Buildout Density Projections for the West Corvallis Growth Management Project

A Comprehensive Approach to the Collection, Creation, Confirmation, Compilation, and Analysis of Geographic Data

by

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ABSTRACT:

Benton County, Oregon has been experiencing relatively high growth and development during the last five years. This new growth has put a strain on urban and rural development in the county. To cope with this growth, comprehensive plans, zoning, and many other planning issues must be assessed and revised according to the needs of the community. In 1992, the West Corvallis Growth Management Project was established and intended to be the focus of new urban development in the county. The incorporation of a planning tool, such as buildout density projections, will permit better land use decisions to be made in the West Corvallis Project area. The buildout density projections demonstrate how low, medium, or high growth and development could affect the project area according to its current infrastructure limitations. As a planning tool, density projection information will be important information for determining how to re-delimit the zoning districts in the project area.

INTRODUCTION:

During the last two decades, Oregon's population has increased by nearly one million people. In that period, Benton County's population increased by twenty thousand and continues to grow and develop rapidly. Rapid growth and development makes it difficult for planning personnel to research and use planning tools which may provide a better means for determining how an area could potentially be developed. Therefore, an efficient and accurate method for addressing planning issues, such as buildout density projections, would be very helpful to planners. Buildout density projections are numerical representations of what the maximum potential development of a parcel is under current zoning ordinances; for example, if a parcel is 10 acres and is located in a RR-2.5 (rural residential, 2.5 acre lot minimum) zone, under full "buildout", a total of 4 houses could be constructed.

Buildout density projections would enable the planners to explore multiple density possibilities for a particular area according to specific criteria; for example, whether or not an area could handle low or high density developments according to its current infrastructure limitations (ie. roads, sewer & water, emergency services, etc.).

Planners using traditional planning and researching methods to determine what areas are potentially developable, have found traditional methods to be inefficient and the results possibly inaccurate. Inefficient and inaccurate results are two problems that planners cannot afford to use in the land use decision-making process. Consequently, if planning issues are researched with inefficient and inaccurate methods, poor land use decisions would be the result.

The purpose of this paper is to demonstrate how the application of a variety of traditional and new geographic research methods were used to efficiently produce reliable data which will be used to make land use decisions in the West Corvallis Growth Management Project. The West Corvallis Project area has the potential for high growth and development; so the utilization of accurate planning tools (the buildout density projections) will be an asset to the land use decision-making process.

The first phase of research involved compiling vacant land parcel data (ie. size, tax lot number, location, zoning, etc.) and buildout density projections to create a database in a standard spreadsheet format. The second phase was to incorporate the vacant land parcel database into a geographic information system to be used in displaying buildout density projections graphically. The buildout density projections will be an integral tool used by planners and the West Corvallis Growth Management and Open Space Planning Task Force to assess which parcels in the project area should be developed according to current infrastructure limitations. With the incorporation of this planning tool, better land use decisions can be made.

BACKGROUND:

In 1969, Oregon recognized that its population was growing, so it required all local governments (counties and cities) to adopt a comprehensive plan. The comprehensive plan was intended to protect the environment as well as control the costs of expanding public services, as well as the means by which local jurisdictions created zoning, urban growth boundaries, and development goals according to the particular needs of their community(Rohse, 1987, 3).

To enforce the adoption of the comprehensive plan and initiate new land use programs, Senate Bill 100 (more commonly referred to as ORS Chapter 197) was passed in 1973. ORS Chapter 197 created the Land Conservation and Development Commission (LCDC) and the administering agency, the Department of Land Conservation and Development (DLCD)(Rohse, 1987, 3). Since its inception, the LCDC has been instrumental in the supervision and implementation of land use programs throughout Oregon.

Although all local governments were required to create and adopt their own comprehensive plans, the response was slow. In reaction to the slow response, the LCDC formulated an outline composed of a series of planning issues by which the local governments had to follow and include in the creation of their comprehensive plans; this outline was in the form of nineteen statewide goals.

The goals not only functioned as a guideline for the creation of the comprehensive plans, but also cited important elements such as the need for citizen involvement, how to plan for the development of public facilities and services in both urban and rural areas, and the protection of the state's natural resources which were also to be addressed in the comprehensive plan (Rohse, 1987, 255-286) (**Appendix 1**).

During the last twenty-two years, Oregon's population has increased from 2,091,533 in 1970 to 2,979,331 in 1992 (Keisling, 1993, 301). More specifically, Benton County has increased in population by roughly 20,000 persons in the same twenty-two years (Keisling, 1993, 301).

Since the last population figures were published (for the 1992 year), Benton County has continued to grow and develop more quickly than current comprehensive plans can accommodate. This increase has made Benton County as one of the highest growing and developing areas in the state.

Recent increases in Oregon's population seem to be the result of circumstances such as a lack of population limits outlined in ORS Chapter 197 and the relocation of many Californians to states such as Oregon, Washington, Idaho, Utah, and Colorado because of economic, environmental, and social problems in California (ie. a sluggish economy, urban decay, and the presence of natural hazards such as earthquakes, drought, and wildfires).

Rapid population increases, in turn, have required planning staffs at the state, county, and city levels to re-evaluate their comprehensive plans and overall planning goals and strategies to accommodate the influx of several thousand new citizens per year. Not only has this provided a tremendous challenge to the planners, but it has also immensely increased their work loads. Daily activities such as permit approval and simple question inquiries supersede the time necessary to research and develop new and proactive programs that truly address the development demands an increasing population has forced upon Oregon's landscape.

Due to Oregon's strict land use regulations defined by LCDC's nineteen statewide goals and more specifically by local comprehensive plans, extending an urban growth boundary to allow for new development is not as simple as re-delimiting its lines. Every goal must be thoroughly reviewed to make sure development proposals comply with the concepts established in the nineteen LCDC goals; for example, Goal 5 resources such as aggregate and historic sites and the location of sensitive species are to be protected, thus they must be well researched, inventoried, and documented before any planning revisions can be done. Once each goal has been addressed, re-zoning of the new areas to be incorporated can take place.

In October of 1992, the three jurisdictions of Benton County, the City of Corvallis and the City of Philomath agreed to work together in addressing the development problems and planning issues occurring in the rural and urban fringes of Benton County. This new consortium agreed on delimiting an area of approximately 6,500 acres, to the west of Corvallis and north of Philomath, to act as the most potentially developable land in the county.

The *West Corvallis Growth Management and Open Space Planning Task Force* (the "Task Force") was organized to address the community livability as it affects economic development for the project area mentioned above. The Task Force is composed of twelve citizen members which are intended to represent the diversity of the community: four members were appointed by the Benton County Board of Commissioners, two members were appointed by Oregon State University, three members were appointed by the Corvallis City Council, one member was appointed by the Philomath City Council, and two members were appointed by the Greenbelt Land Trust (West Corvallis Growth Management and Open Space Planning Task Force By-Laws, Article 3, 1992).

The Benton County members were given the role of coordinating project activities, while the City of Corvallis, the City of Philomath, and Oregon State University were to be equal partners in the planning process, providing staff, services, and contributions to accomplish the project's objectives.

Figure 1 lists seven issues the Task Force was assigned to consider as it proceeded through the planning process for the West Corvallis Growth Management Project area.

