TECHNICAL REPORT

RESIDENTIAL REFILL STUDY

METRO

Prepared by: Sonny Conder
Data Resource Center
Growth Management Services Department
Metro

2/10/99

RESIDENTIAL REFILL STUDY: SUMMARY

Introduction

The Residential Refill Study answers the question of what percent of dwelling units are we building on land we already consider developed? In the past we have referred to "refill" as redevelopment and infill. Redevelopment being generally defined as some structure being demolished and another constructed in its place. Infill means constructing on land considered developed but unoccupied with an existing structure. For example, a homeowner on a large lot may take advantage of less restrictive zoning, partition the large lot into two lots and build an additional dwelling. Since both redevelopment and infill increase the residential capacity of an existing developed area, the terms have been combined into "refill."

The Residential Refill Study represents work over the period from August 1997 to October 1998 of the *ad hoc* refill technical team made up of staff from Data Resource Center, Growth Management Services and assistance of two student interns. The technical aspects of redevelopment and infill measurement are state-of-the-art for regional governments. Staff's ability to obtain and measure these data reflects the value and technical maturity of the Regional Land Information System (RLIS) that Metro has developed and nurtured over the years.

The Refill Study contains sections on the study background, development of definitions and measurement protocols, basic results and discussion of factors affecting present and future refill estimates.

Study Background

The subject of residential refill is significant in terms of legal and policy contexts. Metro accounts for a "refill" factor when estimating the residential land supply available within the Urban Growth Boundary (UGB) per the requirements of ORS 197.296 and 197.301. For instance, if the residential refill rate is estimated at 20 percent and Metro's 20-year growth is assumed to be 215,000 dwelling units, this means 20 percent of 215,000 units (43,000) will be built on land Metro considers previously developed. If the refill rate were 100 percent, all residential development would occur on developed land and Metro would require no additional vacant land for housing. Conversely, if the refill rate were 0 percent, all future residential development would require vacant land. Clearly, estimates of the present residential refill rate and projections of its future value strongly influence calculations of how much residential land will need to be included within the UGB.

Major Study Findings

Study results are summarized as follows:

1. The best point estimate of the actual refill rate is 25.4 percent for 1995-96 after weighting and adjusting the sample to match the total distribution of new residential building permits issued within the UGB during that time period. Significantly, this rate is observed when the Metro region is producing a share of housing output consistent with its 20-year target assumption (70 percent of regional share).
2. Areas or regions with high refill rates tend to have less total residential output. The Metro data, the Vancouver BC data, and inferentially the inter-regional data point to an inverse relationship between the residential refill rate and total dwelling unit output.
3. Available data indicate that policy incentives can change the residential refill rate. Allowing more buildable units on already developed land will increase the refill rate and not adversely affect total residential output. Limiting the supply of vacant land will also increase the refill rate. Similarly increasing residential real estate prices will increase the refill rate. However, under most conditions the latter two options will act to reduce total residential output.
4. With available information, the best example of residential refill is Vancouver BC which appears to have a refill rate in excess 40 percent and still maintains a high level of total housing output.
5. In the Metro study, 17 of 37 sample areas had refill rates in excess of 50 percent but contributed less than 19 percent of total housing output.
6. Looking at past history, which included a long period of low and negative growth, the Metro region appears to have had a very low or at times even a negative refill rate (demolitions and dilapidations exceed building).
7. Economic theory and available empirical academic research strongly support the role of prices and potential productivity in determining the refill rate.
8. Given the results of the study, the residential refill rate is expected to rise and fall in the future as the region goes through economic cycles of expansion and contraction. However, the overall residential refill rate trend should increase as 2040 Planning guidelines take effect.
9. While residential refill rates are expected to increase somewhat over time, uncertainty remains as to whether Metro's share of the economic region's overall growth will decline below the present "capture rate" assumption of 70 percent.
10. Though the 25.4 percent is a precise point estimate, staff conclude that over the next 2-5 years the refill rate could well vary between 20 percent and in excess of 30 percent.

Recommendations

1. For purposes of present Urban Growth Report calculations a point estimate 25.4 percent should be considered as an alternative to 28.5 percent.

2. The study should be repeated within the next 12 months to be consistent with the need to monitor 2040 Plan performance. Monitoring will also allow a further assessment of the impact of 2040 Plan changes, decreased vacant land supply and slightly higher residential prices.

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Ironically, despite being very well developed in a policy context, the actual measurement state-of-the-art range is not well developed. Academic literature searches yielded only three papers that report any measurement results.[1] Similarly, most planning discussions assume the "self-evident" nature of redevelopment and infill. If the city has existed 200 years, but the average building is 40 years old, redevelopment must be happening. In sum no, study was helpful in yielding a "refill percentage" but this research did contribute considerable understanding of the role of economic growth, housing prices and demographics in urban redevelopment behavior.

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[1] S. Rosenthal, R. Helsley, *Redevelopment and the Urban Land Price Gradient,* **Journal of Urban Economics**, (1994), pp. 182 – 200. B. Badcock. *Building Upon the Foundations of Gentrification: Inner-City Housing Development in Australia in the 1990s,* **Urban Geography,** (1995), pp. 70 – 90. H. Munneke, *Redevelopment Decisions for Commercial and Industrial Properties,* **Journal of Urban Economics**, (1996), pp. 229 – 253.

What we were faced with then was the requirement to "invent" our own methodology for measuring residential refill. Inventing and testing the measurement methods became the task of an *ad hoc* work group of Metro Data Resource Center and Growth Management Services technical staff, called the "redevelopment project committee."[2]

Definitions, Development of Measurement Protocol and Sample Selection

Definitions:

The requirement to measure refill in a way consistent with the land accounting system RLIS drove the methodology. Metro uses RLIS as the basis for determining present land consumption and future land need. As a result the committee adopted infill and redevelopment definitions that were exactly defined (in a Boolean sense) by RLIS. The definitions are as follows:

- Infill: Residential development (denominated in dwelling units) on a parcel without a pre-existing physical structure where Metro considers the parcel developed in the fiscal year (or years) prior to the fiscal year for the which the building permit is issued. For instance a single family residential building permit issued between July 1995 and June 1996 for a parcel classed as developed in RLIS as of June 30, 1995 would be classified as infill provided no previous structure occupied it.

- Redevelopment: Same as above except that a structure or the identifiable remains of a structure were visible on the parcel in the fiscal year prior to the issuance of the residential building permit.

When interpreted in the context of the RLIS land accounting system, the above definitions yield a classification system that involves no value judgement. However, by virtue of reducing the exercise to a 99.9 percent mechanical operation a limited number of building permits are classified in a fairly counter-intuitive fashion. First, in some fast growing suburban subdivisions on vacant land, a few building permits are assigned to parcels that Metro had classed as developed in the previous year. Since these parcels are no longer in our vacant land inventory, they are properly classed as infill. While consistent with our accounting framework, this classification is somewhat misleading from an economic and historical urban development perspective that would regard the development as occurring on vacant parcels. Conversely, in some instances on developed land buildings are demolished and the land held vacant for a number of years. In many of those instances RLIS detects the vacant land and restores it to the vacant land inventory. Subsequently, the land is redeveloped and consistent with our accounting system, we account for it as development on vacant land. From an economic and historical urban development perspective, it is clearly redevelopment.

[2] Committee membership consisted of Dick Bolen, Glen Bolen, Jennifer Bradford, Sonny Conder, Carol Hall, Carol Krigger, Bob Knight, Joe Price and Dennis Yee. Most of the actual work was done by two interns: Mr. Hatem Merdad, PhD Candidate at Portland State University, and Mr. Zachary Horowitz, a recent graduate of McGill University.

Measurement Protocol:

In addition to the RLIS consistent definitions noted above, the committee chose to merge the following databases.

1. RLIS vacant lands and developed lands database by parcel for immediate preceding fiscal year.
2. New residential building permits for fiscal year immediately after vacant land database.
3. Assessor parcel file data for year of building permit issue.
4. Jurisdiction specific zoning/planning designations for year of building permit issue.
5. Air photo of sample ¼ section as of time of vacant and developed land database.
6. Air photo of sample ¼ section as of time of building permit issue (one year later than vacant lands photo).

While seemingly redundant, the committee deemed the above data items necessary to resolve many of the ambiguities inherent in the various databases. The building permit database for new issues often times is incomplete with regard to tax lot and less often address. Moreover, multi-family residential building permits may count the same number of units several times for a succession of permits or fail to account for all the units in supplemental permits. The RLIS database in areas of rapid development or small lot partitioning is sometimes not completely specified as to tax lot number, address, and street or in a few cases parcel or subdivision boundary. In short, substantial numbers of building permits do not exactly match to the actual parcel on which building occurs. To ensure accuracy, the committee elected to manually audit and locate every residential building permit on the correct parcel.

