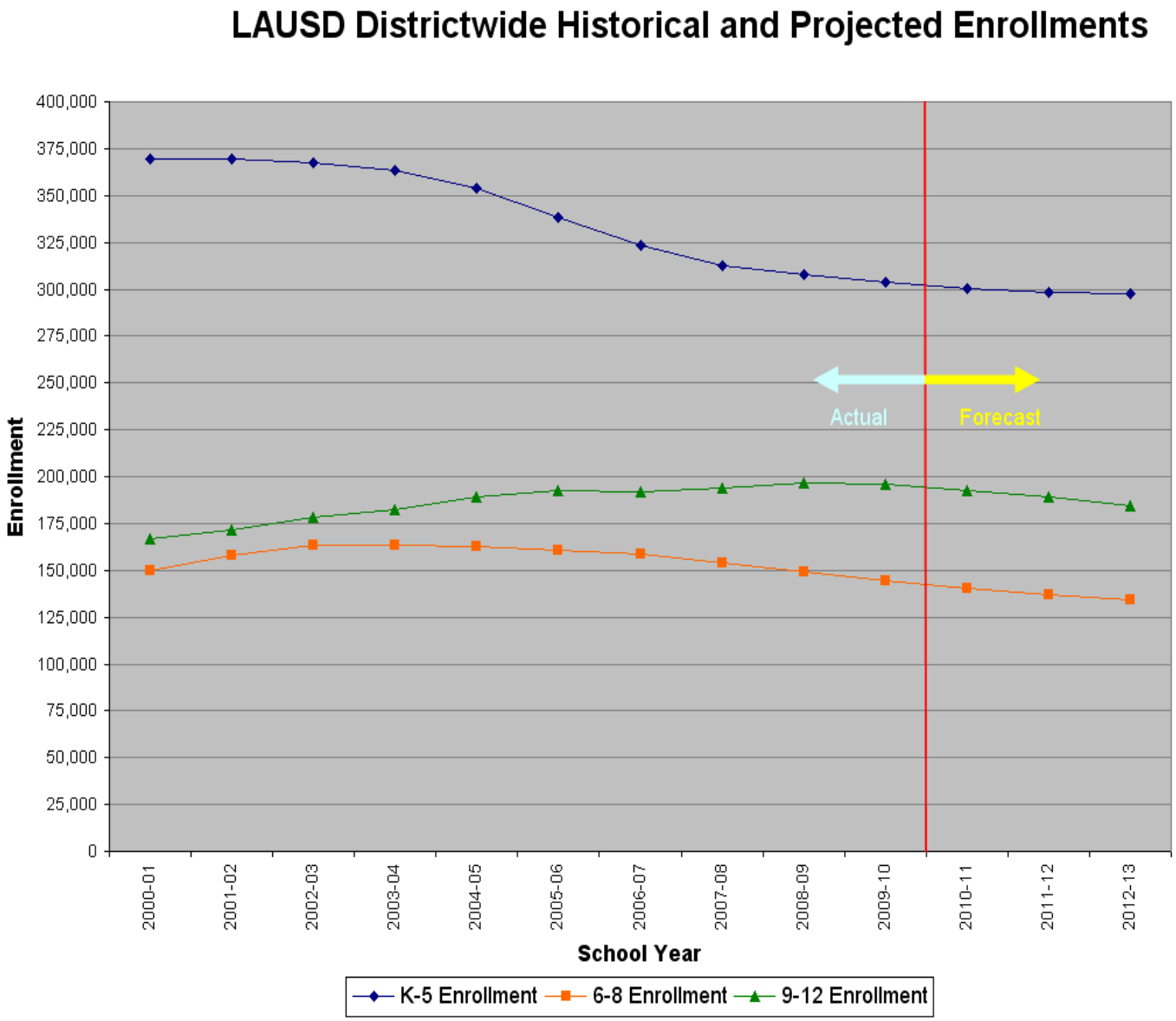
This map provides a geographic orientation of the Los Angeles Unified Schools District (LAUSD) within Los Angeles County and surrounding counties.

LAUSD Districtwide Historical and Projected K-12 Enrollments



	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Total Enrollment	686,488	699,143	709,493	708,821	705,022	690,893	673,493	660,051	653,857	643,463	633,025	624,475	616,451

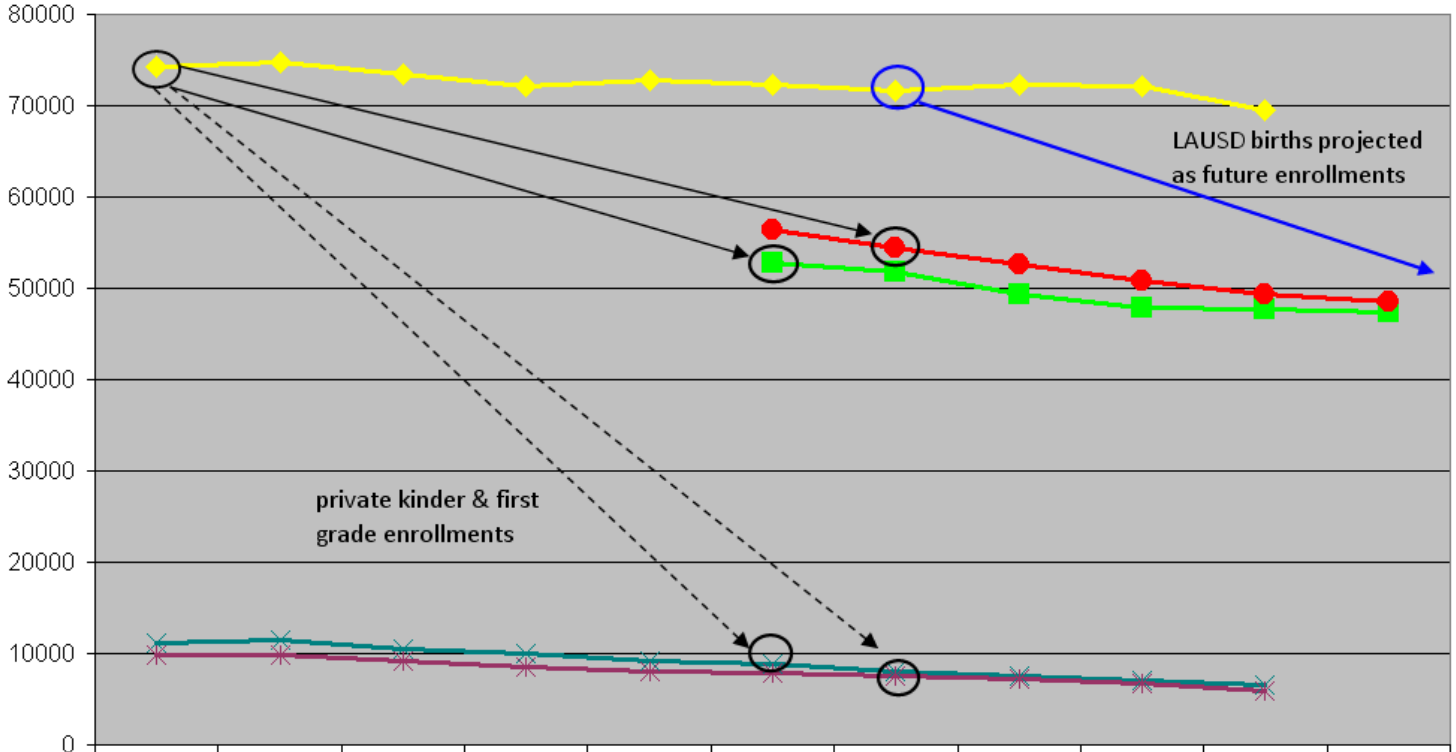
Here is the LAUSD District-wide historical and projected total K-12 enrollment.



Drilling down, we see historical and projected enrollments for elementary, middle, and high school grade levels. The wave of growth that peaked in 2002-2003 can be seen moving through these ranges and leaving the high school range now.

LAUSD Districtwide Birth to Kinder & 1st Grade Enrollments

NOT INCLUDING INDEPENDENT CHARTER ENROLLMENTS



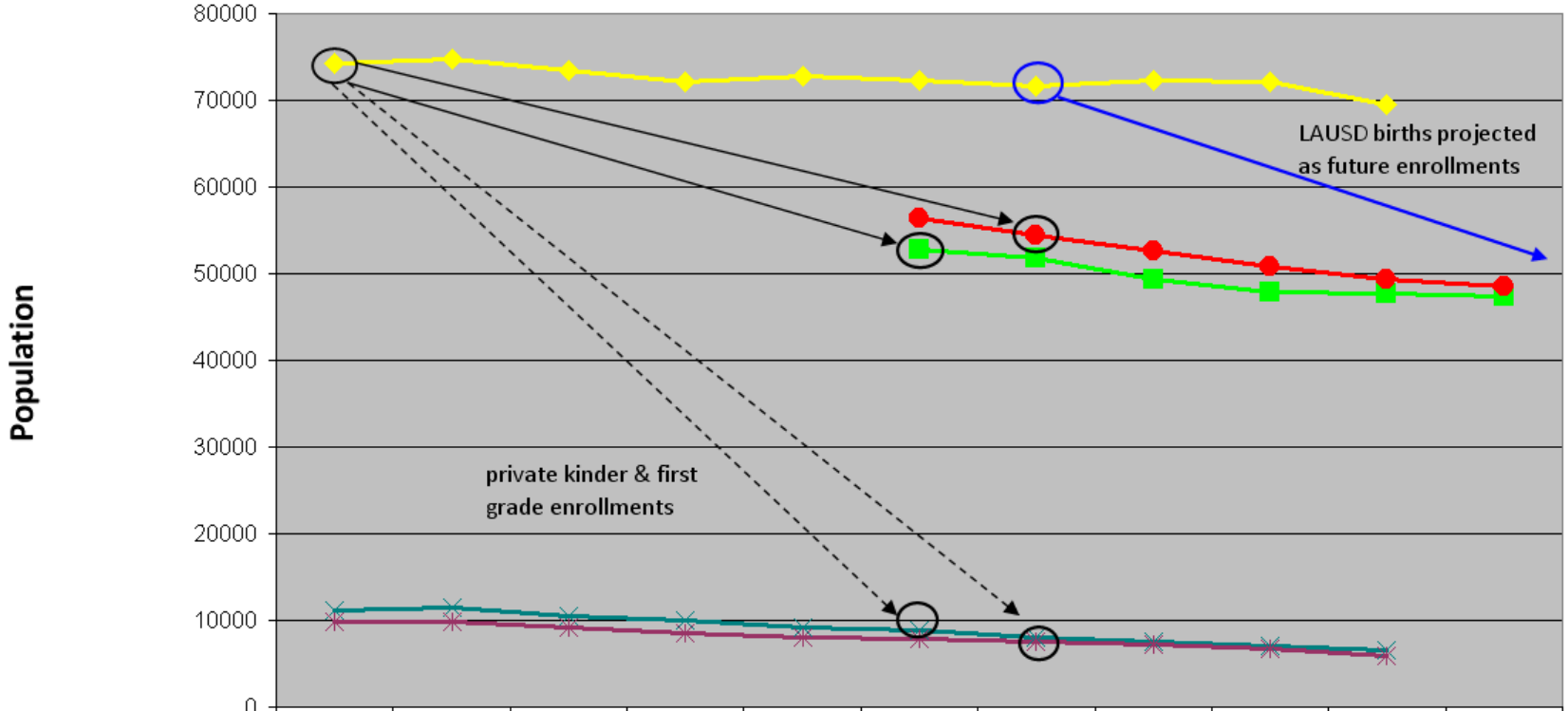
	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010
BIRTHS	74225	74691	73445	72154	72794	72337	71683	72325	72182	69525	
LAUSD K ENROLL						52850	51823	49411	47854	47785	47373
LAUSD 1ST GRADE ENROLL						56373	54467	52581	50878	49411	48601
PRIVATE K ENROLL	11157	11501	10555	9936	9195	8817	8000	7615	7076	6592	
PRIVATE 1ST GRADE ENROLL	9867	9830	9155	8518	7993	7822	7605	7198	6681	5869	

BIRTHS LAUSD K ENROLL LAUSD 1ST GRADE ENROLL PRIVATE K ENROLL PRIVATE 1ST GRADE ENROLL

Displayed here are LAUSD District-wide trends in individual births and in kindergarten and first grade enrollments. Not all of the number of children born in the District ends up enrolled in LAUSD by kindergarten (5 years later) or first grade (6 years later).