1. Recommend appropriate land uses that consider the following:
    a. open space and recreational opportunities
    b. urbanization - particularly housing needs
    c. transportation
    d. OSU research program needs
    e. economic development opportunities
2. Develop strategies to encourage implementation of the project's land use plans
3. Create interagency management agreements
4. Identify public and private financing opportunities for acquisition and development of public facilities that includes:
    a. priorities for future public investment
    b. support for economic development strategies consistent with the West Corvallis Area Plan
5. Evaluate annexation procedures as a growth management tool
6. Develop a staged plan for future urban growth boundary management and modification
7. The Task Force's mandate is limited to planning and land use issues within the study area

Figure 1: West Corvallis Growth Management and Open Space Planning Task Force By-Laws, Article 2, Function (West Corvallis Growth Management and Open Space Planning Task Force By-Laws, Article 2, 1992).

Although the Task Force was given a neat list of planning and land use issues and objectives they must consider, making land use decisions for the project area has not been an easy assignment.

To help in visualizing the spatial extent of the West Corvallis Growth Management Project area, the Task Force contracted out to graduate students at the University of Oregon to construct a three dimensional relief model of the area. This has been relatively helpful in giving the Task Force a better idea of what the West Corvallis Project area looks like physically, but not culturally.

The Benton County Development Department has provided numerous digitally produced maps of the project area showing cultural features such as zoning, political boundaries, transportation routes, tax lot boundaries, and the locations of parks. These maps do provide valuable information and assist in evaluating community needs, but the Task Force still could not look at a map and accurately estimate where buildout would most likely occur according to infrastructure limitations.

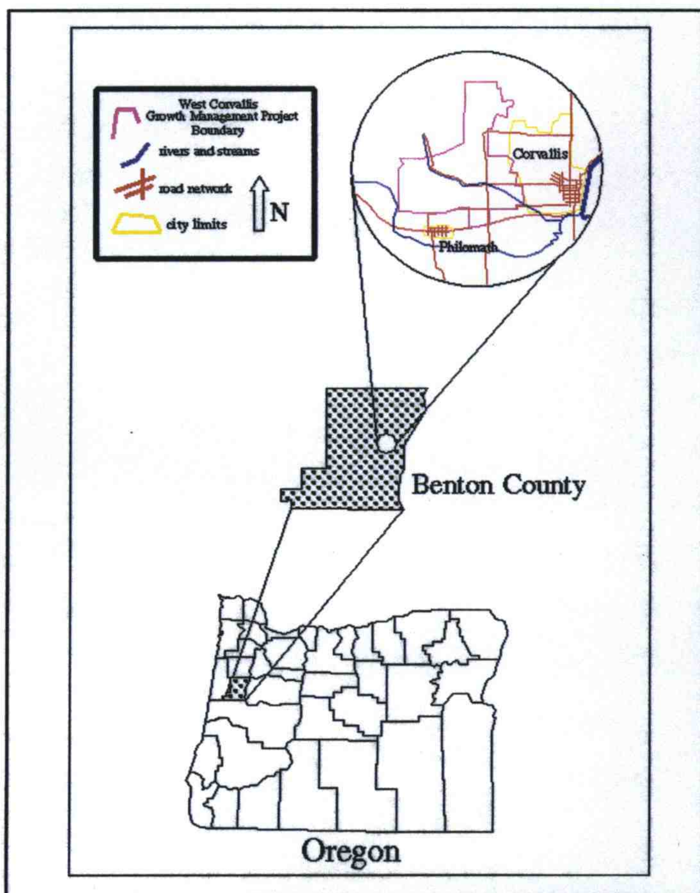
The only tool that can efficiently display multiple cultural (roads, zoning, educational facilities, etc.) and physical features (soil type, vegetation, elevation, hydrology, etc.) is a geographic information system (GIS). The GIS is not limited to displaying just graphical information, it has the capability of storing tabular data as attributes for each item. Each tax lot parcel, road, zoning district, and sewer & water tiling scheme can contain information such as property size and ownership, road composition, and tiling dimensions and implementation/repairs data.

Once all information has been entered into the GIS, scenarios and projections can be produced according to prescribed limitations; for example, all tax lot parcels greater than thirty acres in size and having a Benton County zoning designation of UR-5 or RR-5 (**Appendix 2**) could be displayed in a variety of colors and patterns.

By producing scenarios and projections, the planning staff could create multiple development possibilities that represent the community's needs and desires. New scenarios and projections could be produced practically instantaneously, so the inefficiency of researching development possibilities has been eliminated.

STUDY AREA:

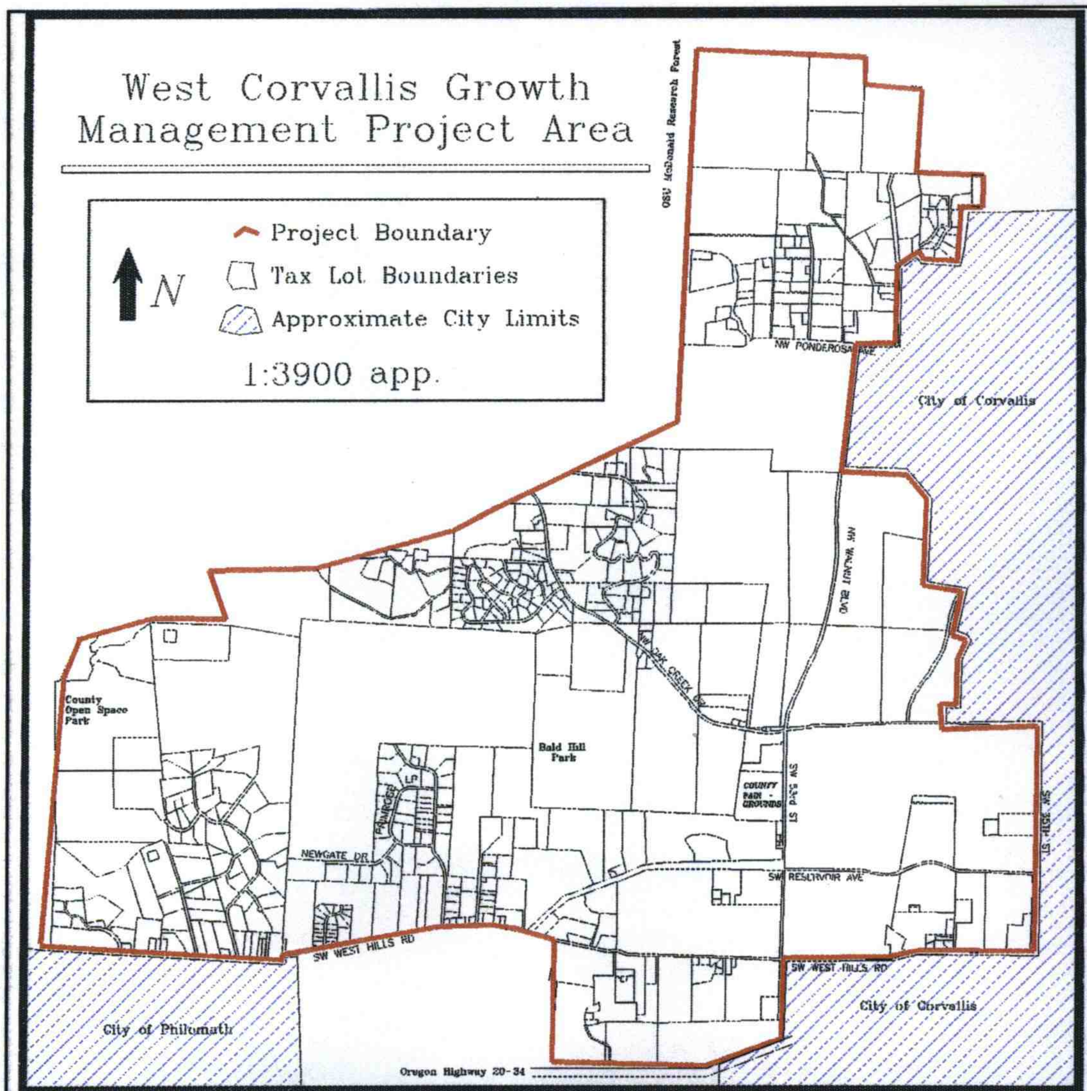
The West Corvallis Growth Management Project is located in east central Benton County (**Map 1**). It lies primarily to the west-northwest of the City of Corvallis and to the north-northeast of the City of Philomath. It is bounded on its northern-most extent by the McDonald Forest and on the southern-most extent by Oregon Highways 20-34 (**Map 2**).