To establish the validity of the examination and audit procedure, the committee in the fall and winter of 1997 performed a series of "ground check" tests. The "ground check" test consisted of comparing the building permit geocode and the air photos to what was actually on the ground. Members of the committee each took a ¼ section with relevant backup materials and verified via field surveys the information that could be gleaned from the source materials.

After the committee identified the range of potential errors, a student intern was hired through the Department of Urban Studies at Portland State University to complete the study.

Sample Selection:

To comprise the refill sample, 37 ¼ sections of the 105 representing the Metro area within the UGB were selected. Because area specific information on maximum allowable development, vacant acreage and housing price was required, a random point sample could not be selected. Consequently, the sample consisted of 37 four-mile square ¼ sections distributed roughly proportionately to development density with the

proviso that every jurisdiction be included in a sample section. Figure One: Redevelopment Pilot Project displays the sample areas chosen.

Sample areas chosen contained over 4,900 of the roughly 10,000 residential units permitted in 1995-96. When completing final tabulations, the data were weighted from each sample section at the County level to reflect the actual number of new residential dwelling units permitted in the County during 1995-96. To determine the overall refill rate, the single family and multi-family refill percentages were again weighted to reflect the long run expected 35/65 split between multi-family and single family versus the 46/54 split actually recorded in 1995-96. The latter weighting procedure adjusted the refill rate upward from 24.9 percent to 25.4 percent. Weighting procedures ensure that the estimate of 25.4 percent is consistent with our 20-year forecast assumptions for the mix of multi-family and single family dwelling units.

Classification Procedure:

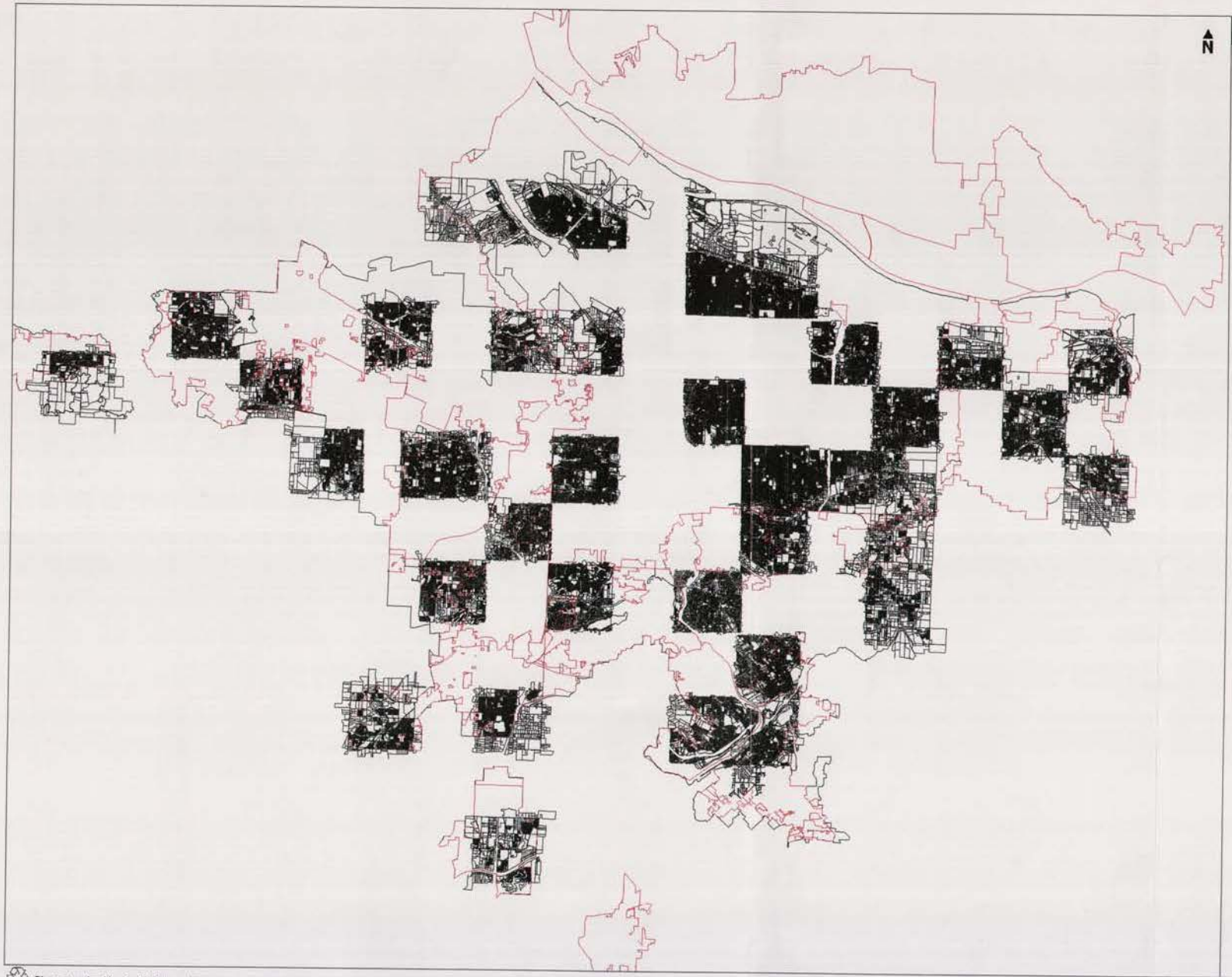
Each sample section was examined and new single-family and multi-family dwelling units were assigned to the classes of infill, redevelopment and vacant. Using the ¼ section maps of building permits geocoded by parcel to the June 1995 RLIS land inventory, the location of each dwelling unit was verified using the air photos. After ensuring the geocode was accurate or after correcting inaccurate geocodes, dwelling units were assigned to the appropriate class. Figures Two, Three and Four depict graphically how this was done.

During the course of the project, the project team conducted several field surveys to ground check for accuracy. This was particularly helpful for multi-family permit data where the number of units sometimes could not be determined from the air photos and there was reason to suspect the permit data were misleading. Actual work on the classification phase was completed in late July 1998 and staff incorporated the refill rate point estimate of 25.4 percent into our August 1998 Urban Growth Report.

Results

The Basic Results:

Exhibit One summarizes the refill study results by sample area.