LAUSD Districtwide Birth to Kinder & 1st Grade Enrollments

NOT INCLUDING INDEPENDENT CHARTER ENROLLMENTS



	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010
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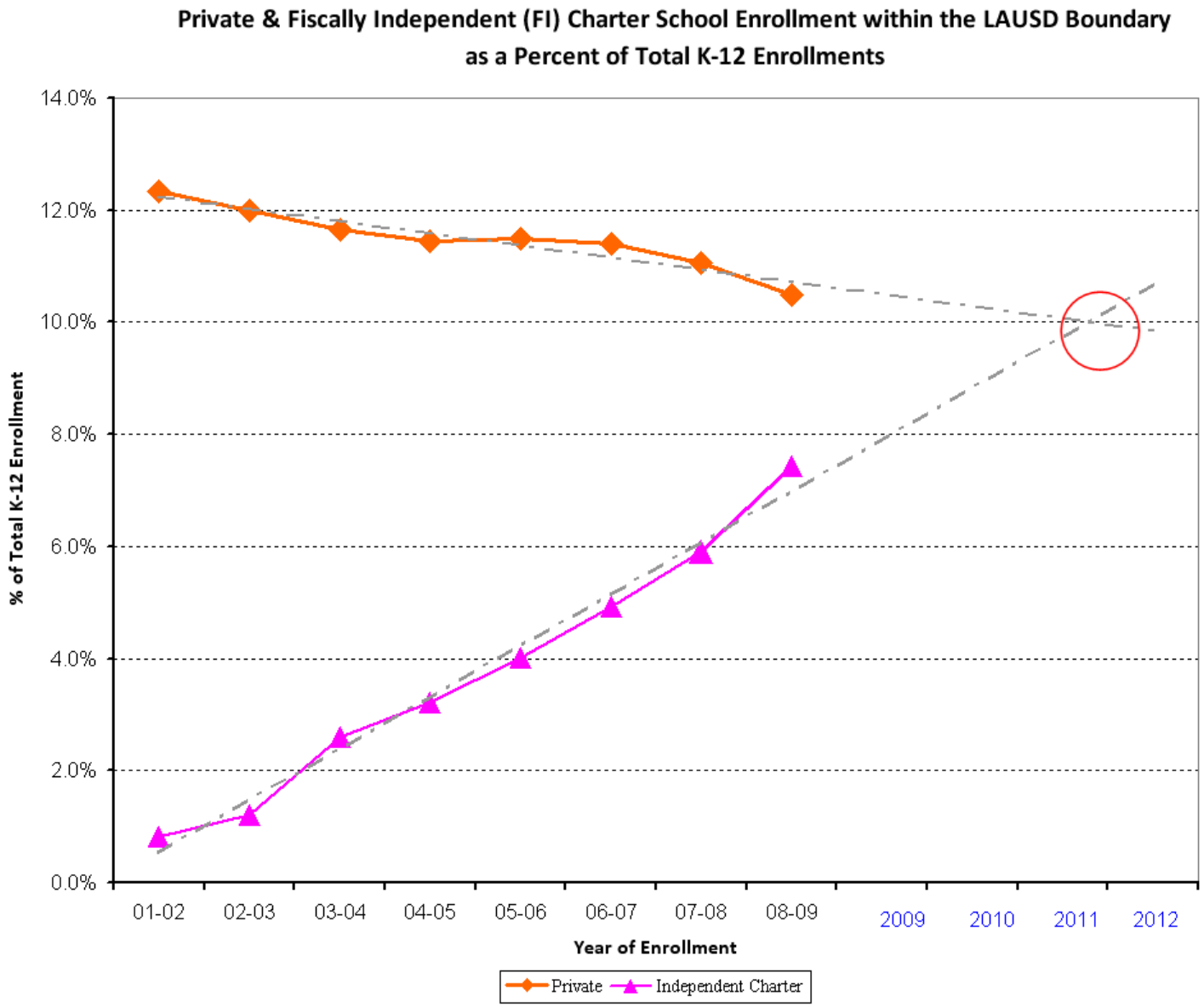
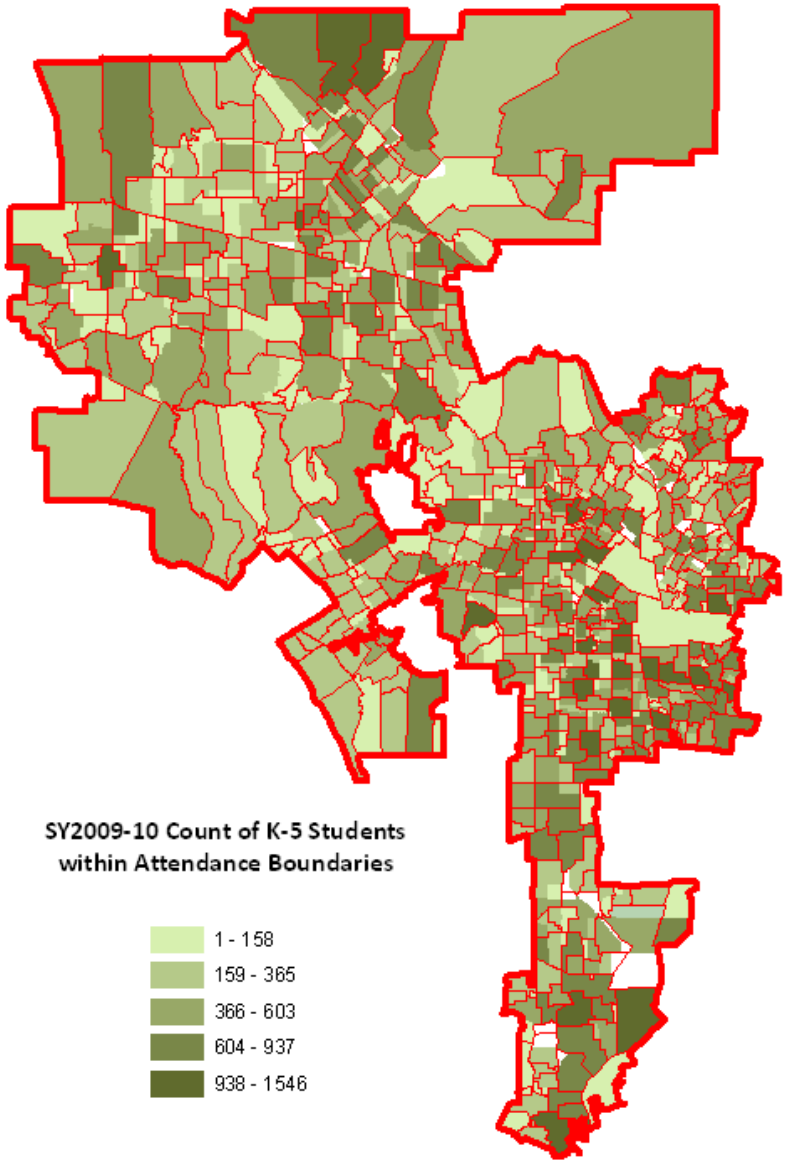
BIRTHS LAUSD K ENROLL LAUSD 1ST GRADE ENROLL PRIVATE K ENROLL PRIVATE 1ST GRADE ENROLL

Only about 70% of the number of children born five years earlier appeared in LAUSD's kindergartens in 2004-05, and that figure has declined to about 65% now. The remaining 30 - 35% of the number of children born either migrated out of the LAUSD area or are attending independent charters or private schools.



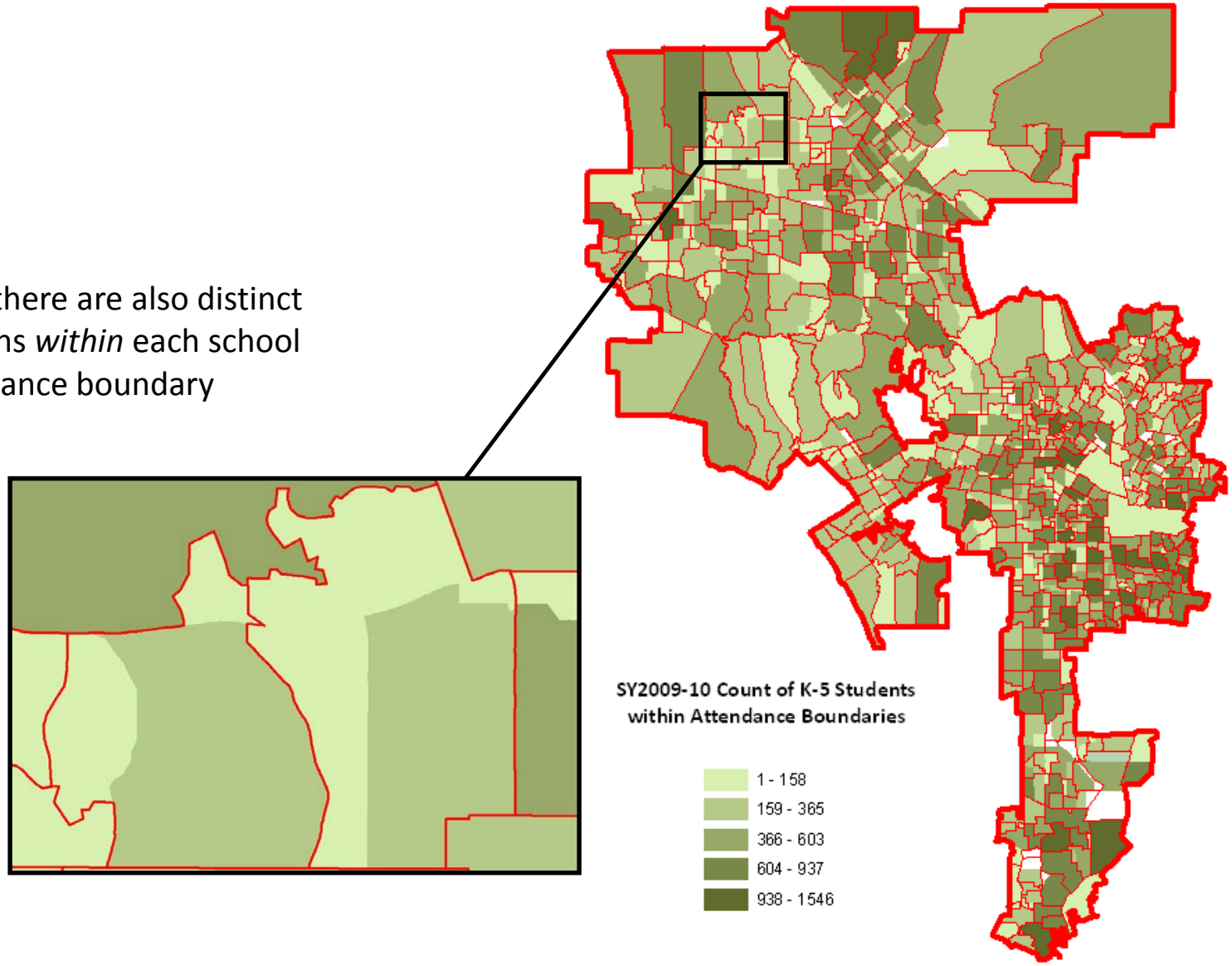
Independent charter school enrollments are growing annually, at the same time that private school enrollments are declining. If the current trends continue, charter schools will soon enroll more children than private schools. District-wide trends are important to MPD to give us the meta-view, but small-area trends are vital to our being able to make accurate projections for individual schools.