Map 1: The West Corvallis Growth Management Project is located in east central Benton County, adjacent to the cities of Corvallis and Philomath.

The project area encompasses approximately 6,500 acres in Benton County. What makes the project area unique is that it overlaps three political jurisdictions, but because all three jurisdictions have equal representation on the Task Force, the needs of each community should be met. It includes private and public properties in Benton County, Philomath and Corvallis City Limits as well as within their urban growth boundaries.

The area was chosen because of its proximity to both Corvallis and Philomath in addition to the sewer & water infrastructure already in place.



Map 2: The West Corvallis Growth Management Project covers approximately 6,500 acres and overlaps three jurisdictions: Benton County, the City of Philomath, the City of Corvallis.

METHODS:

Conventional research methods such as locating data sources and data organization were important, but the implementation of geographic techniques including digital cartography, ground truthing, interpretation of remotely sensed data, and data manipulation and analysis in a geographic information system (GIS) were the means to developing a reliable database and buildout density projections in an efficient manner.

This research project used six steps overall, but was broken down into two phases. **Figure 2** demonstrates how each phase used a particular research method. Essentially, Phase 1 used compilation and confirmation methods, while Phase 2 primarily used a data creation method.

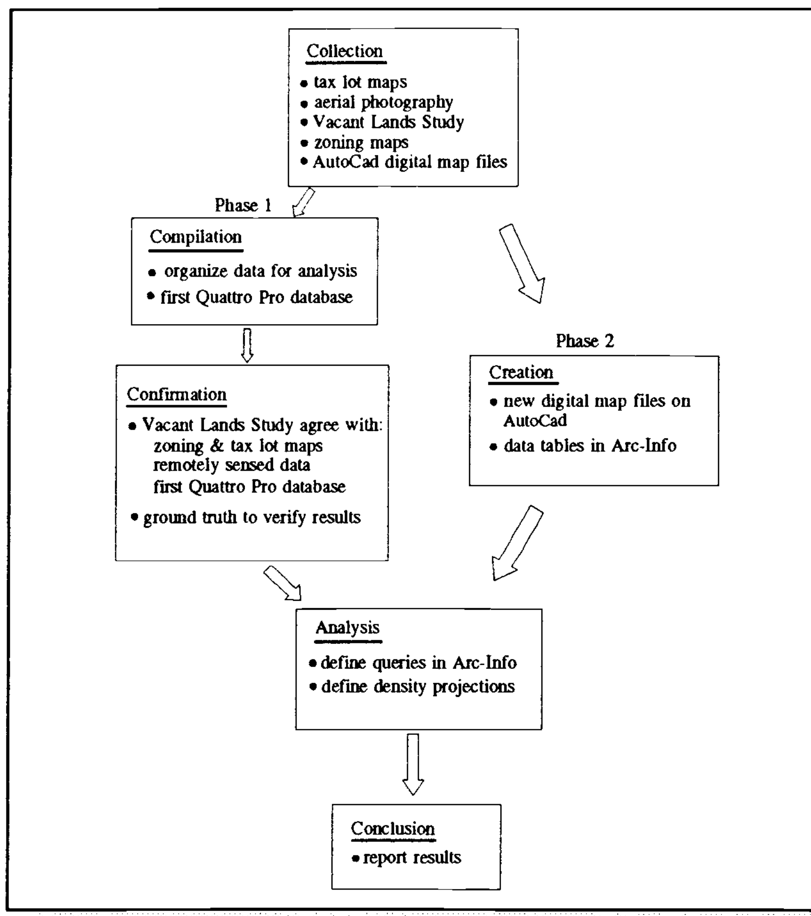


Figure 2: This flowchart of research techniques was used to create buildout density projects.

Collection

All the data necessary to create a database which would be followed by buildout density projections for the West Corvallis Growth Management Project were available from the Benton County Development Department. This collection included the following data.

First, both the database and buildout density projections were to be based on study by an Oregon State University undergraduate intern. The *Vacant Lands Study, West Corvallis-Benton County Area*, was completed by Jay Leroux in the fall term of 1992. Leroux's study was basically an inventory of vacant parcels in the West Corvallis Project area. He identified parcels in the project area, indicated whether or not a parcel had any existing structures (houses, agricultural, commercial, industrial or educational buildings), indicated a parcel's location by quarter section, and cited a serial number for the parcel, if present. The study did not include any analysis, so its usefulness as a planning tool was very limited.

The second major source of data, to be used in Phase 2, was digital map files of the project area. The digital map files were in .dxf, AutoCad Release 12 format. The map files included principal cultural features such as transportation routes, tax lot lines, political boundaries, and street names, but also included township and range based control points and address references.

Finally, copies of tax lot maps, color aerial photography, and zoning maps were collected from the Benton County Development Department for confirmation of the data found in the *Vacant Lands Study.*

Phase 1:

Compilation

Once the data was collected from the Benton County Development Department, the initial database was created on Quattro Pro, version 4.0. The *Vacant Lands Study* was the foundation for the first Quattro Pro database, but other information was added to provide a more comprehensive profile for each tax lot. Tax lot number, acreage, jurisdiction, and current zoning attributes were added for each parcel (**Table 1**). From this data, six buildout density projections were calculated according to these six density definitions:

1 house/acre
1 house/2 acres
low density = 2.5 houses/acre
high density = 12 units/acre
mixed residential - commercial = 13 units/acre
condo clustering = .5 units/acre, common wall, small lots with urban character

Figure 3: Density definitions.

Jurisdictio n	Quarter Section	Tax Lot #	Current Zoning	Acreage	Existing Structures	1 House/ Acre	1 House/ 2 Acres	Low Densit	High Densit	Mixed Res-Com	Condo Clustering
BC	11-05-16	200	FC-40/TR	39.18	V	39.18	19.59	15.67	470.16	509.34	19.59
BC	11-05-16	201	FC-40/TR	40	V	40	20	16	480	520	20
BC	11-05-16	300	FC-40/TR	60	V	60	30	24	720	780	30
BC	11-05-20	100	RR-2	80.06	V	80.06	40.13	32.02	960.72	1040.78	40.03
BC	11-05-20	108	FC-40/TR	66.3	V	66.3	33.15	26.52	795.6	861.9	33.15
BC	11-05-20	111	RR-2	8	V	8	4	3.2	96	104	4
C	11-05-20	1000	RR-5	5.01	V	5.01	2.51	2	60.12	65.13	2.51
C	11-05-21	100	UR-5	20.92	V	20.92	10.46	8.37	251.04	271.96	10.46
C	11-05-21	500	UR-5	5.23	V	5.23	2.62	2.09	62.76	67.99	2.62
BC	11-05-21	507	RR-2	8.72	V	8.72	4.36	3.49	104.64	113.36	4.36
C	11-05-21	512	UR-5	5	V	5	2.5	2	60	65	2.5
C	11-05-21	513	UR-5	8.15	V	8.15	4.075	3.226	97.8	105.95	4.08
C	11-05-21	1003	UR-5	14.87	V	14.87	7.44	5.95	178.44	193.31	7.44

Table 1: An excerpt from the first Quattro Pro database.