R L I S

REGIONAL LAND INFORMATION SYSTEM

Redevelopment Pilot Project

Sample Sections

City Limits

Urban Growth Boundary

Sample Sections

0 1 2 3 4 5 6 7 Miles

1"= 3.0 miles

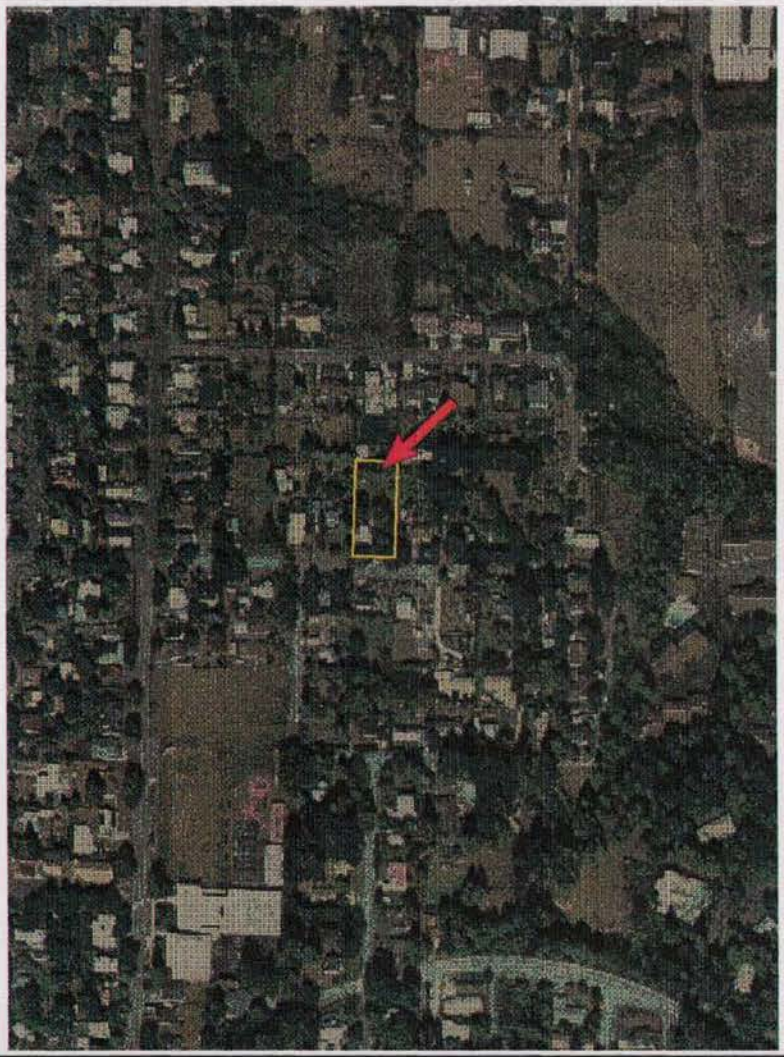
METRO

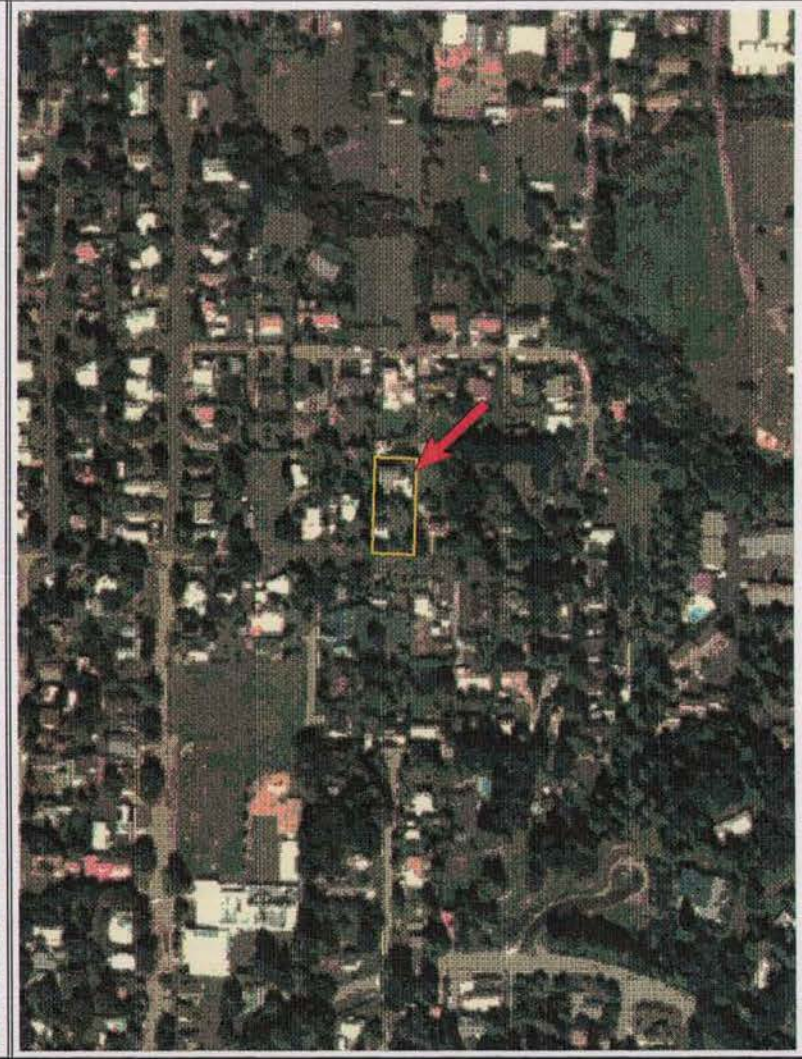
600 NE Grand Ave.
Portland, OR 97232-2736
503 797-1742 FAX 503 797-1909
Email: drc@metro.dst.or.us

Plot date: Jul 31, 1998; nil

Section 1S1E-D 1994

Section 1S1E-D 1997





N

R L I S

REGIONAL LAND INFORMATION SYSTEM

Residential Infill - Redevelopment Project

Map Section 1S1E-D An Example of Infill

Taxlot with Infill

0 100 200 300 400 500 Feet

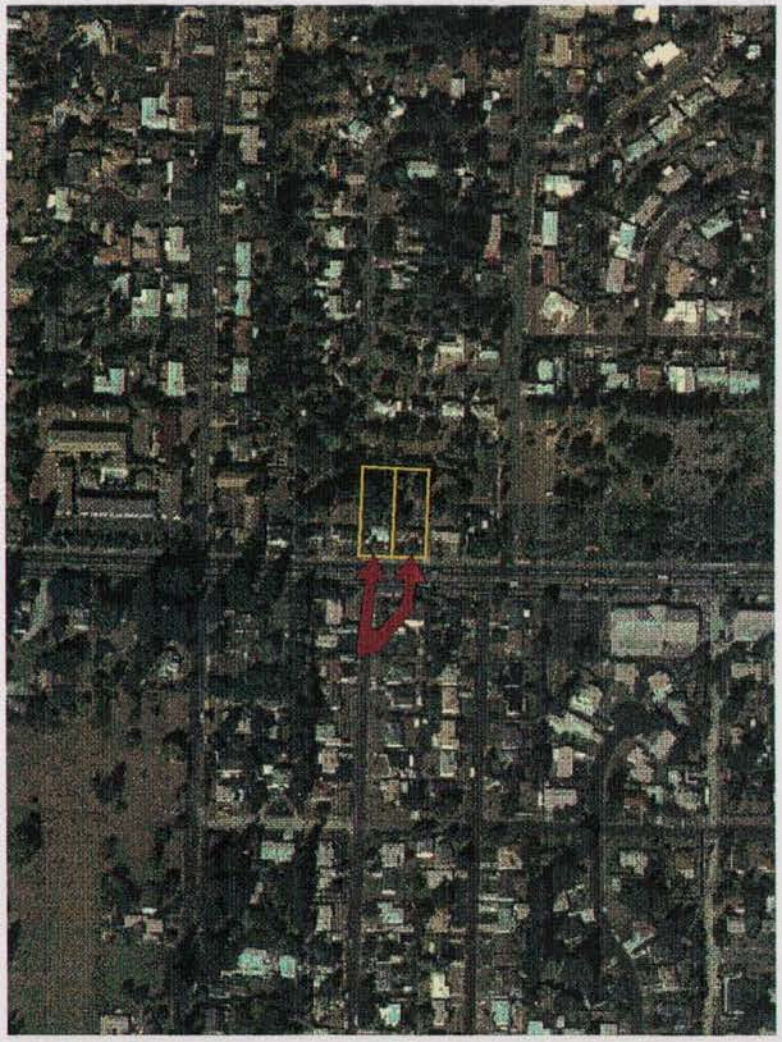
1"= 200 feet

This comparison of air photos from 1994 and 1997, respectively, were used to determine the classification of a residential building permit geocoded to the highlighted tax lot. In this example, it is apparent that a building was constructed at the rear of the tax lot sometime during the 3-year time span of the photos. According to the classification protocol of the residential redevelopment study, this permit was classified as infill.

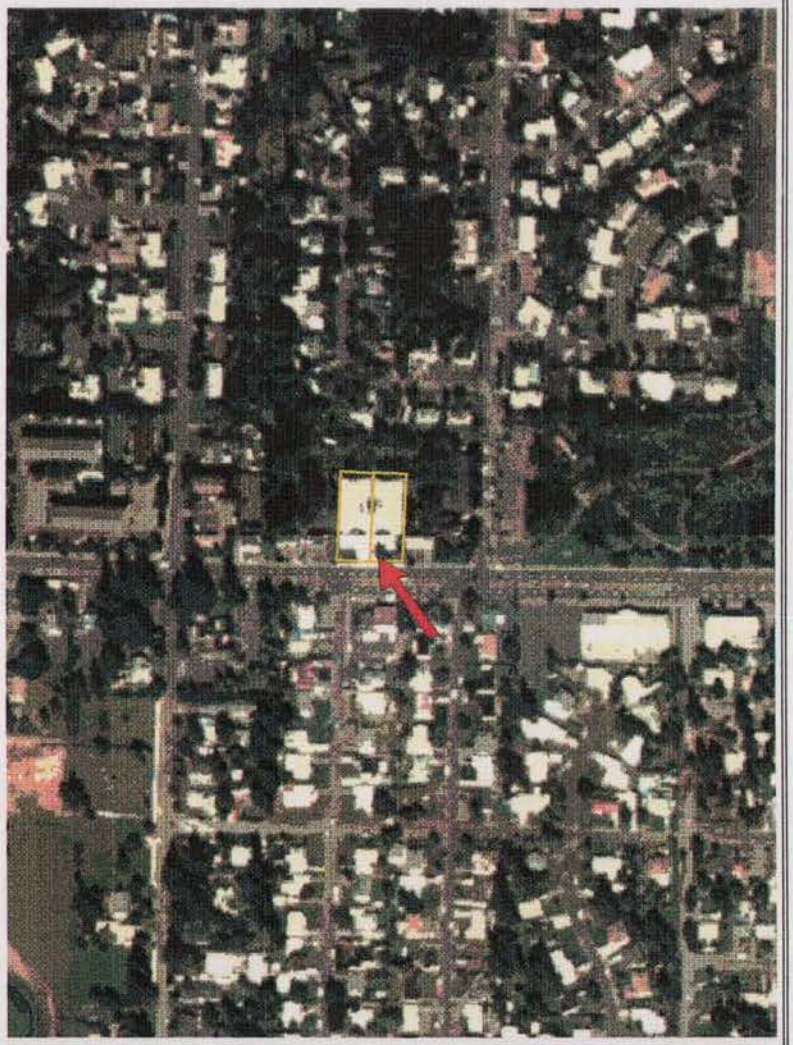
METRO
600 NE Grand Ave.
Portland, OR 97232-2736
503 797-1742 FAX 503 797-1909
Email: drc@metro.dst.or.us