There are important geographic patterns of enrollment & births *within* the District...



There are important geographic patterns of enrollment & births both within the District and within individual school boundaries, and we are developing methods to harness these data relationships. Here we see LAUSD's intra-district enrollment patterns, with student density shown in green and individual school attendance boundaries outlined in red.

…and there are also distinct patterns *within* each school attendance boundary

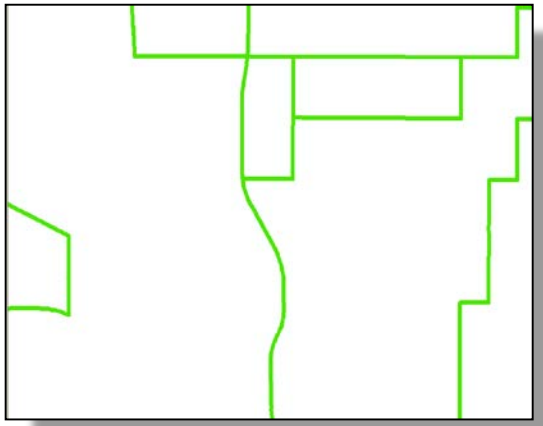


Looking more closely into a school boundary, we see that within a single boundary there are sub-areas with distinctly different student counts. Making use of small-area patterns, or ‘micro-trends’, will help us produce more accurate annual enrollment projections for over 640 individual schools. But there were challenges.

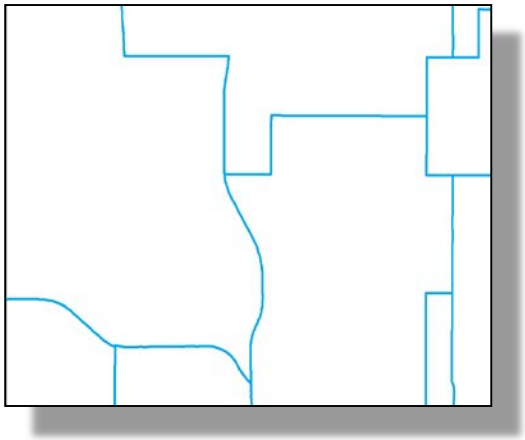
- **KEY PROBLEMS with HARNESSING MICRO-TRENDS:**

1. How can we make geographic information ‘smart’?

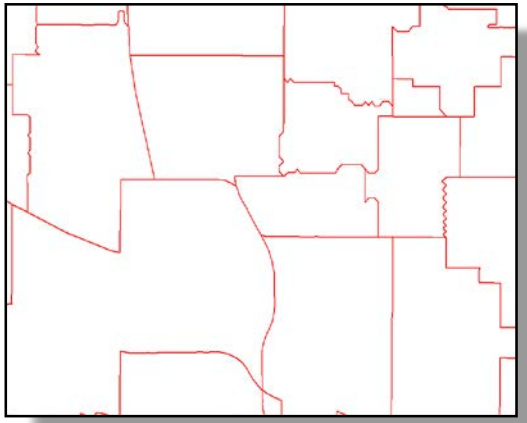
The first problem was making geographic information ‘smart’. Because individual schools’ enrollment projections must be developed using multiple overlapping attendance boundaries that are not co-terminus, we needed a way to combine the data.



Map & Data for High School Boundaries +

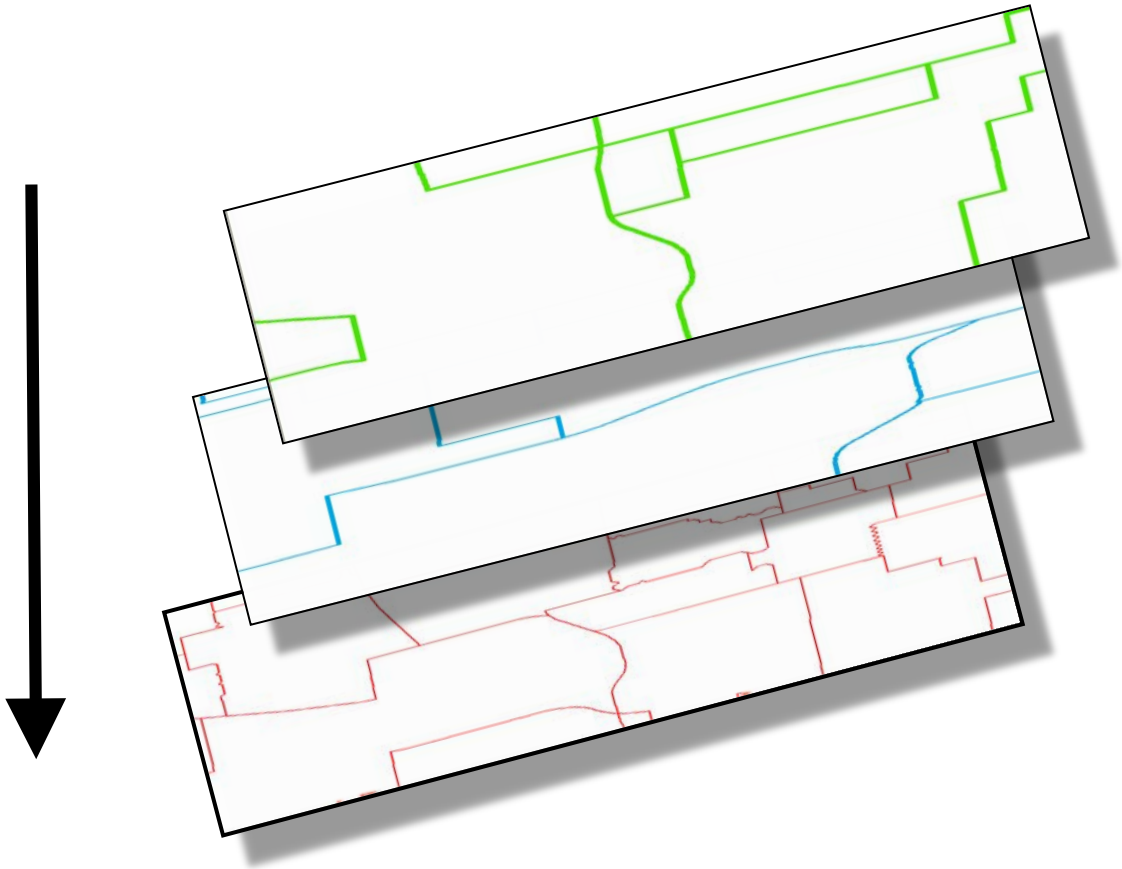


Map & Data for Middle School Boundaries +



Map & Data for Elementary School Boundaries

LAUSD uses independent map layers for elementary, middle and high school boundaries. Each layer contains complete spatial and attribute data for the schools within its grade levels, including referencing to the underlying street map.