Confirmation

After the first database was created, it was necessary to confirm the integrity of the *Vacant Lands Study* data by checking it against alternative data sources. Ground truthing, interpretation of remotely sensed data (aerial photography), and comparison to parcel and zoning maps were the methods used to verify the integrity of the *Vacant Lands Study*.

Ground truthing by vehicle worked well in flat, open areas; but the more densely vegetated and developed areas were difficult to evaluate using this method. Without trespassing, it was difficult to verify whether or not any structures existed on a given piece of property. Furthermore, precisely determining the location of property boundaries made location verification difficult. Therefore, a more precise data source, color aerial photography, was necessary to use for more accurate interpretation.

Color aerial photography at an approximate scale of 1:10,000 was taken of the West Corvallis Project during the summer of 1993. It was the most helpful data source to accurately verify the location of existing structures. Because the photographs were taken during a summer month, the vegetation canopy made interpretation of property lines and any underlying structures somewhat difficult, but not impossible.

Both ground truthing and interpretation of the aerial photographs proved to be worthwhile efforts for checking the *Vacant Lands Study* data. Several properties had been misidentified and other parcel information indicated they had structures on them when they did not, or did not indicate they had structures on them when they actually did. Comparison of the *Vacant Lands Study* to updated tax lot maps indicated that there were further discrepancies between the Leroux inventory and the first database; however, these discrepancies were a function of new developments not present when Leroux made the inventory in 1992.

The quality check further revealed that the *Vacant Lands Study* included a number of parcels not located within the boundaries of the West Corvallis Growth Management Project. Consequently, the database was updated by deleting the unnecessary parcels, indicating new parcel subdivisions, and adding or subtracting structure information where appropriate.

The purpose of the *Vacant Lands Study* was not to just look at vacant parcels, but also large parcels that could potentially be subdivided even though they already possessed a structure. Given that there was no guarantee the large parcels containing existing structures would be subdivided, and assuming that the Task Force would be looking specifically at developable parcels entirely void of structures, it seemed illogical to include those parcels with existing structures in the database. Therefore, the database was further edited; all parcels with existing structures and the existing structure column was eliminated from the table. The first Quattro Pro database was reduced from over two hundred potential parcels to approximately sixty-five parcels, making up the second Quattro Pro database (**Table 2**, p. 14).

Phase 2:

Creation

Data creation was necessary during phase two. The digital AutoCad files appeared to be good digital maps until it was discovered that there were multiple map layers that were blocked together. Judging from their appearance after the blocks were exploded, digitizing of the map layers was not performed consecutively. Each map layer was fragmented, meaning parcel lines did not meet properly, and was incomplete in the sense that some roads and parcel lines were absent.

The solution to this problem required the reproduction of the digital map files into one homogenous layer. This was accomplished by freezing and locking the original layers on AutoCad and performing a tracing method over the original layers. Because the digital map file was being used for visual purposes, ie. graphically showing buildout densities, the tracing method was appropriate. If the digital map was being used for surveying purposes or for precise measurements, the tracing method would have been inappropriate. Planimetrically correct maps would need to be produced by digitizing or scanning methods.

Once all the appropriate data were reproduced, the new layers were frozen, locked, and turned off, while the original layers were unlocked, thawed and then deleted. The end product was a clean, new, homogenous map layer. Then the new digital map file was exported in a .dxf format so that it could later be imported into Arc-Info.

Analysis

Before any analysis could begin, both the AutoCad digital map file and the second Quattro Pro database had to be imported into Arc-Info.

The AutoCad map files were a simple importation into Arc-Info using the DXFARC command. As Arc-Info read in the .dxf formatted AutoCad file, it was translated into the Arc-Info format.

Once the translation had taken place, topology had to be established. Topology enabled the geographic information system to understand what was inside and outside each polygon, as well as identify the arcs which created the polygon in the first place. Next, CLEAN and BUILD POLY commands made sure all polygons were closed and that there were no extra, unwanted arcs.

After topology had been created, each polygon needed to be assigned an identification number using the ADD IDS command. This command simply looked at the map and placed an identification number in each of the polygons it locates. It is this unique identification number that ties each parcel to its appropriate attribute information (location, size, zoning, etc.) in the database.

Before the second Quattro Pro database could be imported, each vacant parcel was identified in Arc-Info and its identification number recorded. Then the identification number was added to the second Quattro Pro database.

Table 2 is what the database looked like before importation into the Arc-Info database module (INFO).

GIS ID	Juris.	Quarter Section	Tax Lot #	Current Zoning	Parcel Acreage	1 House/ Acre	1 House/ 2 Acres	Low Density	High Density	Mixed Res-Com	Condo Clustering
4	BC	11-05-16	200	FC-40/TR	39.18	39.18	19.59	15.67	470.16	509.34	19.59
2	BC	11-05-16	201	FC-40/TR	40.00	40.00	20.00	16.00	480.00	520.00	20.00
3	BC	11-05-16	300	FC-40/TR	60.00	60.00	30.00	24.00	720.00	780.00	30.00
1	BC	11-05-17	200	FC-40/TR	160	160.00	80.00	64.00	1920.00	2080.00	80.00
43	BC	11-05-20	100	RR-2	80.06	80.06	40.03	32.02	960.72	1040.78	40.03
7	BC	11-05-20	108	FC-40/TR	66.30	66.30	33.15	26.52	795.60	861.90	33.15
58	BC	11-05-20	111	RR-2	8.00	8.00	4.00	3.20	96.00	104.00	4.00

Table 2: An excerpt from the second Quattro Pro database.

In order to import the database into Arc-Info, it was saved as an ASCII comma delimited file (**Figure 4**). The only data not included in the ASCII comma delimited file were the column headings.

```
4,BC,11-05-16,200,FC-40/TR,39.18,39.18,19.59,15.67,470.16,509.34,19.59
2,BC,11-05-16,201,FC-40/TR,40.00,40.00,20.00,16.00,480.00,520.00,20.00
3,BC,11-05-16,300,FC-40/TR,60.00,60.00,30.00,24.00,720.00,780.00,30.00
1,BC,11-05-17,200,FC-40/TR,160,160.00,80.00,64.00,1920.00,2080.00,80.00
43,BC,11-05-20,100,RR-2,80.06,80.06,40.03,32.02,960.72,1040.78,40.03
7,BC,11-05-20,108,FC-40/TR,66.30,66.30,33.15,26.52,795.60,861.90,33.15
58,BC,11-05-20,111,RR-2,8.00,8.00,4.00,3.20,96.00,104.00,4.00
0,C,11-05-20,1000,RR-5,5.01,5.01,2.51,2.00,60.12,65.13,2.51
15,C,11-05-21,100,,UR-5,20.92,20.92,10.46,8.37,251.04,271.96,10.46
39,C,11-05-21,500,UR-5,5.23,5.23,2.62,2.09,62.76,67.99,2.62
13,BC,11-05-21,507,RR-2,8.72,8.72,4.36,3.49,104.64,113.36,4.36
29,C,11-05-21,512,UR-5,5.00,5.00,2.50,2.00,60.00,65.00,2.50
18,C,11-05-21,513,UR-5,8.15,8.15,4.08,3.26,97.80,105.95,4.08
```

Figure 4: An excerpt from the ASCII comma delimited file for the second Quattro Pro database.