Plot date: Aug 4, 1998; d:\redev98\proj1.apr

Section 1N2E-H 1994



Section 1N2E-H 1997



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R L I S
REGIONAL LAND INFORMATION SYSTEM

Residential Infill - Redevelopment Project

Map Section 1N2E-H
An Example of Redevelopment

Taxlot with Redevelopment

0 100 200 300 400 500 Feet

1"= 300 feet

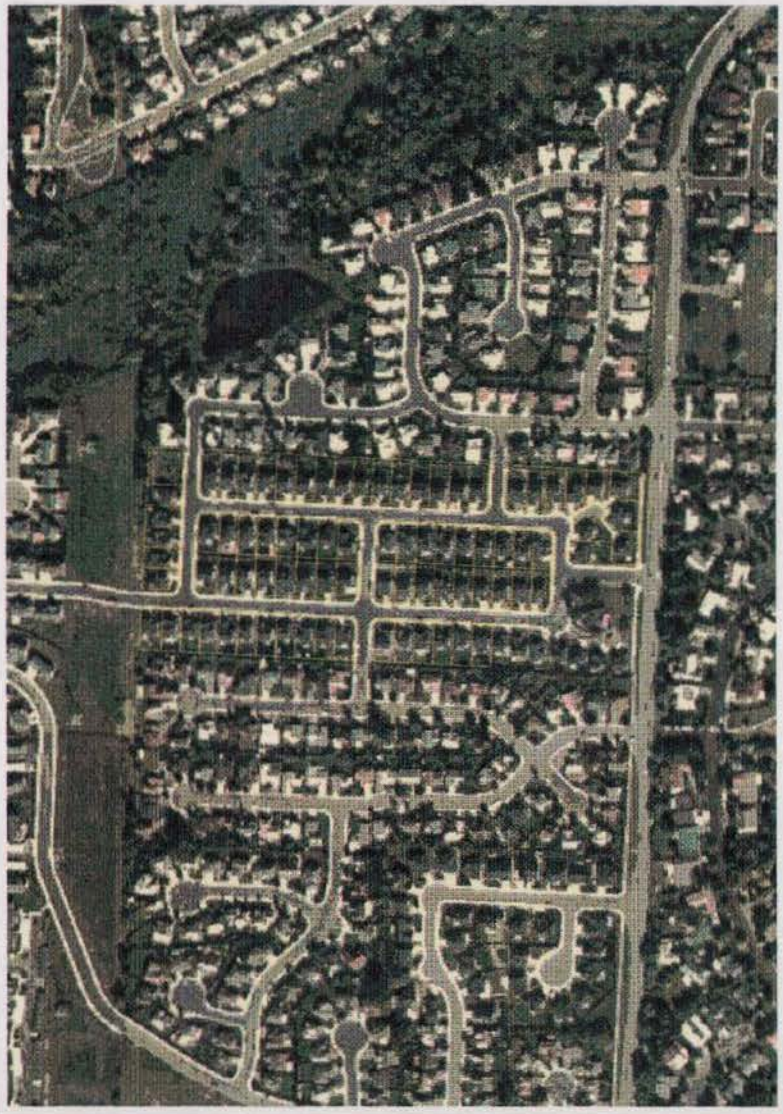
In the 1994 aerial photograph there are buildings on the taxlots highlighted in yellow. Between 1994-97, the lots were redeveloped and newer, higher density dwellings were built. According to the residential redevelopment project protocols, the building permits that correspond to these two taxlots were classified as redevelopment.

METRO
600 NE Grand Ave.
Portland, OR 97232-2736
503 797-1742 FAX 503 797-1909
Email: drc@metro.dst.or.us

Plot date: Aug 3, 1998; d:\redev98\proj1.apr

Section 1N1W-I 1994

Section 1N1W-I 1997



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R L I S
REGIONAL LAND INFORMATION SYSTEM

Residential Infill - Redevelopment Project

Map Section 1N1W-I
An Example of a 'Vacant' Classification

Taxlots Classified as Vacant in 1994

0 100 200 300 400 500 600 Feet

1"= 300 feet

The air photo on the left shows the taxlots of a planned subdivision on land classified as vacant in Metro's database in 1994. By 1997, houses had been built on the land. The building permits that correspond to these taxlots were classified as vacant in the residential redevelopment project, because of the 1994 classification of the land.

METRO
600 NE Grand Ave.
Portland, OR 97232-2736
503 797-1742 FAX 503 797-1909
Email: drc@metro.dst.or.us