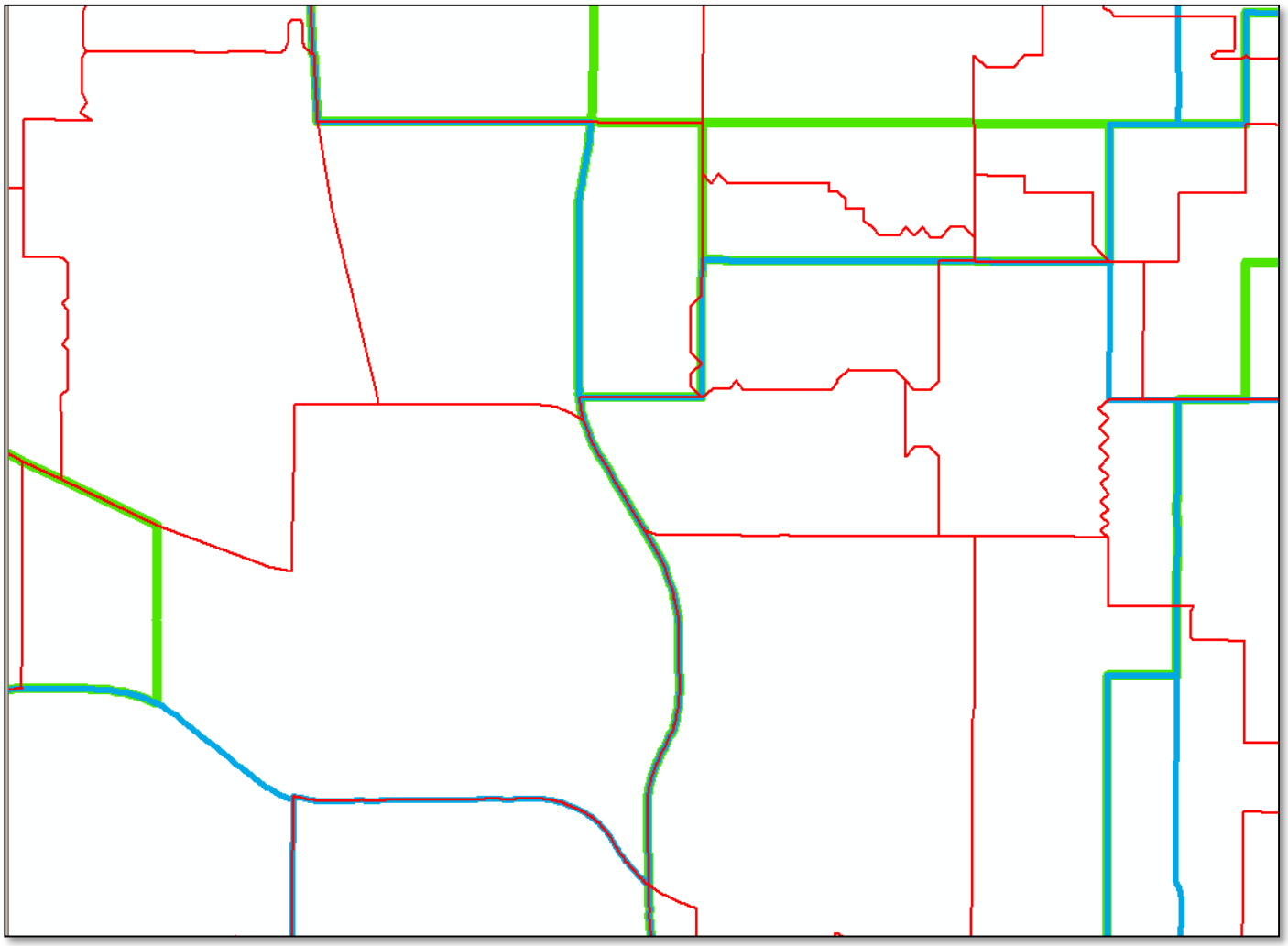


Map & Data from High School Boundaries +

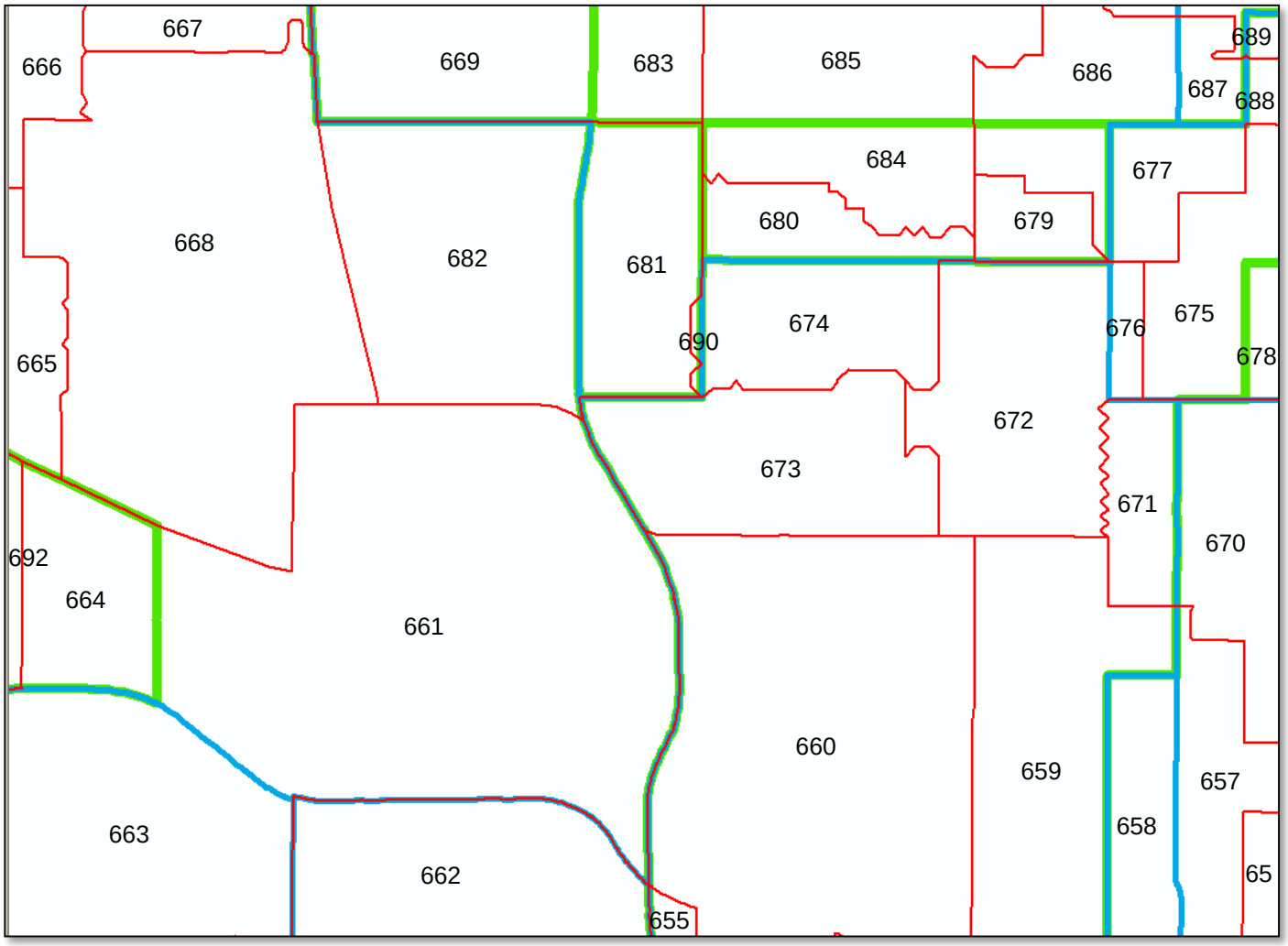
Map & Data from Middle School Boundaries +

Map & Data from Elementary School Boundaries

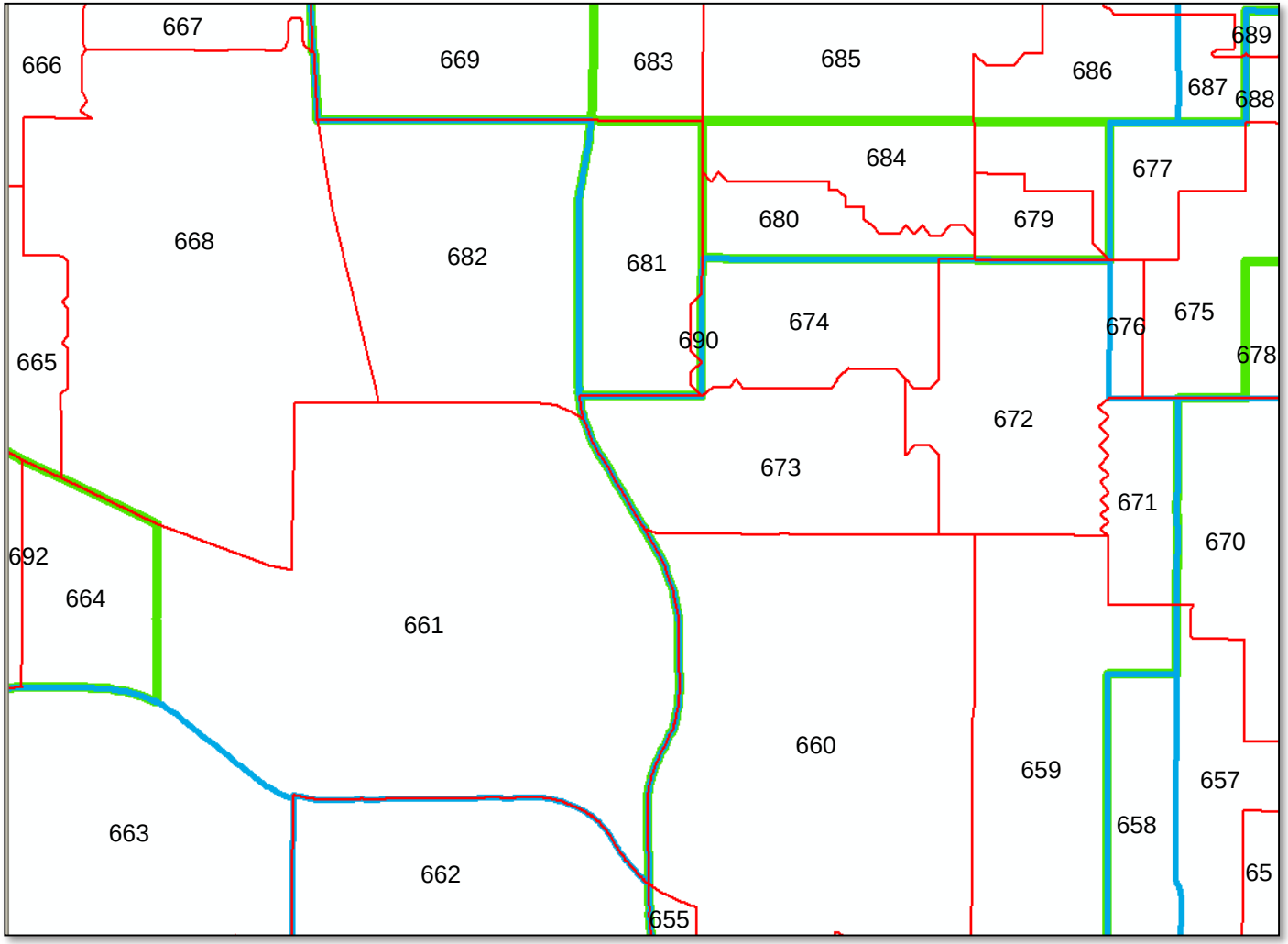
The GIS technique of unioning can be represented visually as layering the independent elementary, middle and high school boundary vertically on top of each other and then fusing them together into a single layer.



The resulting intersection of boundary lines generates a combined layer of smaller, unique geographies called micropolygons.



Each micropolygon is numbered for reference.



Each micropolygon contains the underlying spatial and attribute data of all three of its component elementary, middle and high school layers, so it knows which elementary, middle and high schools it belongs to, thus making it ‘smart’. Consequently, this makes micropolygons LAUSD’s most efficient spatial unit of geographic informational analysis.

