Appendix E - ENERGY TECHNICAL REPORT

Date: April 11, 2011

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Subject: Technical Memorandum on Projected Energy Requirements of Yesler Terrace Redevelopment

This Technical Memorandum summarizes our analysis of the energy use impacts of the Yesler Terrace Redevelopment in support of the project's Final Environmental Impact Statement. Impacts have been estimated for both the Preferred Alternative and several other alternative development scenarios that would involve either more or less new residential and commercial space than the Preferred Alternative. In addition to the energy use impact estimates, this Technical Memorandum provides a brief synopsis of the methodology used to derive the estimates and identifies several potential mitigation measures that could lessen the reported impacts.

Background

Electricity provided by Seattle City Light is the primary source of energy for the buildings in the Yesler Terrace area. Puget Sound Energy also supplies natural gas to the area for some building uses. There are no significant energy supply, transmission, or distribution capacity issues in the area, although it is anticipated that the full development of the site will involve installation or relocation of many distribution facilities, including potential distribution system undergrounding. Thus, the primary impact of Yesler Terrace redevelopment will be increased levels of energy use and the environmental consequences of that increased use.

Development to the levels allowed by existing zoning in the area would require aggregate annual energy use equivalent to approximately 0.9 average megawatts, with peak demand of approximately 5 MW. This level of use is expected to rise by varying degrees depending on the amount and mix of building space constructed during the Yesler Terrace redevelopment.

The SHA team has defined a Preferred Alternative as well as five alternative development scenarios, ranging from "Existing Zoning" at the low end to "Higher Density" at the high end. The Preferred Alternative for Yesler Terrace redevelopment would include significant additions to the number of residential units, total residential space, commercial office space, and other neighborhood commercial space in the 38 acre project area. The amounts of each type of space and their spatial distribution within the redevelopment area differ among the alternative planning scenarios.

Table 1 below shows the estimated square footage of redeveloped space by major building type for each of these planning scenarios.

Table 1
Yesler Terrace Redevelopment:
Projected Building Space by Building Type at Full Build-Out,
Preferred and Other Alternatives (Sq Ft)

Development Type	Preferred Alternative	Alt 1 Lower Density	Alt 1A Lower Density, Less Office	Alt 2 Medium Density	Alt 3 Higher Density	Alt 4 Existing Zoning
Residential	4,415,174	2,757,903	2,757,854	3,634,210	4,496,700	1,415,680
Commercial						
Office	899,688	800,103	401,000	1,001,126	1,201,660	20,259
Neighborhood Retail	88,247	40,000	40,000	60,000	88,000	10,000
Neighborhood Service	64,590	49,971	49,971	49,971	49,971	49,938
Total Developed Area						
Sq Ft, All Types	**5,467,699**	**3,647,977**	**3,248,825**	**4,745,307**	**5,836,331**	**1,495,877**

Source: CollinsWoerman, 2011

As shown in **Table 1**, the Preferred Alternative would result in about three and one-half times as much total redeveloped space as development under "Existing Zoning" (Alternative 4). All other alternative redevelopment scenarios would produce between two and four times as much new space as could be constructed under existing zoning.

Methodology

The energy use impact estimates were derived through a four-step procedure:

1. First, energy use requirements were defined for the major types of residential and commercial "end uses." Using modeling to simulate the Washington State energy code standards, this resulted in estimates of the requirements for space heating, space cooling, water heating, plug loads and lighting.
2. Next, energy use profiles were defined for various building space types anticipated for the Yesler Terrace redevelopment. These are multi-family residential, commercial office, and neighborhood service and retail space. Using these multipliers, energy requirements per square foot (SF) were calculated for residential and commercial space, based on their respective projected distributions of end use.
3. Then these per-SF energy use parameters for various building space types were combined with the development assumptions summarized in **Table 1**, to produce overall electrical energy requirements for the Yesler Terrace Preferred Alternative and each alternative development scenario.
4. Finally, the energy impacts were calculated based on phased timing of redevelopment.