To import the ASCII comma delimited file into Arc-Info, a Simple Macro Language (SML) device was written. The SML told Arc-Info how to read the information coming to it from the ASCII file. Furthermore, it told Arc-Info what labels belonged to what information.

Essentially, the SML looked at the first line in the ASCII file, put the information in the appropriate location, then looped back and looked at the information in the successive line. When no more lines of information existed the SML knew to stop. **(Figure 5)** The result was a clean translation of the vacant land and buildout density data into the Arc-Info, INFO module.

```
&args benton1
&data ARC INFO
ARC
&TYPE ENTERING INFO
SEL BENTON1.PAT
&s X = [open/scott/%benton1% STATUS -r]
$s TARREC = [read %X% READSTAT]
&do &while %READSTAT% ne 102
&s BENTON1-ID [EXTRACT 1 %TARREC%]
%s JURISDICTION = [EXTRACT 2 %TARREC%]
%s QUARTER-SECTION = [EXTRACT 3 %TARREC%]
%s TAX-LOT# = [EXTRACT 4 %TARREC%]
%s ZONING = [EXTRACT 5 %TARREC%]
%s ACREAGE = [EXTRACT 6 %TARREC%]
%s HOUSEACRE = [EXTRACT 7 %TARREC%]
%s HOUSEACRE2 = [EXTRACT 8 %TARREC%]
%s LOW-DENSITY = [EXTRACT 9 %TARREC%]
%s HIGH-DENSITY = [EXTRACT 10 %TARREC%]
%s MIXED-RES-COM = [EXTRACT 11 %TARREC%]
%s CONDO-CLUSTERING = [EXTRACT 12 %TARREC%]
%s RESELECT BENTON1-ID = %BENTON1-ID%
MOVEI [QUOTE %JURISDICTION%] TO JURISDICTION
MOVEI [QUOTE %QUARTER-SECTION%] TO QUARTER-SECTION
CALC TAX-LOT# = %TAX-LOT#%
MOVEI [QUOTE %ZONING%] TO ZONING
CALC ACREAGE = %ACREAGE%
CALC HOUSEACRE = %HOUSEACRE%
CALC HOUSEACRE2 = %HOUSEACRE2%
CALC LOW-DENSITY = %LOW-DENSITY%
CALC HIGH-DENSITY = %HIGH-DENSITY%
CALC MIXED-RES-COM = %MIXED-RES-COM%
CALC CONDO-CLUSTERING = %CONDO-CLUSTERING%
ASEL
&S TARREC = [READ %X% READSTAT]
&END
&S CLOSESTAT = [CLOSE %X%]
Q STOP
&END
```

Figure 5: The SML used to import the second Quattro Pro database into Arc-Info.

After the second Quattro Pro database information was imported into Arc-Info's database, INFO, one last information attribute was added before the analysis took place. Each parcel-polygon was identified as having one of three possible Sewer & Water Level classifications (**Figure 6**).

Level I:	below 287 feet mean sea level
Level II:	between 287 and 407 feet mean sea level
Level III:	above 407 feet mean sea level

Figure 6: Sewer & Water Level classifications.

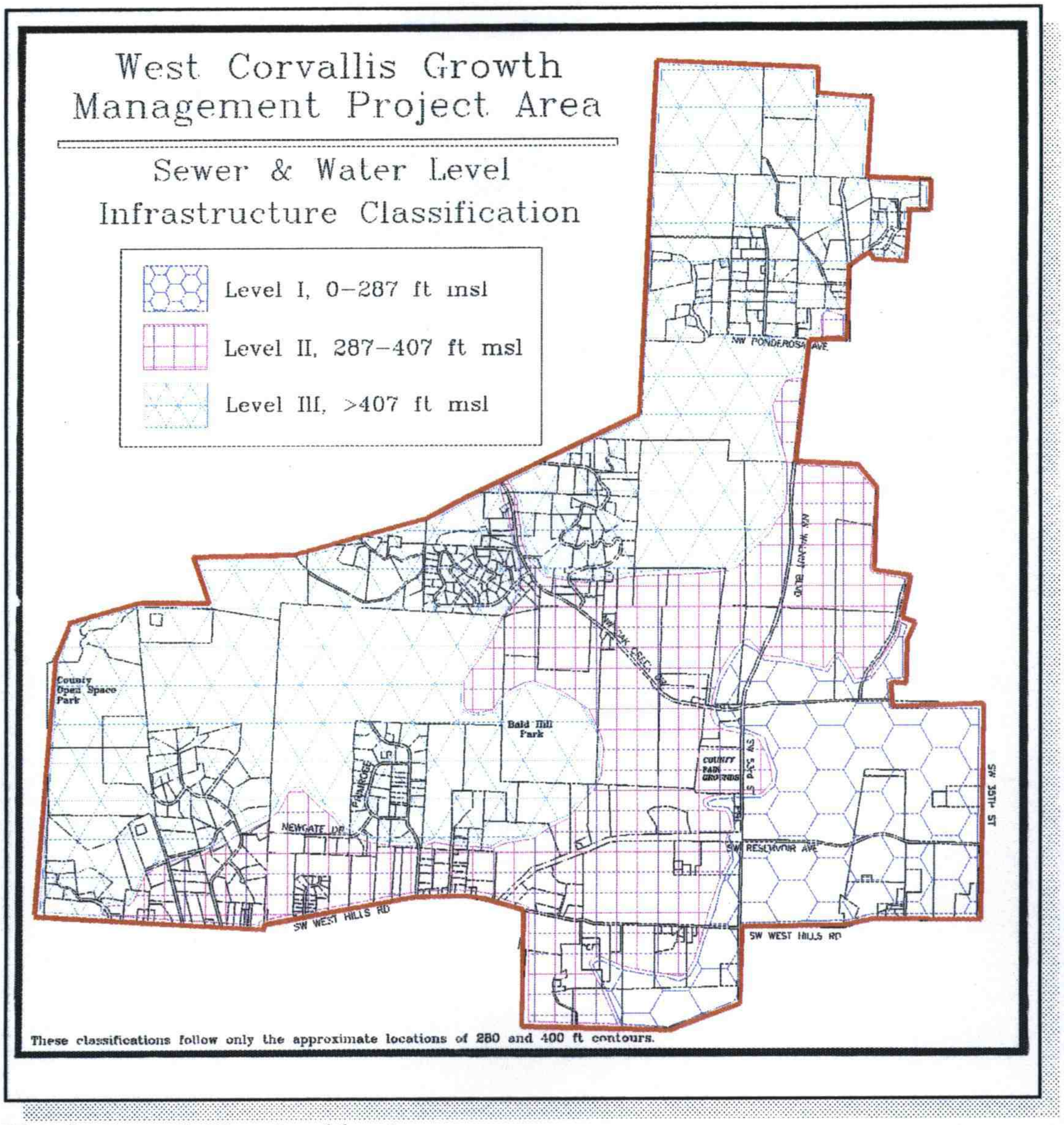
This information was important because the cities of Corvallis and Philomath only have facilities that can accommodate Levels I and II Sewer & Water; thus, elevation would be the limiting factor in determining which parcels could be considered the most developable and ultimately, how the West Corvallis Project area would be re-zoned.