- **KEY PROBLEMS with HARNESSING MICRO-TRENDS:**

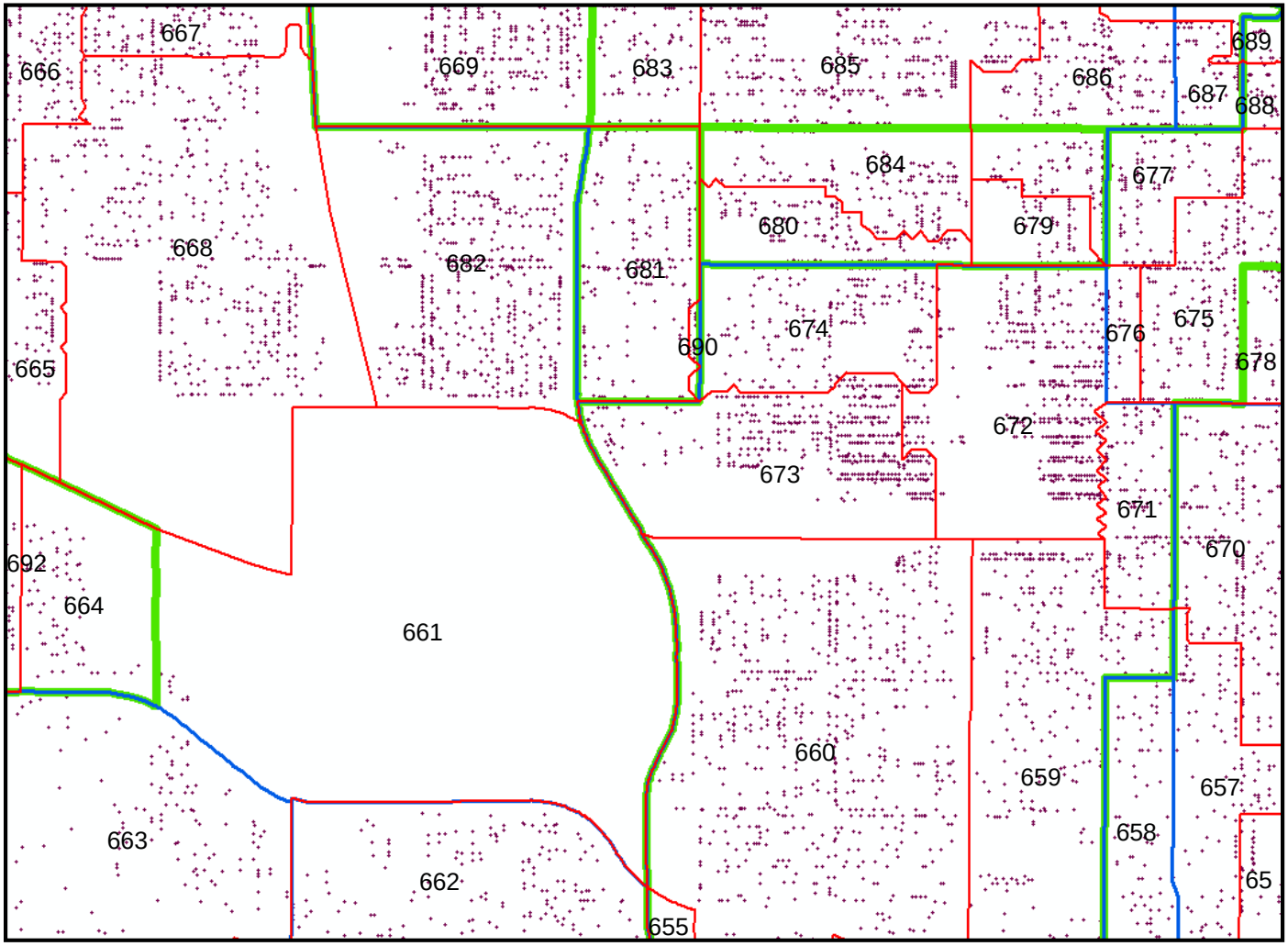
1. How can we make geographic information ‘smart’?
    1. ***Solution: Geographic Micropolygons - connect all data into one ‘smart’ layer***

We’ve now seen how the solution to the first problem was to fuse school and spatial data into a single ‘smart’ layer of geographic micropolygons.

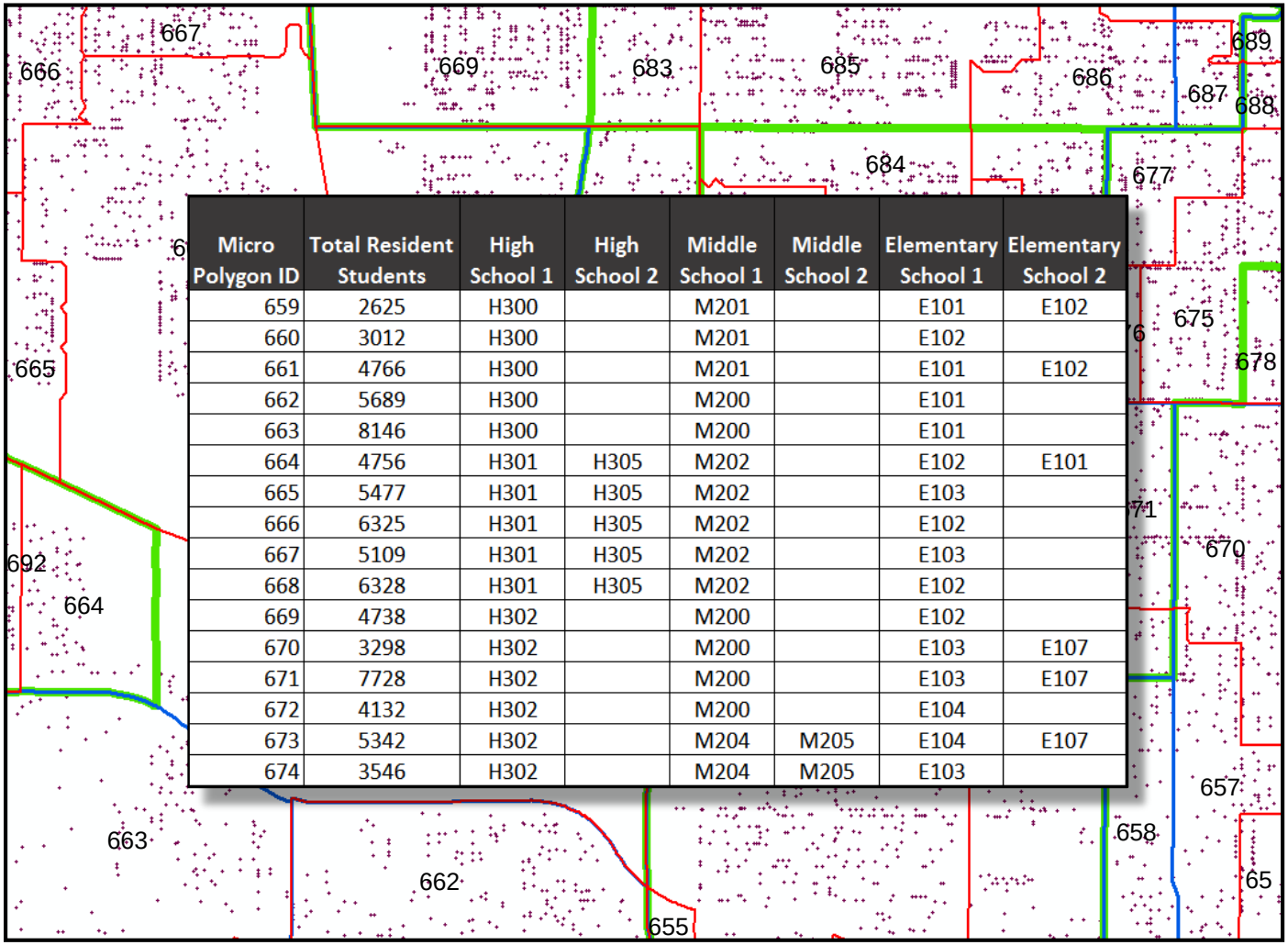
- **KEY PROBLEMS with HARNESSING MICRO-TRENDS:**

1. How can we make geographic information ‘smart’?
    1. ***Solution: Geographic Micropolygons - connect all data into one ‘smart’ layer***
2. How can we connect the micro-patterns of student residence and births to enrollments?

The second problem was how to connect the micro-patterns of births and student residency to K-12 enrollment forecasting.



By matching addresses to the resident base map underlying the micropolygon layer, the ‘smart’ micropolygons were spatially joined to over 640,000 student residence points and over 60,000 birth points.



Micro Polygon ID	Total Resident Students	High School 1	High School 2	Middle School 1	Middle School 2	Elementary School 1	Elementary School 2
659	2625	H300		M201		E101	E102
660	3012	H300		M201		E102	
661	4766	H300		M201		E101	E102
662	5689	H300		M200		E101	
663	8146	H300		M200		E101	
664	4756	H301	H305	M202		E102	E101
665	5477	H301	H305	M202		E103	
666	6325	H301	H305	M202		E102	
667	5109	H301	H305	M202		E103	
668	6328	H301	H305	M202		E102	
669	4738	H302		M200		E102	
670	3298	H302		M200		E103	E107
671	7728	H302		M200		E103	E107
672	4132	H302		M200		E104	
673	5342	H302		M204	M205	E104	E107
674	3546	H302		M204	M205	E103	

Counts of students and births were calculated for each micropolygon. This process was repeated for 10 years of historical data, amounting to over 6.5 million processed records.

		STUDENTS BY GRADE													
SCHOOL	BIRTHS	K	1	2	3	4	5	6	7	8	9	10	11	12	K-12
E100	939	857	1014	999	994	988	977	1098	989	1014	1039	857	745	636	12207
E101	1381	1299	1456	1441	1436	1430	1419	1540	1431	1456	1481	1299	1187	1078	17953
E102	1737	1655	1812	1797	1792	1786	1775	1896	1787	1812	1837	1655	1543	1434	22581
M200	2482	2400	2557	2542	2537	2531	2520	2641	2532	2557	2582	2400	2288	2179	32266
M201	1575	1493	1650	1635	1630	1624	1613	1734	1625	1650	1675	1493	1381	1272	20475
H300	3616	3534	3691	3676	3671	3665	3654	3775	3666	3691	3716	3534	3422	3313	47008
H301	441	359	516	501	496	490	479	600	491	516	541	359	247	138	5733

Micropolygon data were further re-aggregated by attendance boundary to create a K-12 profile for each school.

		STUDENTS BY GRADE													
SCHOOL	BIRTHS	K	1	2	3	4	5	6	7	8	9	10	11	12	K-12
E100	[illegible]	857	1014	999	994	988	977	1098	989	1014	1039	857	745	636	12207
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Each school’s K-12 profile consists of its total resident students by grade,

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SCHOOL	BIRTHS	K	1	2	3	4	5	6	7	8	9	10	11	12	K-12
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as well as its total births.

SELECTED PERSISTENCE AND COHORT MOVEMENT

SELECTED GIS GR-to-GR PERSISTENCE

Actual ← | → Forecast

		2005 to 2006	2006 to 2007	2007 to 2008	2008 to 2009	2009 to 2010	2010 to 2011
Bir to 0		72.39%	77.50%	71.15%	74.83%	74.05%	74.05%
Bir to 1		71.43%	79.14%	78.13%	73.08%	79.10%	76.40%
0 to 1		97.46%	109.32%	100.81%	102.70%	103.17%	103.17%
1 to 2		96.30%	104.35%	99.22%	100.80%	100.87%	100.87%
2 to 3		94.66%	94.62%	104.17%	101.56%	101.27%	101.27%
3 to 4		98.43%	100.81%	90.24%	93.60%	93.68%	93.68%
4 to 5		88.24%	97.60%	100.80%	100.90%	100.32%	100.32%
5 to 6		86.21%	88.33%	92.62%	81.75%	86.47%	92.52%
6 to 7		102.17%	97.60%	97.17%	89.38%	93.35%	93.35%
7 to 8		96.27%	88.65%	101.64%	101.94%	99.63%	99.63%
8 to 9		119.09%	126.36%	135.20%	127.42%	129.84%	129.84%
9 to 10		71.35%	72.52%	68.10%	74.56%	72.06%	72.06%
10 to 11		84.68%	70.08%	89.47%	90.09%	86.55%	86.55%
11 to 12		80.95%	84.04%	75.28%	80.00%	79.10%	79.10%

Percentages were calculated for the birth-to-kindergarten draw (5-year offset) and for birth-to-first grade draw (6-year offset). Percentages were also calculated for grade-to-grade persistence. Each school had it's own cohort movement pattern, which the enrollment projection operator used to create the school's K-12 enrollment forecast.