Plot date: Aug 4, 1998; d:\redev98\proj1.apr

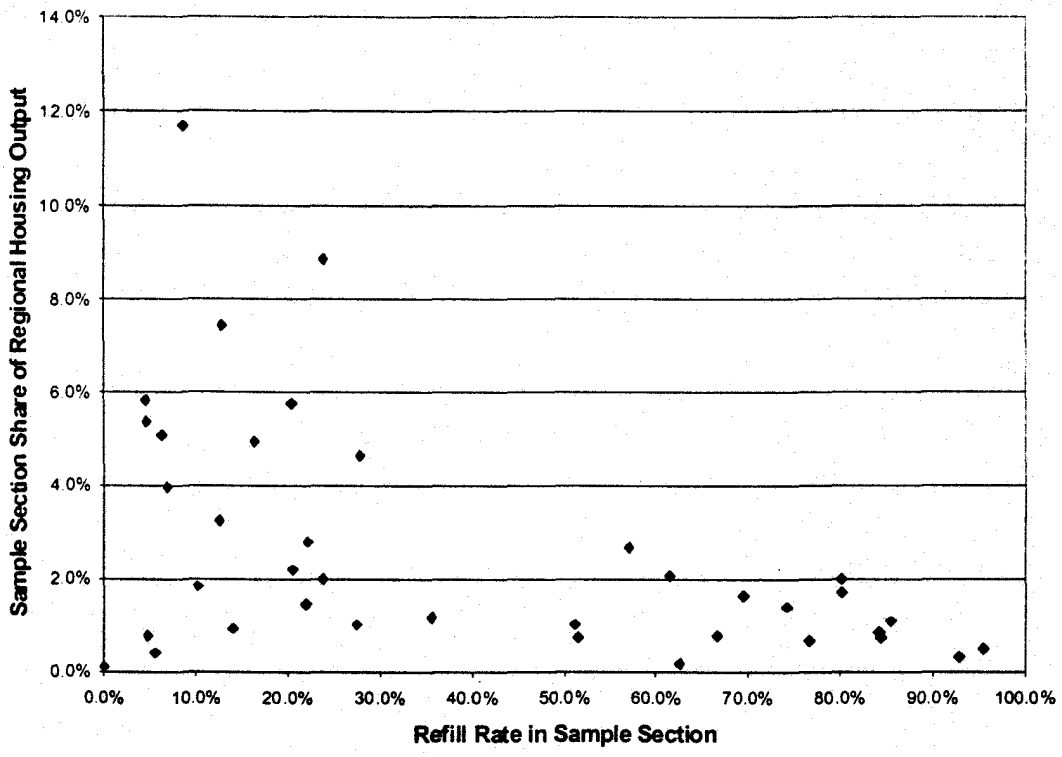
Exhibit One: Refill Rate and Residential Production Share By Sample Area 1995-96							
1/4 Section Notation	Jurisdiction/Area Description	Permitted D.U.	Refill Units	Vacant Land Units	Percent Refill	Percent Total D.U.	Cumulative D.U. Share
1s1e-a	Portland – Buckman-Belmont-Hawthorne	24	23	1	95.5%	0.5%	0.5%
1n2e-d	Portland – Cully Neighborhood	16	14	1	92.9%	0.3%	0.8%
1n3e-l	Gresham – Rockwood	53	46	8	85.4%	1.1%	1.9%
1n2e-h	Portland – Outer East County	36	30	6	84.4%	0.7%	2.6%
1n1e-c	Portland – St. Johns	42	36	7	84.2%	0.9%	3.5%
1s1w-g	Beaverton – Tigard	84	67	17	80.2%	1.7%	5.2%
3s1w-f	Wilsonville	98	78	19	80.2%	2.0%	7.2%
1n1w-a	Portland – St. Johns	33	26	8	76.7%	0.7%	7.9%
1s2e-d	Portland – Woodstock-Brentwood-Darlington	69	51	18	74.2%	1.4%	9.3%
1s2e-a	Portland – Old Suburb	80	56	24	69.4%	1.6%	10.9%
2s1e-a	Oak Grove – Clackamas Co. unincorp.	39	26	13	66.7%	0.8%	11.7%
1s1w-e	Beaverton	8	5	3	62.5%	0.2%	11.8%
1n1e-l	Portland – N.W.	9	6	3	62.5%	0.2%	12.0%
1s2e-f	Portland – Suburban Southeast	101	62	39	61.5%	2.1%	14.1%
1s2w-f	Aloha	132	75	57	57.0%	2.7%	16.8%
1s1e-d	Portland – West Hills-Multnomah	37	19	18	51.5%	0.7%	17.5%
1n1e-f	Portland – Northeast Portland	50	26	24	51.1%	1.0%	18.5%
1n1w-g-w	Portland – Forest Park; unincorp. Northeast Washington County	58	20	37	35.6%	1.2%	19.7%
1s3e-b	Gresham – Downtown	228	63	164	27.8%	4.6%	24.3%
1s3w-b	Cornelius – Forest Grove	50	14	36	27.5%	1.0%	25.3%
2s1w-l	Sherwood	435	103	331	23.8%	8.9%	34.2%
2s1w-g	Tualatin	98	23	75	23.8%	2.0%	36.2%
2s1e-g	West Linn – Tanner Basin	137	30	107	22.1%	2.8%	39.0%
1s3e-f	Gresham – east end	71	16	56	21.9%	1.4%	40.4%
2s2e-d	Gladstone	108	22	86	20.5%	2.2%	42.6%
1s2w-b	Hillsboro – Reedville-Beaverton	283	58	225	20.3%	5.8%	48.4%
2s2e-a	Clackamas County unincorp. – Sunnyside Road	242	40	203	16.3%	4.9%	53.3%
2s2e-l	Oregon City – Older Area	46	6	40	14.0%	0.9%	54.3%
2s1w-b	Tigard	365	47	318	12.8%	7.4%	61.7%
1s2e-e	Portland – Lents	160	20	140	12.5%	3.3%	65.0%
2s1e-c	Lake Oswego	90	9	81	10.2%	1.8%	66.8%
1n1w-l	Beaverton – Oak Hills	574	49	525	8.5%	11.7%	78.5%
1n1w-g-m	Portland – Forest Park; Northeast Multnomah County	194	13	181	6.9%	4.0%	82.4%
1n3e-g	Troutdale	249	16	233	6.3%	5.1%	87.5%
1n1e-a	Portland – Columbia South Shore	20	1	19	5.6%	0.4%	87.9%
1s2e-g	Happy Valley – Clackamas County unincorp.	39	2	37	4.8%	0.8%	88.7%
1s2e-l	Milwaukie – Clackamas County unincorp.	263	12	251	4.6%	5.3%	94.1%
1n2w-l	Hillsboro	287	13	274	4.4%	5.8%	99.9%
1n1w-b	West Hills-Skyline-Portland	6	0	6	0.0%	0.1%	100.0%
	TOTAL	4909	1221	3688	24.9%	100.0%	
	Weighted for Long Run SFD/MFD Mix:				25.4%		

In Exhibit One we have sorted the sample ¼ sections by refill rate. From Exhibit One we can see that the refill rate range goes from 95.5 percent down to 0.0 percent with both the high and low ends of the range being located in Portland – the high end moderate income inner refill rates in excess of 50 percent. Clearly, substantial portions of the region experience most of their residential growth through the infill and redevelopment process. Moreover, ground checks of sample sections in 1997-98 suggest the level of refill activity in these areas is continuing and perhaps intensifying.

By the same token, from the final column, the 17 sample sections with refill rates in excess of 50 percent comprised but 18.5 percent of total regional residential output. This finding underscores a basic relationship embedded in the data: sample sections with fairly high refill rates tend to have much less total residential output. Chart One depicts this relationship.

Examining Chart One suggests that refill rates below 30 percent are compatible with

Chart One: Housing Output Declines with Increasing Refill Rate



substantial residential output levels while rates beyond 30 percent are correlated with much lower output levels.[3] What Chart One underscores is that refill is much different than residential development on fairly large parcels of vacant land. Residential refill

[3] There are a number of sample ¼ sections that have both low refill levels and low output for reasons of economic demand, vacant land and infrastructure availability.

occurs on scattered, small sites usually no more than 2-3 dwelling units at a time; oftentimes just one unit. On the other hand land supply permitting, residential development on vacant land may be sequential over time with 10-50 units or more produced per year on adjacent lots. The results are that more units can be produced on vacant land in a given time period and oftentimes the costs per square foot are substantially less.

Though private market rate producers do not make auditable and verifiable production cost data available, non-profit developers do. A recent study in the Portland area of housing costs[4] notes the following in regard to location:

> "In many older neighborhoods, expensive in-fill sites are the only locations available for development. They may require environmental cleanup, negotiations with neighborhood associations, and challenges for staging materials delivered to the site. These in-fill sites are often undeveloped due to physical challenges: steep slopes, poor soils, environmental problems, and odd lot configurations. All of these factors increase cost. Finally, the small size of these sites eliminates the economies of scale, which usually lower development costs for larger suburban developments."

While part of these impediments may be compensated for by lower lot costs, the restrictions on construction volume are extremely difficult to overcome particularly in the case of owner occupied dwellings regardless of whether they are detached or attached units.

Much of the limits on the refill rate are really applicable to single family detached and attached units. Though the data look similar for multi-family units, the restrictions on multi-family refill output remain much less since much less land is required.

In sum, the relationship between total residential output and the refill rate is a limitation on the long run refill rate. Total residential output remains a concern since Metro's 70 percent capture rate assumption[5] means production of 10,000-11,000 dwelling units per year for the next 20 years. Fortuitously, total dwelling unit production inside the UGB averaged 10,000-12,000 units per year for 1995 and 1996. Consequently, we know that given the economic conditions and land availability during the 1995-96 period the refill rate of 25.4 percent was measured when total residential output was consistent with the Urban Growth Report planning assumptions.

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[4] W. White, R. Bole, B. Sheehan. *Affordable Housing Cost Study: An Analysis of Current Housing Development Costs in Portland Oregon*, (October 1997), (Draft Copy), p. 8.

[5] Capture rate is the percent of the four-county (economic) regions' growth expected inside the UGB.

Long Run Estimates of Refill Rate and Factors that Increase or Decrease It:

Used in the context of the Urban Growth Report, the residential refill rate constitutes an estimate of future performance. What this means is that we do not necessarily need use the point estimate for 1995-96 as our long run estimate. We may presume that underlying economic and regulatory conditions will change sufficiently to merit an alternative estimate. Of course a variable refill rate leads to a consideration of those factors which influence the refill rate. The study committee made a substantial effort to determine via literature review and measurement those historical, regulatory and market factors that influence the refill rate. While not sufficient to yield any definitive refill rate prediction, staff findings do point to factors and policies that may move the refill rate up or down.

A. Metro History

Looking first at the historical record we cannot observe refill directly. But we can make some general inferences from the relationships between building permit data, population growth and the net increase in dwelling units in the City of Portland.[6] We have included the data in Exhibit Two. (Refer to Exhibit Two.)