Sewer & Water Level location approximations were determined using the 280 and 400 foot contours from a Corvallis-West, USGS topographic quadrangle. A parcel's Sewer & Water Level classification was determined by calculating what percentage of the parcel fell into a particular classification. A parcel with fifty percent in two different categories was assigned to the lower elevation classification (**Map 3**).

This information could have been included in the second Quattro Pro database, but was still easily entered as a new attribute in the INFO database. This process was slightly more time consuming than transferring the data by means of the SML, but was of no consequence given its small size.

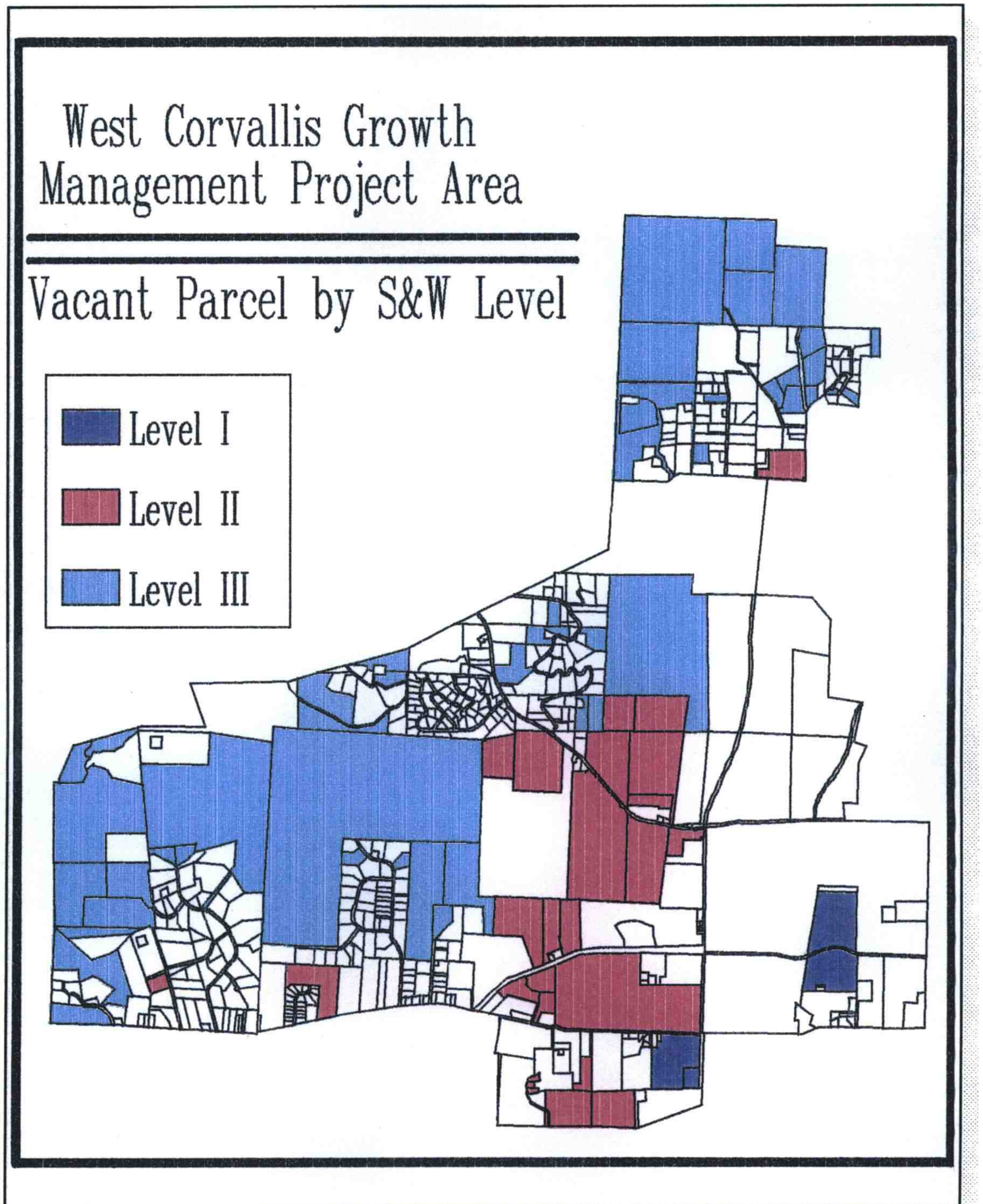
Analysis for the West Corvallis Growth Management Project was in the form of a graphic display tool. The tool, buildout density projections, would be used by the Task Force for land use decision-making during planning proceedings.

Buildout density projections were created by defining the limiting parameters. First, the spatial extent would be limited only by elevation. And second, development could only take place on parcels having Levels I and II Sewer & Water classifications.



Map 3: Sewer & Water Level locations.

To display those parcels eligible for development, a query was made to find all parcels having either Level I or II Sewer & Water classification. Subsequently, those parcels in Level I were shaded dark blue and parcels in Level II were shaded magenta to match their respective colors in **Map 3**. Then, a second query was made to show the Level III parcels as cyan which also matched its color in **Map 3**. **Map 4** was produced using another SML (**Appendix 5**) and shows the query outcomes.



Map 4: Vacant parcels potentially available for development in Sewer & Water Levels I and II.

The above queries were made to graphically show where development could take place according to the current sewer and water infrastructure, but tabular information could also be calculated according to the defined parameters.

As a planning tool, these graphical displays of buildout densities would be a primary data source used by the Task Force for re-delimiting the zoning districts. If necessary, vacant parcels showing Level I or II Sewer & Water classification could be re-zoned with a residential status.

RESULTS and CONCLUSIONS:

In the land use decision-making process, the Task Force will assume there will be three general development trends:

- high growth-high density = represented by an average annual growth of approximately 2%, with an average density of 12 units/acre
- medium growth-medium density = represented by an average annual growth of approximately .5%, with an average density of 5.5 units/acre
- low growth-low density = represented by clustered, single family homes, with an average density of 2.5 houses/acre

and assume that there will be an average of 3.5 inhabitants/house and an average of 2 inhabitants/apartment. Under these specifications, the buildout and population density results would be:

		Buildout Density			Population Density			
S&W Level	**Total Acres**	**Low (2.5/acre)**	**Med. (5.5/acre)**	**High (12/acre)**	**Low (3.5/house)**	**Med. (3.5/house)**	**Med. (2/apt)**	**High (2/apt)**
I	201.94	504.85	1110.67	2423.28	1766.975	3887.345	2221.34	4846.56
II	514.86	1287.15	2831.73	6178.32	4505.025	9911.055	5663.46	12356.64
III	1928.04	4820.1	10604.22	23136.48	16870.35	37114.77	21208.4	46272.96
I&II	716.8	1792	3942.4	8601.6	6272	13798.4	7884.8	17203.2

Table 3: Buildout and population densities for Sewer & Water Levels I and II. Buildout density = total number of units at maximum buildout. Population density = total number of inhabitants if maximum buildout occurs.

The following is an example: if Parcel A is 50 acres and has a Level II Sewer & Water classification, under the development trends specified above, the results for Parcel A would be:

- at a low buildout density, a total of 125 units could be built and the population density could be 437.5 inhabitants
- at a medium buildout density, a total of 275 units could be built and the population density could be either 962.5 or 550 inhabitants depending on the type of living unit
- at a high buildout density, a total of 600 units could be built and the population density could be 1200 inhabitants

★ *this example does not take zoning into account*

Although these results only indicate approximate buildout and population densities for the West Corvallis Project area according to infrastructure limitations, the numbers will be of great assistance to the Task Force in determining how zoning should be re-delimited. By adding graphical and tabular data in their land use decision-making process, the Task Force should make better land use decisions which reflect the community's needs.