- **KEY PROBLEMS with HARNESSING MICRO-TRENDS:**

1. How can we make geographic information ‘smart’?
    1. ***Solution: Geographic Micropolygons - connect all data into one ‘smart’ layer***
2. How can we connect the micro-patterns of student residence and births to enrollments?
    - ***Solution: Mapping student residence points and individual births into the ‘smart’ layer to increase forecast accuracy and precision***

We’ve now seen how the solution to the second problem was to join birth and student data to the ‘smart’ layer of geographic micropolygons.

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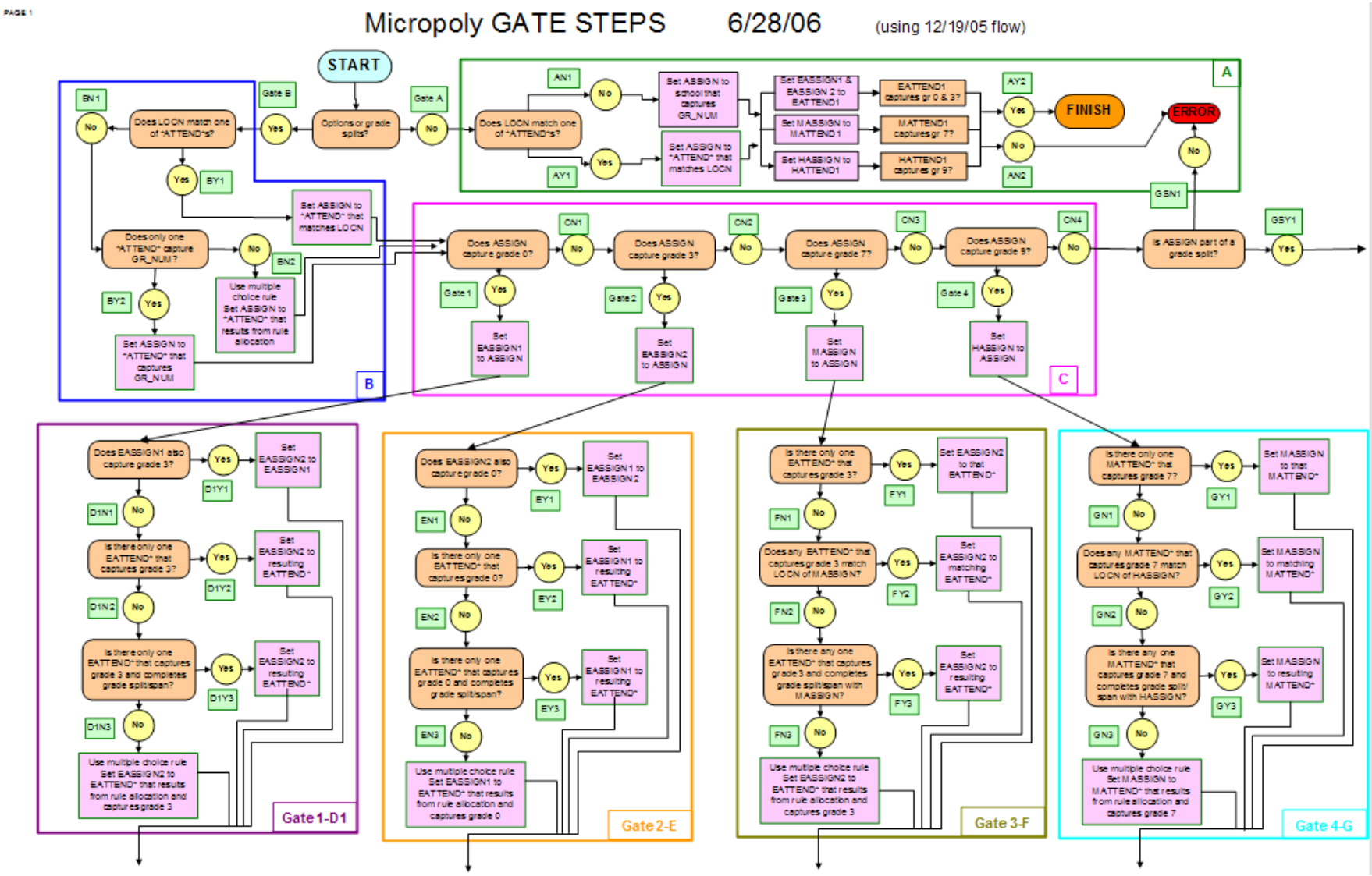
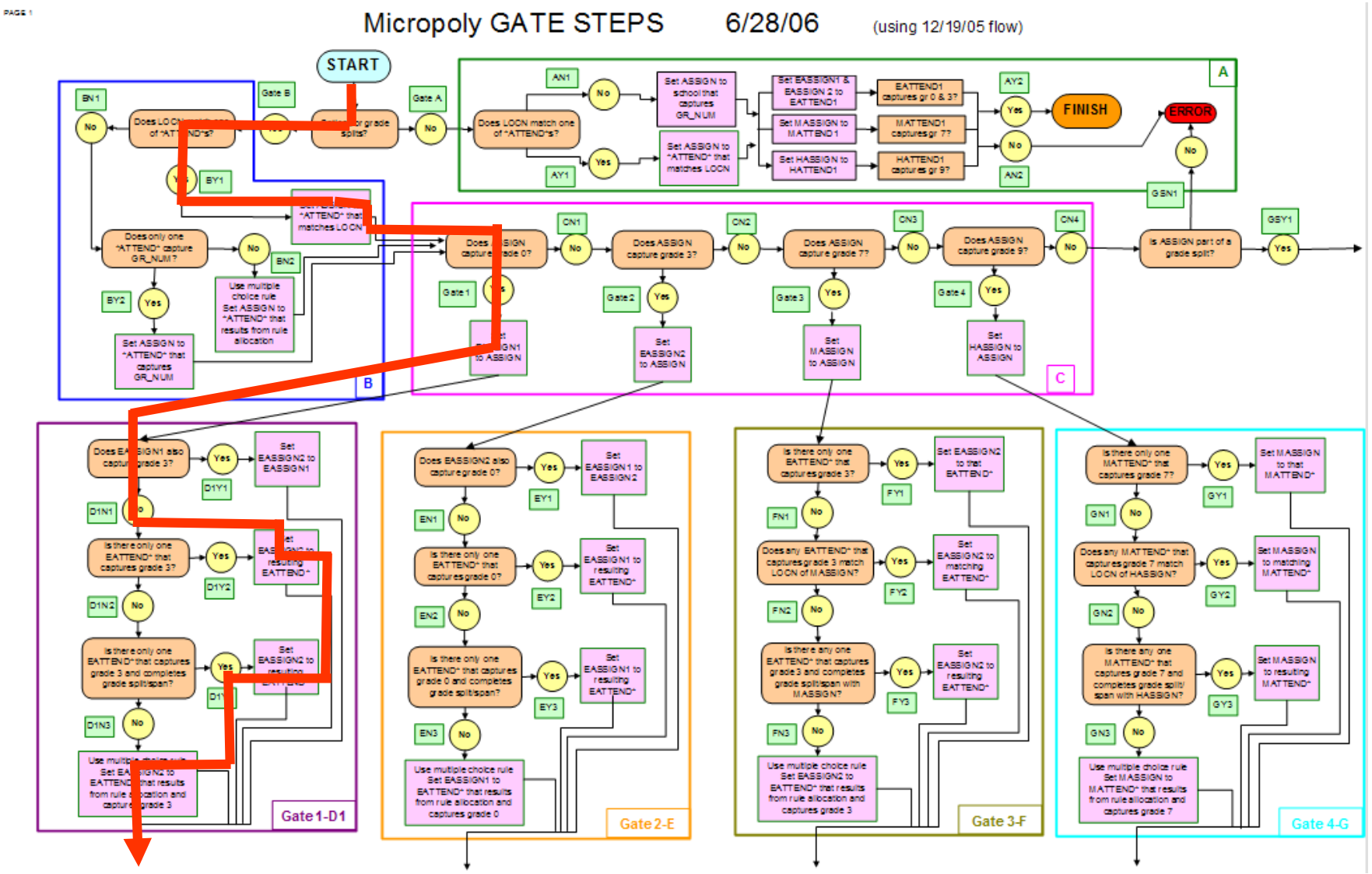
3. How do we simulate how students make decisions in option areas?

The third problem was how to simulate student choice. In LAUSD, school choice is available at some schools via Option Areas, where multiple attendance boundaries overlap and are not co-terminus. However, students must be counted in only one attendance boundary, so our data model needed a way of simulating the school that each Option-Area student would choose.



We simulate student choice by means of a demand model that predicts the decisions that students are likely to make, based on historical trends. We plot all possible choice pathways from kindergarten through high school,



and then used a prediction algorithm to estimate of how students living in option areas will behave. Once applied, each student is then routed into the appropriate school's boundary. Using a demand model thus allows us to include choice area students into our demographic forecast equation.

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3. How do we simulate how students make decisions in option areas?
    - ***Solution: Choice Modeling - simulates which options students will take***

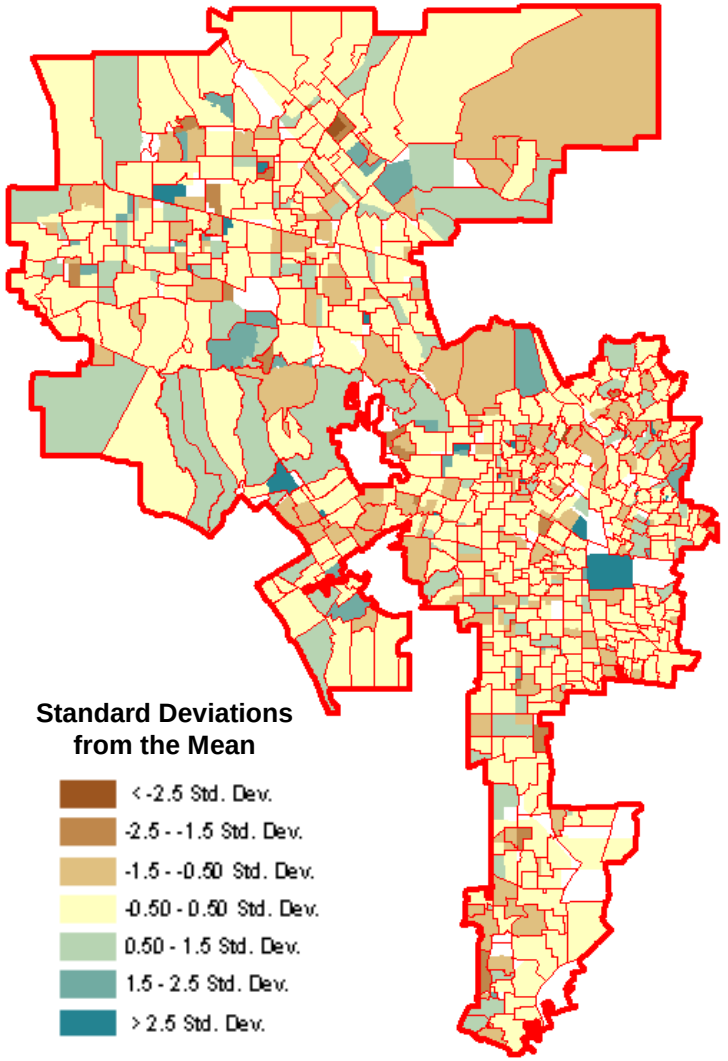
We've seen that the solution to the third problem was to develop a choice-pathway demand-model that simulates students' choices in Option Areas.