Key Assumptions

The projected energy use impact estimates presented below depend on a two key assumptions. These assumptions involve:

- the retail energy supply source assumed, and
- levels of energy use per square foot for various building energy use requirements.

Retail Energy Source Assumption. This analysis assumes the construction of all-electric building energy systems. Current energy use within the project area is primarily electricity, but includes a mix of electric and natural gas service. Defining the energy use projections in terms of electricity alone simplifies head-to-head comparisons among scenarios, while preserving the overall magnitude of energy requirements.

It should be noted that SHA has studied the possibility of pursuing a Yesler Terrace district heat system or district energy system in the future. Either of these alternative systems would reduce the level of electricity use, but would require a commensurate increase in the energy content supplied by another source or sources (see Mitigation comments below).

Changes in Energy Use Per SF Over Time. A more critical assumption concerns the changing level of energy use over time assumed for the end-use building blocks of the analysis. This analysis assumes that there will be phased redevelopment of Yesler Terrace, with each phase conforming to Energy Code requirements that become increasingly stringent over time. Specifically, it is assumed that in response to the Architecture 2030 Challenge, the energy use per square foot will fall by 13 percent to 14 percent every five years for both residential and commercial space. (These improvements in energy efficiency are generally consistent with Washington RCW 19.27A.160, which establishes a goal for the State Building Codes Council to improve the state energy code by 10 percent every three-year code cycle through 2031.)

These declining levels of energy use over time are then combined with an assumed phasing plan that assumes redevelopment will be done by geographic sub-area and spread over approximately twenty years:

The result of these phasing assumptions and the declining levels of Energy Code-mandated use associated with each successive phase is a composite level of projected energy use for each Yesler Terrace development scenario about 25 percent lower than would be required if all redevelopment were built to satisfy the current Energy Code.

Energy Use Impacts

Table 2 reports the estimated energy use of the fully developed Yesler Terrace for the Preferred Alternative and five alternative development scenarios defined in Table 1. The estimates reflect the assumption of twenty-year phased development for each scenario, along with the expected decline in Code-compliant building use for buildings developed further in the future.

Table 2
Yesler Terrace Redevelopment:
Projected Electricity Consumption at Full Build-Out,
Preferred and Other Alternatives (MWh/year) [1]

Development Type	Preferred Alternative	Alt 1 Lower Density	Alt 1A Lower Density, Less Office	Alt 2 Medium Density	Alt 3 Higher Density	Alt 4 Existing Zoning
Residential	21,955	13,658	13,658	17,632	21,967	7,121
Commercial						
Office	8,622	7,694	3,844	9,639	9,862	191
Neighborhood Retail	867	397	396	549	737	102
Neighborhood Service	584	445	445	422	277	449
Total Energy Use						
MWH/year	**32,028**	**22,195**	**18,343**	**28,243**	**32,844**	**7,863**
Average MW	**3.66**	**2.53**	**2.09**	**3.22**	**3.75**	**0.90**

Source: Gibson Economics, 2011

[1] Attachment A contains disaggregated electricity consumption estimates at full build-out for the East of Boren/East of Twelfth sector and the remainder of the development.

To interpret the scale of these total energy use estimates, the current estimated energy load of Seattle City Light is about 1100 average megawatts (aMW). The 3.66 aMW use under the preferred Alternative would represent about 0.3 percent of the total system demand, as compared to less than 0.1 percent under existing zoning. Among the alternatives assuming rezoning, the range is from 2.09 aMW for Alternative 1A - the Lower Density scenario with less office space, to 3.75 aMW for Alternative 3 - the Higher Density scenario.

The impact estimates in **Table 2** are for the entire Yesler Terrace area. Separate estimates have been developed for two main sub-areas: 1) the entire area West of Boren Avenue, and 2) the area East of Boren Avenue, which in the Preferred Alternative only includes a small sub-area East of Twelfth Avenue. These disaggregated sub-area energy impact estimates are contained in **Attachment A**.