The Task Force established the project area's development potential as a function of the current infrastructure; but by using a combination of the graphical and tabular data, they can speculate how development will occur when the cities of Corvallis and Philomath upgrade their Sewer & Water Level infrastructures to Level III capacity.

Therefore, the buildout density projections not only assist in determining current development potential, but can also be used to speculate what and where future development will take place.

DISCUSSION:

This research project created a starting point from which an important planning tool can be actively used by the Benton County Development Department. Now that an initial database in Arc-Info has been created, adding the same information for developed parcels within the West Corvallis Growth Management Project and outside the project boundaries can be completed relatively easily.

Adding new parcel data will be relatively easy because a format has already been established. By using the procedure outlined in this paper, the input of new data will not require a great deal of time, but will require someone who knows and understands the techniques and how to apply them to the subject data.

Benton County could give each parcel a more comprehensive profile by including additional information such as contour lines, soils types, vegetation, address, ownership and hydrological data. The possibilities are practically limitless.

Although the original AutoCad digital map file was intended for being used in the creation of thematic maps in Arc-Info, these maps could be corrected and used for making precise measurements through the incorporation of a global positioning system (GPS) program. The GPS program would be used initially to rectify the parcel maps; rectification would make the maps planimetrically correct. Furthermore, the continual use of a GPS program in conjunction with the county's GIS program would make adding, editing, and updating digital map files and attribute data a more consistent, efficient, and accurate system.

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APPENDICES:

Appendix 1

Oregon's Statewide Planning Goals

Goal 1: Citizen Involvement
Goal: To develop a citizen involvement program that insures the opportunity for citizens to be involved in all phases of the planning project

Goal 2: Land Use Planning
Goal: Part I-Planning.
To establish a land use planning process and policy framework as a basis for all decisions and actions related to use of land and to assure an adequate factual base for such decisions and actions.
Part II-Exceptions

Goal 3: Agricultural Lands
Goal: To preserve and maintain agricultural lands.

Goal 4: Forest Lands
Goal: To conserve forest lands for forest uses.

Goal 5: Open Spaces, Scenic and Historic Areas, and Natural Resources
Goal: To conserve open space and protect natural and scenic resources

Goal 6: Air, Water, and Land Resources Quality
Goal: To maintain and improve the quality of the air, water and land resources of the state.

Goal 7: Areas Subject to Natural Disasters and Hazards
Goal: To protect life and property from natural disasters and hazards.

Goal 8: Recreational Needs
Goal: To satisfy the recreational needs of the citizens of the state and visitors and, where appropriate, to provide for the siting of necessary recreational facilities including destination resorts.

Goal 9: Economy of the State
Goal: To diversify and improve the economy of the state.

Goal 10: Housing
Goal: To provide the housing needs of citizens of the state.

Goal 11: Public Facilities and Services
Goal: To plan and develop a timely, orderly and efficient arrangement of public facilities and services to serve as a framework for urban and rural development.

Goal 12: Transportation
Goal: To provide and encourage a safe, convenient and economic transportation system.

Goal 13: Energy Conservation
Goal: To conserve energy.

Goal 14: Urbanization
Goal: To provide for an orderly and efficient transition from rural to urban land use.

Goal 15: Willamette River Greenway
Goal: To protect, conserve, enhance and maintain the natural, scenic, historical, agricultural, economic and recreational qualities of lands along the Willamette River as the Willamette River Greenway.

Goal 16: Estuarine Resources
Goal: To recognize and protect the unique environmental, economic, and social values of each estuary and associated wetlands; and
To protect, maintain, where appropriate develop, and where appropriate restore the long-term environmental, economic, and social values, diversity and benefits of Oregon's estuaries.

Goal 17: Coastal Shorelands
Goal: To conserve, protect, where appropriate, develop and where appropriate restore the resources and benefits of all coastal shorelands, recognizing their value for protection and maintenance of water quality, fish and wildlife habitat, water-dependent uses, economic resources and recreation and aesthetics. The management of these shoreland areas shall be compatible with the characteristics of the adjacent coastal waters; and
To reduce the hazard to human life and property, and the adverse effects upon water quality and fish and wildlife habitat, resulting from the use and enjoyment of Oregon's coastal shorelands.

Goal 18: Beaches and Dunes

Goal: Too conserve, protect, where appropriate develop, and where appropriate restore the resources and benefits of coastal beach and dune areas; and
To reduce the hazard to human life and property from natural or man-induced actions associated with these areas.

Goal 19: Ocean Resources

Goal: To conserve the long-term values, benefits, and natural resources of the nearshore ocean and the continental shelf.
All local, state, and federal plans, policies, projects and activities which affect the territorial sea shall be developed, managed and conducted to maintain, and where appropriate, enhance and restore, the long-term benefits derived form the near shore oceanic resources of Oregon. Since renewable ocean resources and uses, such as food production, water quality, navigation, recreation, and aesthetic enjoyment, will provide greater long-term benefits than will nonrenewable resources, such plans and activities shall give clear priority to the proper management and protection of renewable resources.

Appendix 2

Summary of Zoning Districts

City of Philomath Zoning Districts:

R-1	low density residential
R-2	medium density residential
R-3	high density residential
C-1	neighborhood commercial
C-2	general commercial
PC	planned commercial
O	office
LI	light industrial
HI	heavy industrial
IP	industrial park

Overlay Zones-

/PUD	planned unit development
SPD	special planned development
/MH	mobile home
P	public

City of Corvallis Development Districts:

RS-3.5	low density family residential dwellings
RS-5	medium low density family res. dwellings
RS-9	medium density residential dwellings
RS-12	family and group residential dwellings
RS-20	high density group residential dwellings
RD-6	single family housing types in newly developing low density areas
P-AO	professional and Administrative Office Dist.
SA	shopping area
SA(U)	shopping area - university
CS	community shopping
LC	linear shopping
CB	central business district
LI	limited industrial
GI	general industrial
II	intensive industrial
AG-OS	agriculture - open space

Special Districts-

WRG	Willamette River Greenway
CBF	central business fringe
OSU	Oregon State University
HPO	historic preservation overlay
RTC	research technology center
RSC	regional shopping center
SSD	special shopping district

Benton County Zoning Designations:

Resource Zones-

EFU	exclusive farm use
FC	forest conservation
OS	open space

Non-Resource Zones-

RR-2	rural residential 2 acre min.
RR-5	rural residential 5 acre min.
UR-5	urban residential with a 5 acre min. lot size suitable for future urban density residential development
P	public