Exploring Additional Methods For Understanding Demographic Trends

We are continuing to explore additional ways of looking at and understanding birth and enrollment trends and patterns over time.

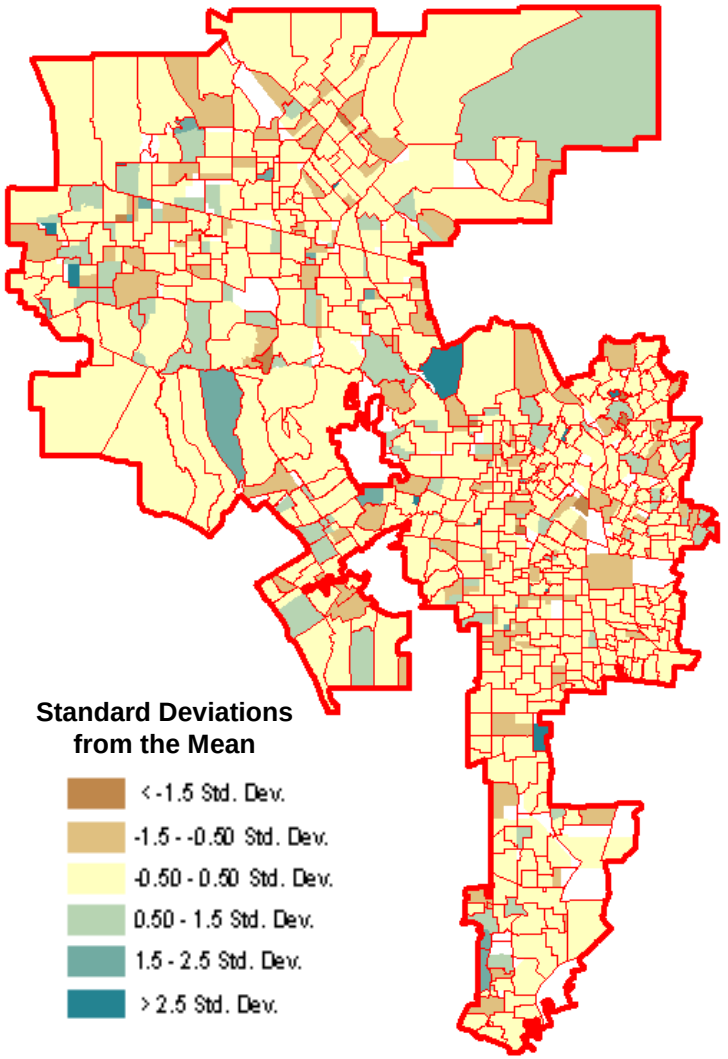
While our district-wide forecast conveys a macro view of the ‘average’ of LAUSD enrollments,

SY2006-07 to SY2007-08: %Change in GR 1 Enrollment



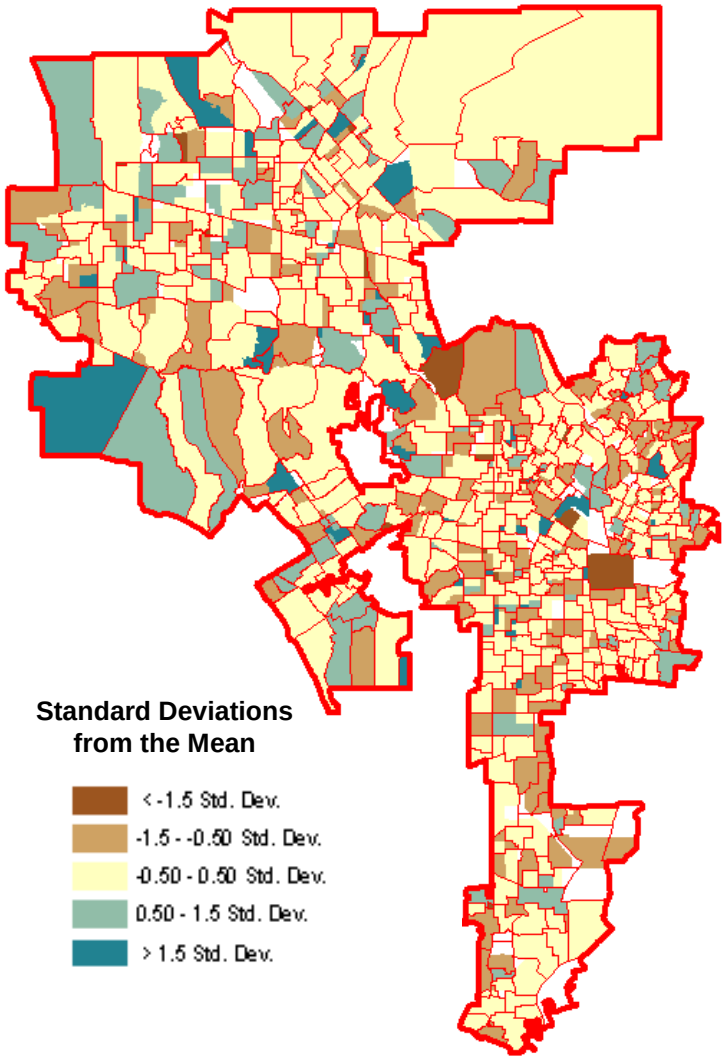
a thematic map can provide a fast way to see how smaller areas may be behaving differently from that average. By mapping data, we can visually compare the demographic changes in small areas and run comparative statistics to find relationships. Here is the first of three years of change in first grade enrollments by microgeography within individual attendance boundaries.

SY2007-08 to SY2008-09: %Change in GR 1 Enrollment



Using standard deviations, we can identify areas that are changing at a rate greater or less than the mean, as well as see in which years and areas there is greater variation in the rates of change. This second thematic map, one year later, illustrates the change between SY 2007-08 and SY 2008-09, as compared to the district's average change.

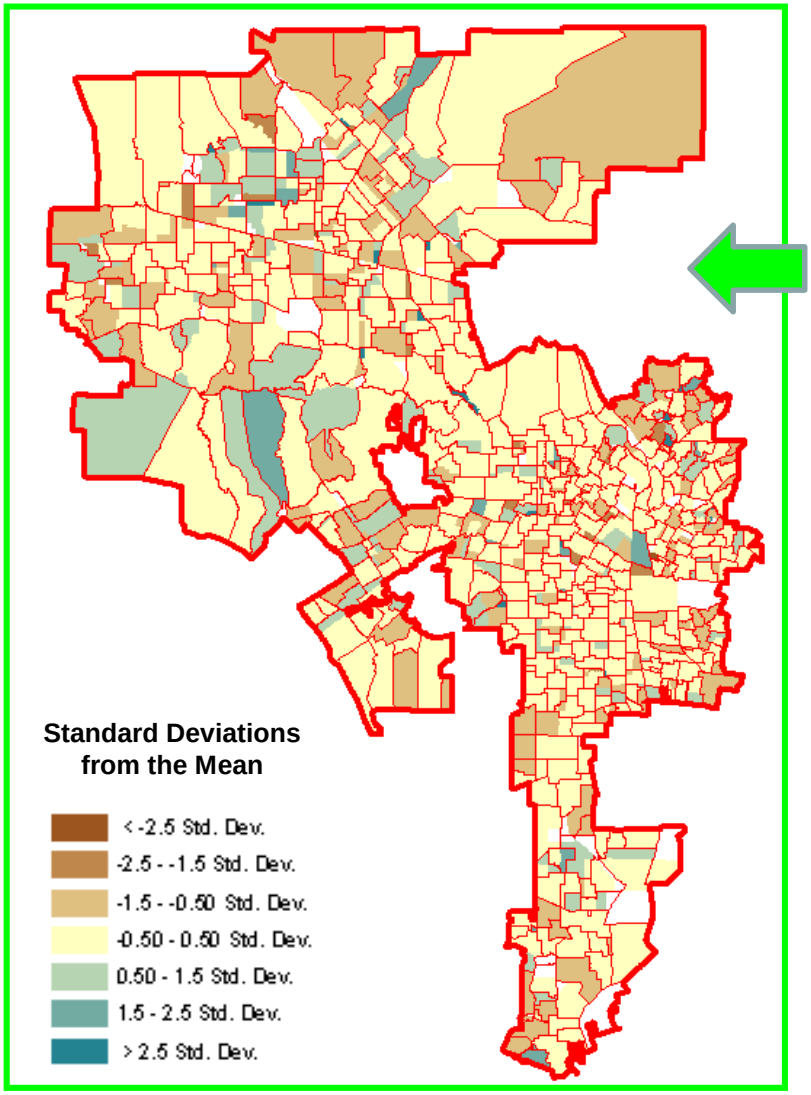
SY2008-09 to SY2009-10: %Change in GR 1 Enrollment

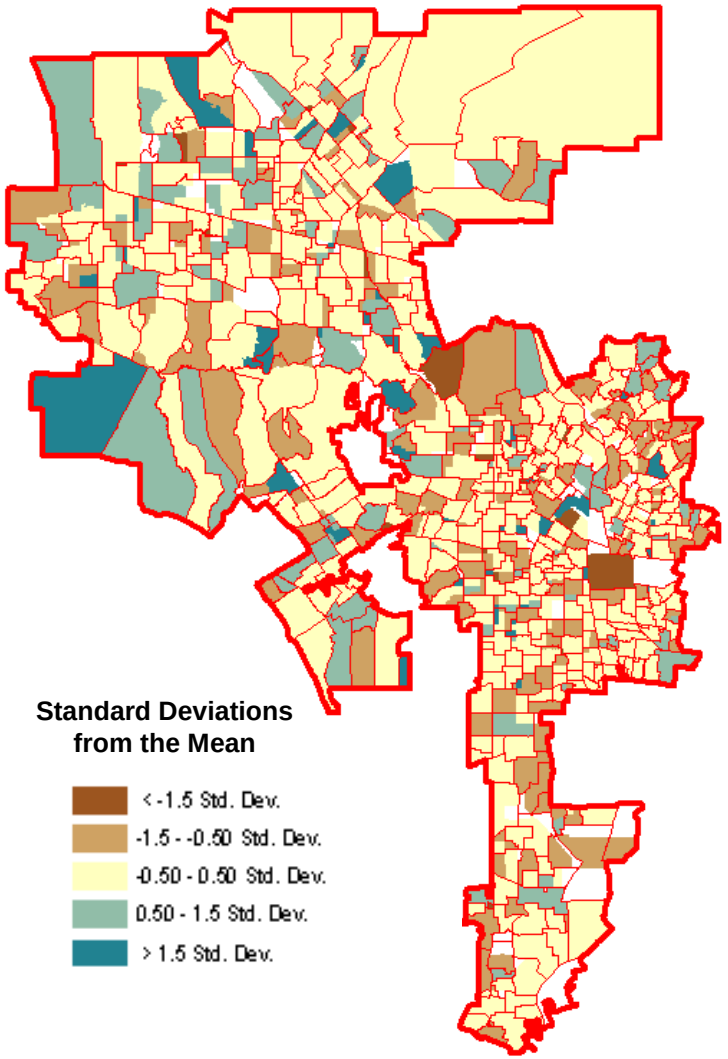


This third thematic map, one year later, illustrates the change between SY 2008-09 and SY 2009-10.