Mitigation Measures

The energy use impact estimates above incorporate assumed reductions over time in Energy Code-compliant levels of energy use. They do not, however, reflect other possible changes from standard building design or consumer behavior that could reduce both electricity requirements and greenhouse gas emissions.

District Heat System. The SHA Sustainable District Study identified a set of on-site renewable energy sources that could provide most of the space heating and cooling and water heating requirements of the Yesler Terrace redevelopment. The most economically viable of such systems was determined to be a geo-exchange/solar hot water strategy, which could reduce the net annual electricity consumption of the project by 25 percent relative to the estimates in **Table 2**, while reducing peak electricity demand by over 40 percent. This geo-thermal/solar strategy would lower the production of greenhouse gas emissions associated with electricity generation, and would replace those electrical energy needs with renewable energy from some combination of geo-thermal, passive solar and sewer heat recovery sources.

Increased Energy Conservation Efforts. It is always possible to both construct buildings and make choices within buildings that conserve energy beyond the minimum requirements of the Energy Code. This analysis does not assume such investments or behavior, but they remain a potential source of mitigation, and could be further supported by external factors such as rising energy prices and conservation assistance programs.

Energy-Reducing Building Design. The detailed designs and layouts of buildings in each alternative Yesler Terrace scenario were not treated as variables in this analysis. They are assumed to be representative buildings, in terms of energy use requirements. However, as development proceeds, energy use could be reduced further, through the selection of design features. Examples of building design choices that naturally reduce energy use are building orientation and external wall design for "day-lighting," to capture higher levels of natural light, and installation of green roofs and strategically placed trees to provide natural cooling. Retaining mature trees could also provide environmental mitigation through carbon sequestration and air purification.

Attachment A
Disaggregated Electricity Use Impact Estimates by Sub-Area

Table A-1
Yesler Terrace Redevelopment, West of Boren Sectors:
Projected Electricity Consumption at Full Build-Out,
Preferred and Other Alternatives (MWh/year) [1]

Development Type	Preferred Alternative	Alt 1 Lower Density	Alt 1A Lower Density, Less Office	Alt 2 Medium Density	Alt 3 Higher Density	Alt 4 Existing Zoning
Residential	19,199	12,269	12,269	16,242	20,297	5,496
Commercial						
Office	8,622	7,694	3,844	9,639	9,862	191
Neighborhood Retail	762	329	328	476	593	68
Neighborhood Service	556	411	411	393	237	382
Total Energy Use						
MWH/year	**29,140**	**20,703**	**16,851**	**26,751**	**30,990**	**6,136**
Average MW	**3.33**	**2.36**	**1.92**	**3.05**	**3.54**	**0.70**

Source: Gibson Economics, 2011

Table A-2
Yesler Terrace Redevelopment, East of Boren (EOB) and East of 12th (EOT) Sectors:
Projected Electricity Consumption at Full Build-Out,
Preferred and Other Alternatives (MWh/year) [1]

	EOB	EOT	East of Boren Only (no East of 12th development)				
Development Type	**Preferred Alternative E of Boren**	**Preferred Alternative E of 12th**	**Alt 1 Lower Density**	**Alt 1A Lower Density, Less Office**	**Alt 2 Medium Density**	**Alt 3 Higher Density**	**Alt 4 Existing Zoning**
Residential	1,472	1,284	1,389	1,389	1,390	1,670	1,625
Commercial							
Office	0	0	0	0	0	0	0
Neighborhood Retail	71	34	68	68	73	144	34
Neighborhood Service	21	7	34	34	29	40	67
Total Energy Use							
MWH/year	**1,564**	**1,324**	**1,492**	**1,492**	**1,492**	**1,854**	**1,727**
Average MW	**0.18**	**0.15**	**0.17**	**0.17**	**0.17**	**0.21**	**0.20**

Source: Gibson Economics, 2011