Overlay Zones-

/MH	manufacture homes
/FL	flexible industrial

Appendix 3

Sewer & Water Level Classifications

Level I: below 287 feet mean sea level

Level II: between 287 and 407 feet mean sea level

Level III: above 407 feet mean sea level

Appendix 4

Third Quattro Pro Database

GIS ID	Juris.	Quarter Section	Tax Lot #	Current Zoning	Parcel Acreage	1 House/ Acre	1 House/ 2 Acres	Low Density	High Density	Mixed Res-Com	Condo Clustering
4	BC	11-05-16	200	FC-40/TR	39.18	39.18	19.59	15.67	470.16	509.34	19.59
2	BC	11-05-16	201	FC-40/TR	40.00	40.00	20.00	16.00	480.00	520.00	20.00
3	BC	11-05-16	300	FC-40/TR	60.00	60.00	30.00	24.00	720.00	780.00	30.00
1	BC	11-05-17	200	FC-40/TR	160	160.00	80.00	64.00	1920.00	2080.00	80.00
43	BC	11-05-20	100	RR-2	80.06	80.06	40.03	32.02	960.72	1040.78	40.03
7	BC	11-05-20	108	FC-40/TR	66.30	66.30	33.15	26.52	795.60	861.90	33.15
58	BC	11-05-20	111	RR-2	8.00	8.00	4.00	3.20	96.00	104.00	4.00
	C	11-05-20	1000	RR-5	5.01	5.01	2.51	2.00	60.12	65.13	2.51
15	C	11-05-21	100	UR-5	20.92	20.92	10.46	8.37	251.04	271.96	10.46
39	C	11-05-21	500	UR-5	5.23	5.23	2.62	2.09	62.76	67.99	2.62
13	BC	11-05-21	507	RR-2	8.72	8.72	4.36	3.49	104.64	113.36	4.36
29	C	11-05-21	512	UR-5	5.00	5.00	2.50	2.00	60.00	65.00	2.50
18	C	11-05-21	513	UR-5	8.15	8.15	4.08	3.26	97.80	105.95	4.08
91	C	11-05-21	1003	UR-5	14.87	14.87	7.44	5.95	178.44	193.31	7.44
83	C	11-05-21CB	800	UR-5	5.79	5.79	2.90	2.32	69.48	75.27	2.90
105	C	11-05-29	290	P	194.60	194.60	97.30	77.84	2335.20	2529.80	97.30
210	C	11-05-29	300	UR-5	17.41	17.41	8.71	6.96	208.92	226.33	8.71
211	C	11-05-29	400	UR-5	29.62	29.62	14.81	11.85	355.44	385.06	14.81
114	BC	11-05-29BD	300	RR-2	5.01	5.01	2.51	2.00	60.12	65.13	2.51
125	BC	11-05-29C	100	RR-2	7.48	7.48	3.74	2.99	89.76	97.24	3.74
135	BC	11-05-29C	312	RR-2	13.50	13.50	6.75	5.40	162.00	175.50	6.75
206	BC	11-05-29C	600	UR-5	5.80	5.80	2.90	2.32	69.60	75.40	2.90
207	BC	11-05-29C	700	UR-5	8.80	8.80	4.40	3.52	105.60	114.40	4.40
	C	11-05-29CA	200	RR-2	7.19	7.19	3.60	2.88	86.28	93.47	3.60
140	C	11-05-30C	600	RR-5	20.40	20.40	10.20	8.16	244.80	265.20	10.20
161	BC	11-05-30C	1200	RR-5	6.11	6.11	3.06	2.44	73.32	79.43	3.06
165	BC	11-05-30C	1900	RR-5	25.65	25.65	12.83	10.26	307.80	333.45	12.83
216	BC	11-05-30C	2000	RR-5	19.44	19.44	9.72	7.78	233.28	252.72	9.72
259	BC	11-05-31	200	EFU/T	482.73	482.73	241.37	193.09	5792.76	6275.49	241.37
303	BC	11-05-31	300	RR-2	54.36	54.36	27.18	21.74	652.32	706.68	27.18
304	BC	11-05-31	400	OS	39.60	39.60	19.80	15.84	475.20	514.80	19.80
355	BC	11-05-31	502	RR-5,PUD	8.67	8.67	4.34	3.47	104.04	112.71	4.34
284	BC	11-05-32	100	UR-10	99.97	99.97	49.99	39.99	1199.64	1299.61	49.99
263	BC	11-05-32	200	UR-5	43.79	43.79	21.90	17.52	525.48	569.27	21.90
273	C	11-05-32	300	UR-5	20.69	20.69	10.35	8.28	248.28	268.97	10.35
344	C	11-05-32	500	UR-5	30.25	30.25	15.13	12.10	363.00	393.25	15.13
347	C	11-05-32	600	I	13.26	13.26	6.63	5.30	159.12	172.38	6.63
348	C	11-05-32	700	I	17.17	17.17	8.59	6.87	206.04	223.21	8.59
266	C	11-05-32A	200	UR-5	37.15	37.15	18.58	14.86	445.80	482.95	18.58
269	C	11-05-32A	201	UR-5	44.04	44.04	22.02	17.62	528.48	572.52	22.02
285	C	11-05-32A	700	UR-5	7.05	7.05	3.53	2.82	84.60	91.65	3.53
295	C	11-05-32D	100	UR-10	9.05	9.05	4.53	3.62	108.60	117.65	4.53
283	C	11-05-32D	400	UR-10	47.38	47.38	23.69	18.95	568.56	615.94	23.69
339	C	11-05-33	600	P	37.84	37.84	18.92	15.14	454.08	491.92	18.92
283	C	11-06-36	201	FC-40	84.70	84.70	42.35	33.88	1016.40	1101.10	42.35
278	C	11-06-36	202	FC-40	41.30	41.30	20.65	16.52	495.60	536.90	20.65
258	C	11-06-36	203	FC-40	40.30	40.30	20.15	16.12	483.60	523.90	20.15
308	BC	11-06-36	300	FC-40	40.00	40.00	20.00	16.00	480.00	520.00	20.00
316	BC	11-06-36	302	FC-40	24.20	24.20	12.10	9.68	290.40	314.60	12.10
	BC	11-06-36	307	FC-40	40.00	40.00	20.00	16.00	480.00	520.00	20.00
	BC	11-06-36	500	FC-40	197.00	197.00	98.50	78.80	2364.00	2561.00	98.50
407	C	12-05-04	300	UR-5	29.8	29.80	14.90	11.92	357.60	387.40	14.90
412	C	12-05-05	100	PD(RD-6)	101.70	101.70	50.85	40.68	1220.40	1322.10	50.85
655	C	12-05-05	403	UR-5	7.32	7.32	3.66	2.93	87.84	95.16	3.66
478	C	12-05-05B	100	UR-5	5.75	5.75	2.88	2.30	69.00	74.75	2.88
449	C	12-05-05B	101	UR-5	10.31	10.31	5.16	4.12	123.72	134.03	5.16
434	C	12-05-05B	102	UR-5	9.84	9.84	4.92	3.94	118.08	127.92	4.92
553	C	12-05-05DA	100	UR-10	32.60	32.60	16.30	13.04	391.20	423.80	16.30
556	C	12-05-05DC	101	UR-10	20.53	20.53	10.27	8.21	246.36	266.89	10.27
433	P	12-05-06	200	UR-5	24.16	24.16	12.08	9.66	289.92	314.08	12.08
656	BC	12-06-01	428	RR-5	8.84	8.84	4.42	3.54	106.08	114.92	4.42
380	BC	12-06-01	432	RR-5	40.00	40.00	20.00	16.00	480.00	520.00	20.00
440	BC	12-06-01A	434	RR-5/MHT	5.25	5.25	2.63	2.10	63.00	68.25	2.63
501	BC	12-06-01B	600	RR-5/MH	16.86	16.86	8.43	6.74	202.32	219.18	8.43

Appendix 5

Map 4 SML

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shadesymbol 2
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box .5 6.0 1 5.7
box .5 5.3 1 5.0
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move 1.1 5.7
text 'Level II'
move 1.1 5
text 'Level III'
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