BIRTHS: 2002 to 2003

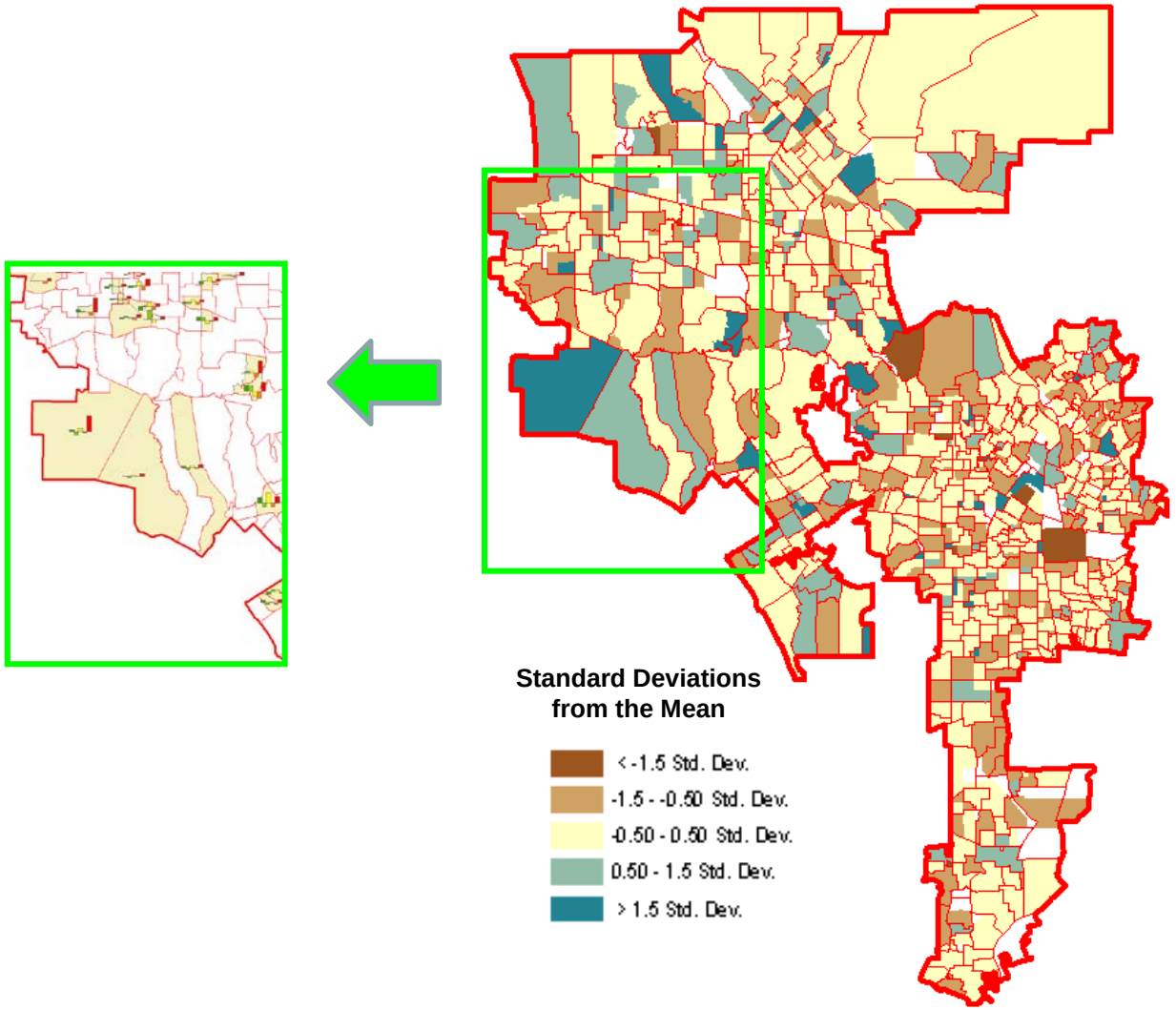
GR 1 ENROLLMENT: SY2008-09 to SY2009-10





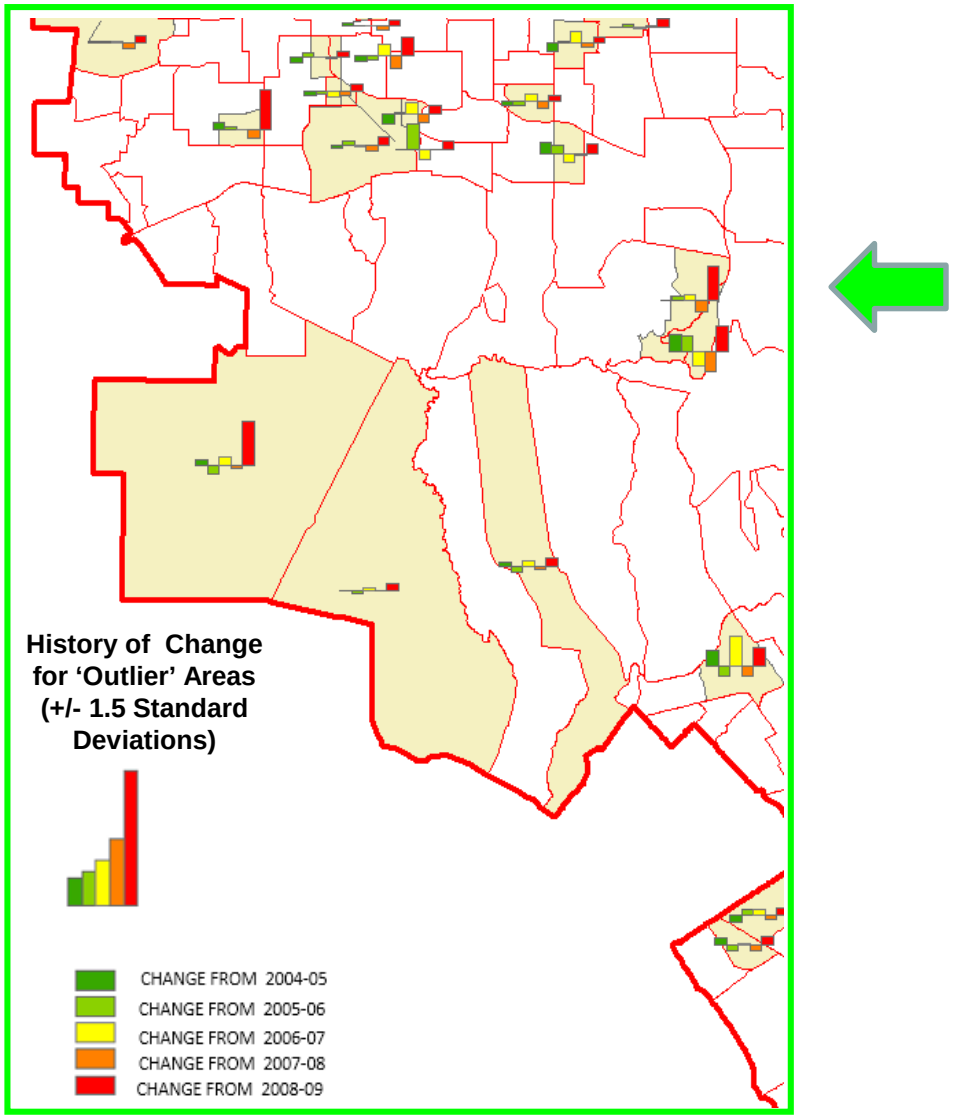
To that map, we can add a comparison of the %change in births between 2002 and 2003 across the same microgeographies. The children born during this time period will grow up to become the pool of LAUSD's eligible first grade students six years later in SY 2008-09.

SY2008-09 to SY2009-10: %Change in GR 1 Enrollment



Or we could select an area of interest,

SY2008-09 to SY2009-10: %Change in GR 1 Enrollment



and provide an even more detailed analysis of trends and behavior across microgeographies over time, using data dimensions of interest.

Los Angeles Unified School District
Ramon Cortines, Superintendent

About the Master Planning and Demographics Unit

Rena Perez, Director

The Los Angeles Unified School District is the nation's second largest public school system, serving approximately 688,000 children in grades K-12. The Master Planning and Demographics Unit supports the Los Angeles Unified School District's mission to educate students through its dedication to the research and analysis utilized in the planning for the optimal utilization of existing schools and determining the need for new school facilities. For more information, please visit us on the web at www.lausd.net or www.laschools.org/employee/mpd/.

About the Authors

Valerie Edwards, Chief Enrollment Analysis Coordinator

Ms. Edwards leads and oversees all demographic research and data analysis for LAUSD's Master Planning and Demographics Unit, where she is in charge of strategic planning and coordination of demographic analysis and enrollment projections in support of LAUSD's $14 billion facilities Strategic Execution Plan. She is currently directing the automation of enrollment projection procedures for the modeling of geographic attendance boundary distribution and simulation of school choice. Ms. Edwards has been a frequent participant at Population Association of America's (PAA) Annual Meetings, serving as session organizer, presenter, panelist and discussant. She is a member the Southern California Association of Governments' (SCAG) Plans & Programs Technical Advisory Committee. She holds a Master's degree in City Planning from the Massachusetts Institute of Technology.

Mary Ehrenthal Prichard, Demographic Research and Planning Analyst

Ms. Prichard's work focuses on the production of short and long range enrollment forecasts for the District's 600+ schools and the production of specialized demographic research and analysis, including the analysis of internal LAUSD and general population demographic data. She has worked extensively with spatially referenced U.S. Census data within a GIS environment. Ms. Prichard has served for a number of years in adjunct faculty positions for community colleges in the Los Angeles region as well as at California State University at Los Angeles. She served as President of the Los Angeles Geographical Society from 2002 to 2004. She holds B.A. and M.A. degrees in the field of Geography from California State University at Los Angeles.