Examining the record we note that even when the region experienced slow or negative population growth 3,000-4,000 new dwelling units were built each year. This demand for new dwelling units results from dilapidation of some existing units and new household formation owing to the continuing decrease in household size. Even with little or no growth the region continues to change and add dwelling units. However, the location of the construction has not been evenly distributed throughout the region. Looking at similar City of Portland data for 1980 and 1990 indicates that very little of the population and dwelling unit change occurred in Portland during that period. Most of the growth in dwelling units and population in the tri-county area took place in the areas surrounding the central city. During the mid 1980s, the City of Portland faced a problem with a growing stock of inner city abandoned and dilapidated residential structures. At the same time slow to moderate dwelling unit growth continued in most suburban jurisdictions.

History only relates to the refill issue when we consider that Portland is the locus with a much higher than average percent of dwelling unit construction stemming from refill (43 percent). Since we observe little net growth in the area most likely to have refill, we can infer a lower refill rate during the period 1980-1990.

Most significant in the period 1980-1990 was low housing demand and resultant low housing prices through most of the period. For cost of production reasons, conditions of relatively low home prices and low to moderate growth favor residential development on available, serviced, large parcels of vacant land. We

[6] For the City of Portland we are using Metro sub-areas 1-4 so as to keep constant boundaries.

Exhibit Two: Population Change and Dwelling Unit Growth
3 County 80 - 90

Year	3 County Population Change	3 County New Residential D.U.	Portland Population	Portland Dwelling units
1980	36000	7157	476864	213915
1981	13600	4859		
1982	8000	2963		
1983	-10800	3764		
1984	10300	4258		
1985	9200	7049		
1986	9700	6515		
1987	9400	7482		
1988	22600	7601		
1989	21800	13311		
1990	32791	11143	485210	217680
Totals:	126591	68945	8346	3765

expect regions with relatively low home prices and large quantities of cheaply serviced vacant land to have low refill rates. Conversely, regions with high home prices and relatively little cheap vacant land should have high refill rates.[7]

The history data suggest the Metro region has experienced periods of decreasing and increasing refill rates. Realistically, we should expect considerable variation in refill rates in the future. Perhaps, most important is better understanding what policy mechanisms are available that can be used to alter refill rates.

B. Interregional Comparisons

Before looking at other regions around North America, we should caution that we have little or no direct observational data and must rely on conjectural assumptions. With that caveat in mind, other regions in North America do provide additional insight into the refill rate versus total output relationship. The most specific and informative is Rosenthal and Helsley's study of single family redevelopment in Vancouver BC.[8] They reported that 532 of 6,842 single-family sales transactions in Vancouver in 1987 resulted in the property being redeveloped. Urban Land Institute data[9] report approximately 6,500-7,000 SFD units being constructed per year in Vancouver for the years 1985-1990. Using 532 as the numerator and 6,500 as the denominator gives us a single family dwelling redevelopment rate of 8.2 percent. Geographically, the redevelopment rate is 27.3 percent for the Central Business District (CBD), 8.8 percent for Vancouver West Side, 5.5 percent for Vancouver East Side and 8.8 percent for Burnaby New Westminster. Similar to the Metro pattern, the area (CBD) with the highest redevelopment rate also had the lowest level of total SFD output: about 1 percent.

By way of comparison, we measured a SFD redevelopment rate of 4.5 percent for the Portland area. The Vancouver SFD redevelopment rate is 1.8 times greater than what we observe for Portland. Using a set of conjectural extrapolations this very tentatively suggests an overall Vancouver refill rate of about 40-50 percent. The Vancouver region is severely constrained in terms of land supply with topography, the Fraser River delta and the U.S. border amounting to a virtual UGB. In 1995 Vancouver newly constructed single family prices were 80 percent higher[10] than comparable housing in the Metro region. However, multi-family rentals when adjusted to US dollars were about the same as Metro region rents.

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[7] Both Munneke, *op.cit.* & Rosenthal, *et. al., op.cit.* confirmed the role of higher prices for land in an alternative use versus an existing use. For infill this means additional housing in lieu of a larger lot. For redevelopment this means more housing units replacing the existing dwelling unit or commercial structure.

[8] Rosenthal, *et. al., op.cit.* p.197.

[9] Urban Land Institute, *ULI Market Profiles: 1996 – North America.* (ULI, Wash D.C.) pp. 385 – 387.

[10] ULI data are in Canadian $. Prices were converted to U.S. for comparison purposes.

Moving to other regions we can make a rough qualitative estimate of refill rate and total output. We compare a few regions that are constrained by natural barriers or political boundaries and have little vacant land with those that are unconstrained and so have are large supply of vacant land available to them. Exhibit Three below shows the data.

While Exhibit Three certainly involves considerable qualitative judgement, the data do indicate somewhat the same pattern as obtained in the Metro region results. That is areas with presumptively higher refill rates had lowers levels of residential output than areas with low refill rates and presumably abundant vacant land. However, we need keep in mind that Vancouver BC, our best documented comparison to Metro, had a growth rate higher than most US regions while having a refill rate we estimate to be substantially higher than Metro's. This suggests that higher refill rates can be maintained and compatible with moderate to high growth rates provided the planning and incentives exist for it to happen.

Exhibit Three also notes that regions with land constraints and higher refill rates are producing more multi-family housing. This reflects vacant land scarcity and supplier response to efficiently use land in areas with high real estate prices.

C. Role of Regulation

The most important aspect of the refill rate that Metro jurisdictions control is regulation. Refill can only occur if allowable densities may be increased. In the Vancouver example above, we suspect that regulation is fairly liberal with respect to density increases. Certainly knowing the role of regulation on refill rates will be helpful.

To better understand regulation and refill rates we plotted the refill rate in each sample as compared to the ratio of actual units on each parcel to allowable units on each parcel. A ratio of one means no more units can be built. A ratio of 2 means one more unit can be built on each parcel. A ratio of 3 allows two more units on each parcel. Chart Two depicts the results.

Chart Two demonstrates that the more dwelling units we can build on a given parcel, the more we will indeed build. Roughly doubling the regulatory capacity of the region could possibly result in a refill rate of 50 percent. Again this result only deals with the refill rate and does not at the same time account for overall residential output. However, from an intuitive perspective it is likely that regulatory changes will be able to move the refill rate up or down somewhat without significantly impacting total residential output.

Also meriting consideration is the role of subsidized housing; most of which may be located on developed land. Data for 1998[11] indicate an annual rate of over

[11] Metro Growth Management, H-Tac Fair Share Subcommittee Meeting Handout, (Feb. 9, 1999) p.10.

Chart Two: Increasing Regulatory Capacity Increases Refill Rate

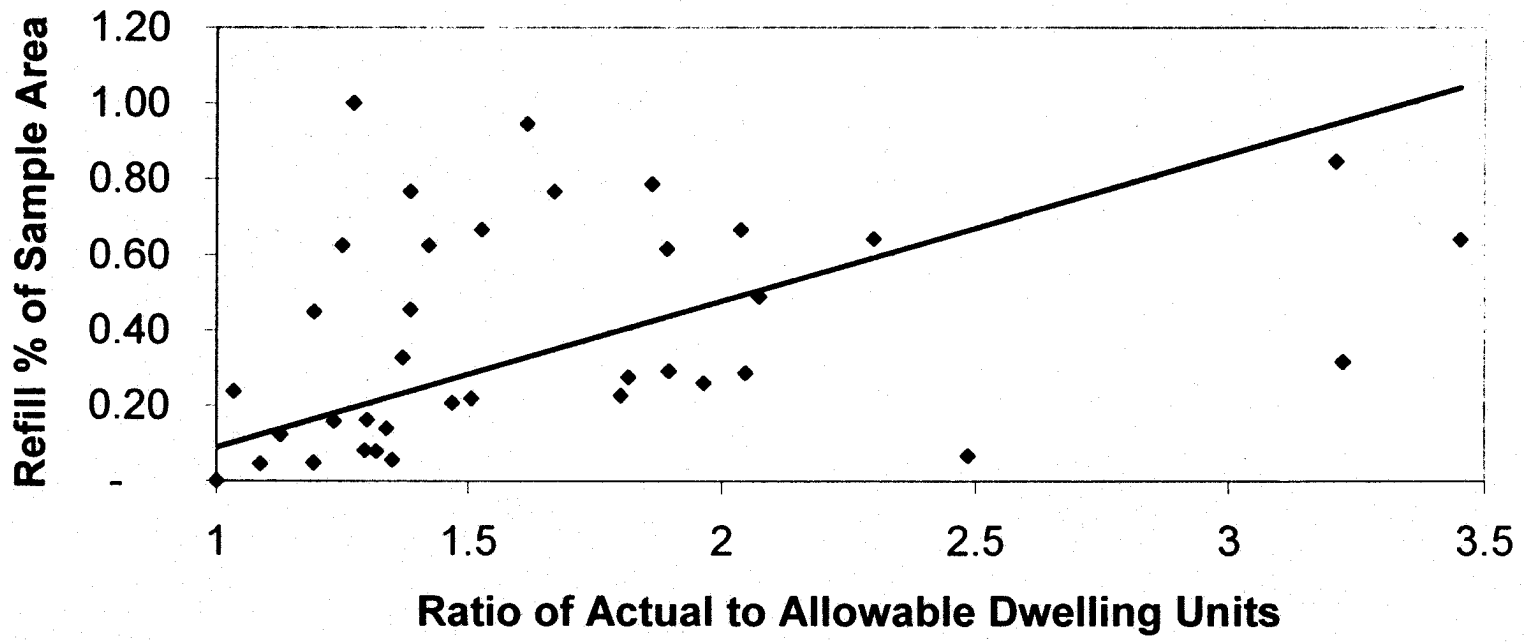


Exhibit Three: Inter-Regional Comparison of Qualitative Refill Rate, Output and Housing Type

Region	Qualitative Refill Rate	Approximate Total D.U.	Output as % of Total Region D.U.	Output % SFD	Output % MFD
San Francisco	High	650000	0.6%	41.0%	59.0%
Vancouver	Mid - High	701000	1.80%	35.6%	64.4%
New York	Mid - High	2631000	0.40%	25.70%	74.30%
Miami	Middle	698000	1.40%	52.90%	41.10%
Oakland	Middle	815000	1.20%	74.20%	25.80%
Portland-Vancouver	Mod - Mid	716000	2.80%	57.40%	42.60%
Chicago	Moderate	2808000	1.10%	71.80%	28.20%
Phoenix-Mesa	Low	1007000	4.30%	74.50%	25.50%
Las Vegas	Low	465000	6.70%	66.70%	33.30%

Source: National Association of Home Builders, **Housing Economics,** (Dec. 1998), pp 20 - 27.

1,000 subsidized units being built. Should the Metro region substantially increase subsidized housing output and locate the bulk of it on developed land, the refill rate will be increased.

D. Roles of Vacant Land and Parcel Size

Earlier discussion pointed out the cost disadvantages of refill when compared to large-scale development on moderate to large tracts of vacant land. Charts Three and Four below underscore this relationship.

Chart Three demonstrates the decrease in SFD refill rate as the amount of available vacant land increases in a given sample section. When available acreage increases beyond 200 acres, SFD refill rates fall below 30 percent. Chart Four indicates that much of the pattern in Chart Three owes to increasing vacant parcel size which renders refill uncompetitive in terms of production cost. For sample sections with average parcel size under 1 acre, refill appears cost competitive with a full range of refill rates in evidence. Once average parcel size moves beyond 1-acre refill rates drop steadily as development on vacant acreage becomes much more cost competitive.

E. Role of Price

Economic theory and careful academic empirical work to date assign a pivotal role to price in determining redevelopment. Munneke succinctly notes: " ...that redevelopment will occur when the value of the existing bundle, plus demolition costs, is less than or equal to the price of vacant land."[12] In terms of the region's jurisdictional authority, the simplest price-based approach is to increase the productivity of land by allowing more intensive development. As we have noted in the previous discussion, more intensive use increases the refill rate. To better understand the role of price in affecting the refill rate we conducted a number of simulations using the housing hedonic price equations we estimate from actual sales data within the Metro region. Chart Five presents the results.

Since we are simulating effects from an estimated statistical model, the results in Chart Five are much sharper than the actual measurements reported earlier. The simulated results in Chart Five clearly reveal that as allowable yield per unit of land increases, the chances of infill and redevelopment increase. Similarly, as prices increase the chances of infill and redevelopment increase. Also, we note that other things equal there will always be more infill than redevelopment usually by a factor of 4-6. Our actual Metro measurements indicate an actual ratio of 3.5 and over for MFD and 5.0 and over for SFD.

[12] Munneke, *op.cit.*, p.251

Chart Three: SFD Refill % Goes Down With Increase in Vacant Acres

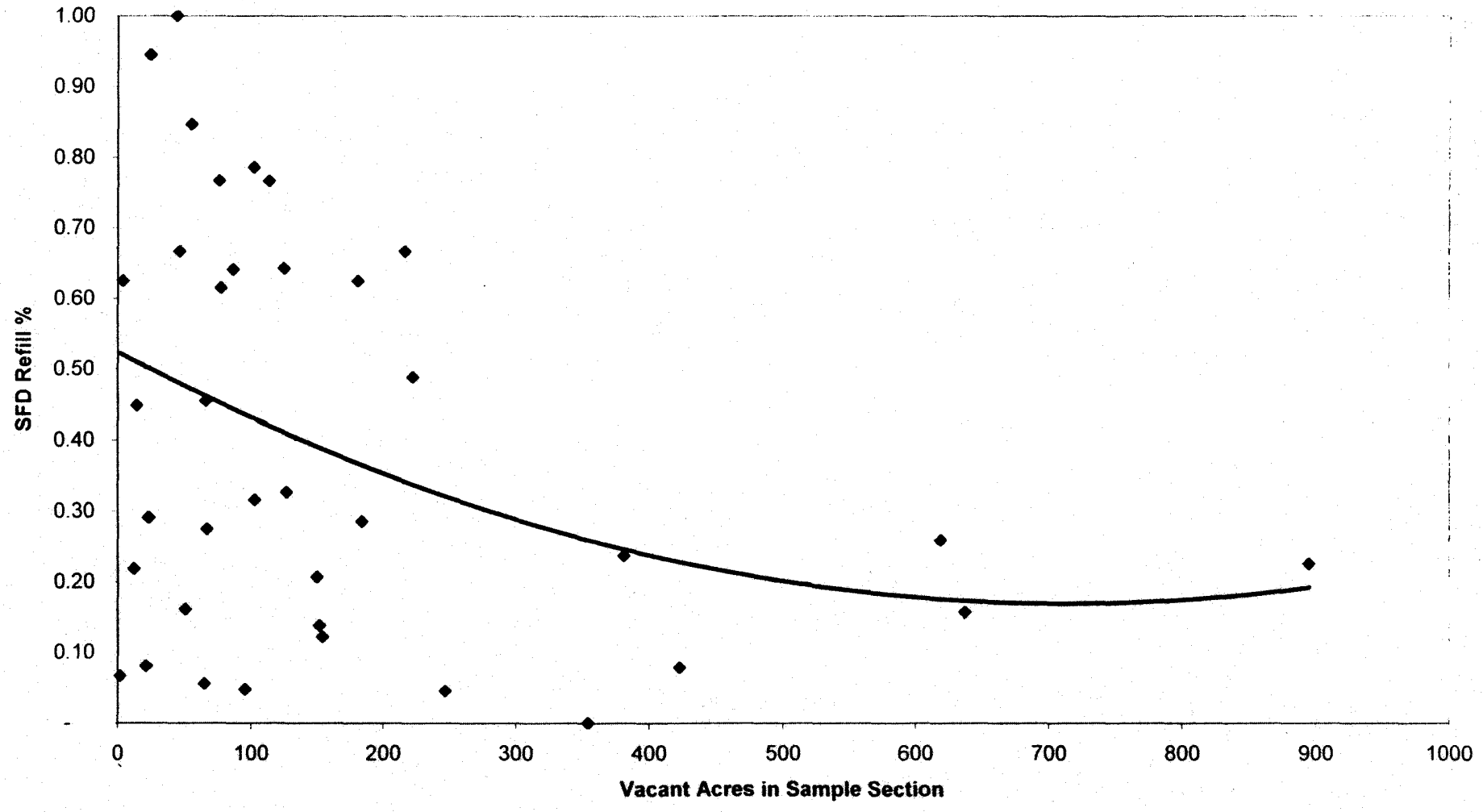


Chart Four: Decreasing Parcel Size of Vacant Land Makes Refill More Competitive

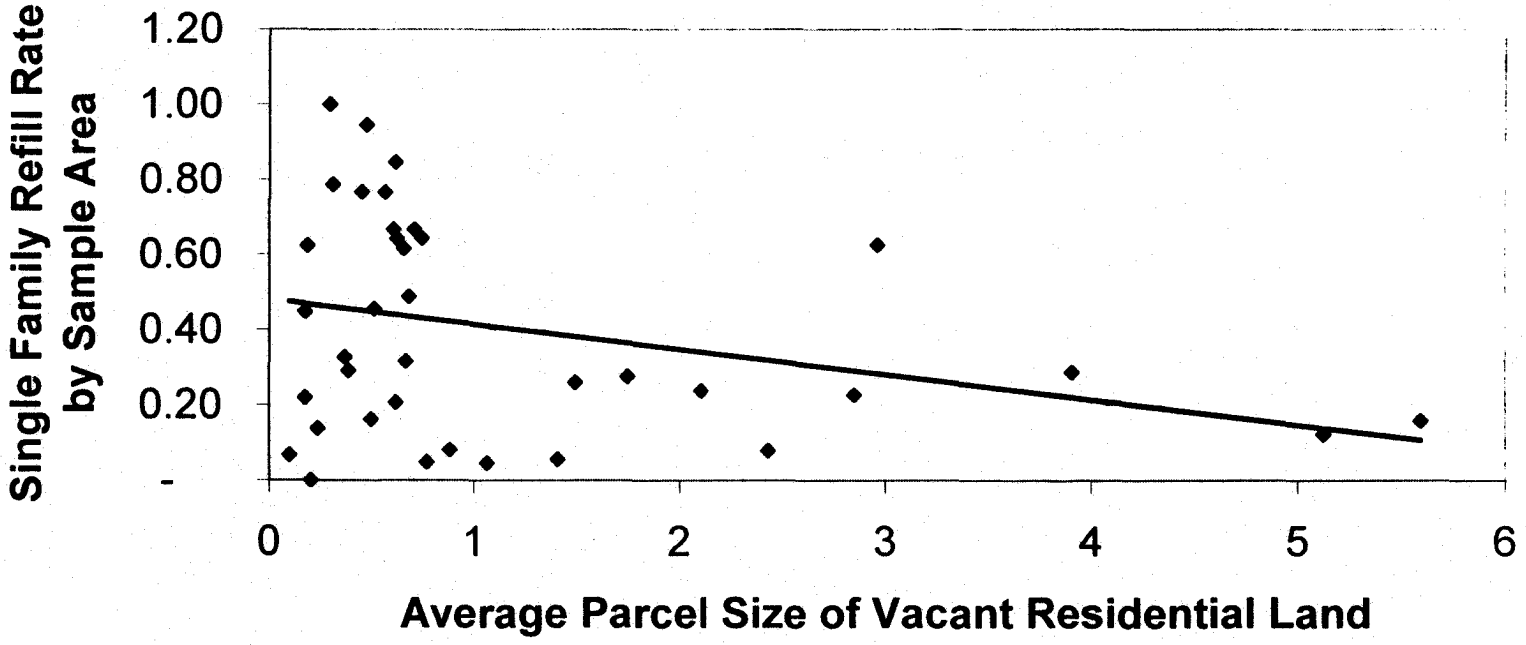
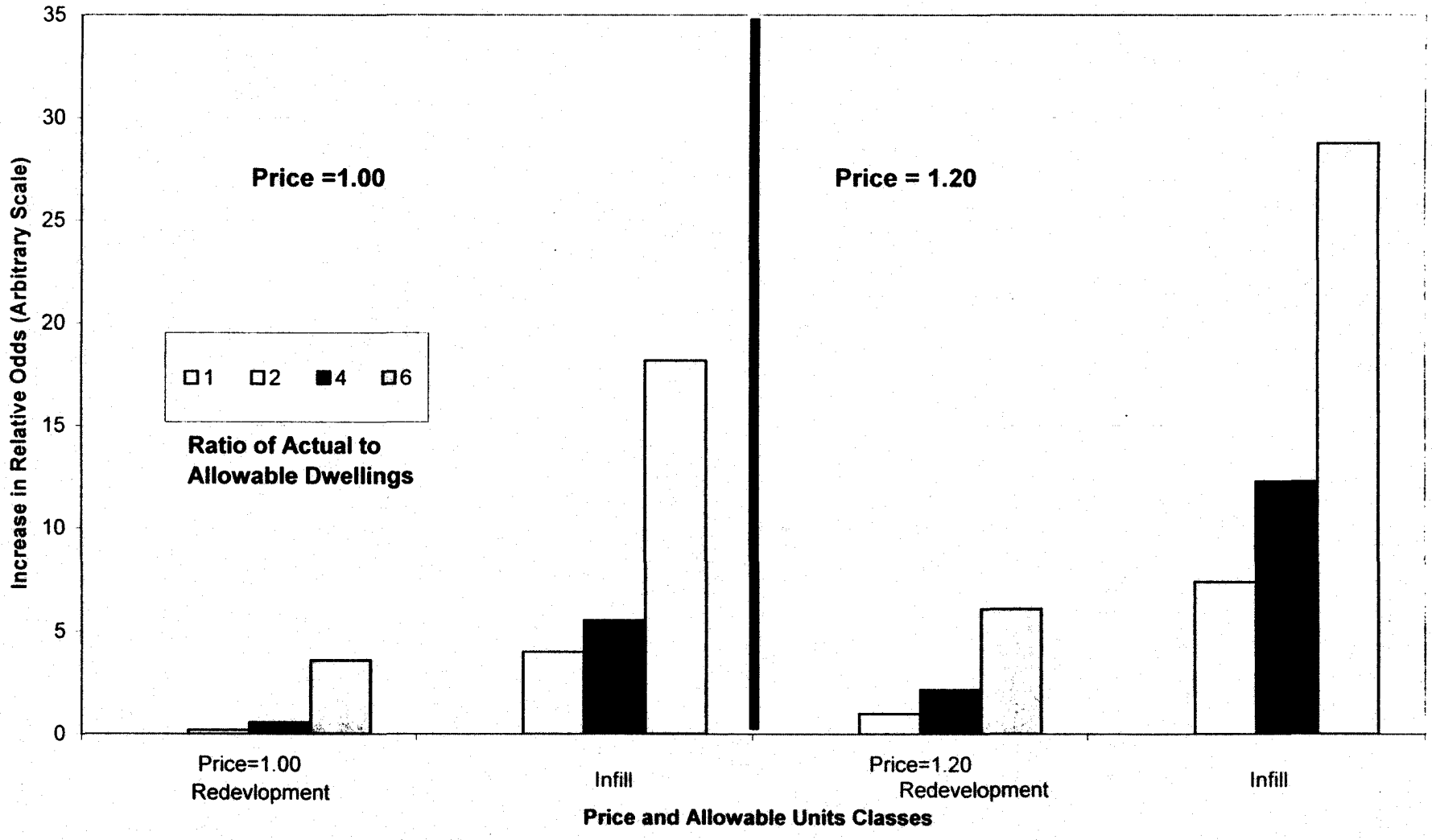


Chart Five: More Units and Increased Price Increase Chances of Refill



So What Have We Learned?

Findings:

Study results are summarized as follows:

1. The best point estimate of the actual refill rate is 25.4 percent for 1995-96 after weighting and adjusting the sample to match the total distribution of new residential building permits issued within the UGB during that time period. Significantly, this rate is observed when the Metro region is producing a share of housing output consistent with its 20-year target assumption (70 percent of regional share).
2. Areas or regions with high refill rates tend to have less total residential output. The Metro data, the Vancouver BC data, and inferentially the inter-regional data point to an inverse relationship between the residential refill rate and total dwelling unit output.
3. Available data indicate that policy incentives can change the residential refill rate. Allowing more buildable units on already developed land will increase the refill rate and not adversely affect total residential output. Limiting the supply of vacant land will also increase the refill rate. Similarly increasing residential real estate prices will increase the refill rate. However, under most conditions the latter two options will act to reduce total residential output.
4. With available information, the best example of residential refill is Vancouver BC which appears to have a refill rate in excess 40 percent and still maintains a high level of total housing output.
5. In the Metro study, 17 of 37 sample areas had refill rates in excess of 50 percent but contributed less than 19 percent of total housing output.
6. Looking at past history, which included a long period of low and negative growth, the Metro region appears to have had a very low or at times even a negative refill rate (demolitions and dilapidations exceed building).
7. Economic theory and available empirical academic research strongly support the role of prices and potential productivity in determining the refill rate.
8. Given the results of the study, the residential refill rate is expected to rise and fall in the future as the region goes through economic cycles of expansion and contraction. However, the overall residential refill rate trend should increase as 2040 Planning guidelines take effect.
9. While residential refill rates are expected to increase somewhat over time, uncertainty remains as to whether Metro's share of the economic region's overall growth will decline below the present "capture rate" assumption of 70 percent.
10. Though the 25.4 percent is a precise point estimate, staff conclude that over the next 2-5 years the refill rate could well vary between 20 percent and in excess of 30 percent.