

## **Appendix E: Comparative Sustainability Analysis**

The table below provides the analysis behind the SPeAR graphics illustrated in Section 3 - a listing of the criteria used to evaluate the three Plan Alternatives, which is taken from the Sustainability Principles in Section 2 and the conclusions of the Land Use Conversion Implications Analysis in Section 3. The scores have been added for the purpose of determining a favored Alternative assuming that all categories are weighted equally. However, as each category undoubtedly should be accompanied by different weighting factors, if appropriate, these factors will be determined with input from the Project Team and other key stakeholders.

Please note, the scores and estimated values represent order of magnitude estimates for comparison purpose only and do not represent quantification of actual predicted values. Further analysis would be necessary to achieve such results.

Category	Indicator	Metric(s)	Estuary Policy Plan (EPP)	Oakland Project Statement	Issues and Opportunities Report (IOP)	Infrastructure report (IR) - Arup	Transport Report (TR) - Arup	Urban Env Accords (UEA)	CA Renewable Portfolio Standard (RPS)	AB32	Storm Water Quality Management Plan (SWQMP)	Zero-waste Strategic Plan (ZWSP)	New (Arup)	Alternative 1	Alternative 2	Alternative 3	Comments
Sc	Open Space Availability	Park acres per 1000 residents											✓	-1	0	-1	Alternative 2 has the highest open space availability with ~11 acres / 1000 residents. Alternative 1 and 3 perform worse with 7 and 5 acres per 1000 residents, respectively. The benchmark for healthy neighborhoods is estimated to be around 10 acres per 1000 residents; however, accessibility of parks is another important indicator for parks as well.
Sc	Open Space Accessibility	Plan-based qualitative assessment											✓	0	-1	-1	Alternative 1 performs relatively well due to the waterfront development on eastern and western subareas of the site that provide good access to MLK & Union Point parks as well as the Bay Trail. Alternative 2 provides good access to parks in western and ConAgra sections of the site, however, on the eastern site, the green industry cluster blocks off the access to MLK park significantly. Alternative 3 provides good access on the eastern side to MLK park but the Union Point park on the west side is impeded by food-related Industrial use. Overall, the accessibility of parks could be improved in all the three alternatives, especially in the central subareas of the site.
Sc	Housing Diversity	Simpson index (LEED ND)											✓	0	1	0	Insufficient data exists regarding exact variety of housing due to the level of detail of design (e.g. townhomes vs life work vs. single family). Assessing the Alternatives using the 4 given housing types, Alternative 2 exhibits the greatest amount of diversity based on the distribution of dwelling units. However, the size of the residential program in Alternative 3 provides the greatest opportunity for diversity if planned accordingly.
Sc	Historic Preservation	Percentage sf of buildings retained (based on sf of "old and retained" buildings compared to "total sf" of existing site)	✓											0	1	-1	Alternative 2 demonstrates the most extensive overlap with existing conditions and retains more than 60 percent buildings currently on site (based on square footage). Alternative 3 proposes a variety of new land uses and retains less than 55 percent of current land uses.
Sc	Connectivity to Retail Services	retail sf / resident, retail location on site, retail type (neighborhood vs. regional)	✓										✓	1	0	-1	Alternative 1 has more retail/resident than the other alternatives. Alternative 2 performs reasonably well in retail/resident due to low residential land use area but will need additional retail if the residential density is increased. Alternative 3 has less retail per resident than 1 & 2 due to high population.

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Sc	Connectivity to Schools	location of existing schools on site with respect to residential development				✓								-1	1	-1	There is one school located in the western subarea of the site, Beacon Day School, as well as a few other ones on the north side of the site. In comparison, Alternative 2 performs the best because it has residential density mostly at mid-sections of the site, providing easier access to existing schools. Alternative 3 has some residential development on eastern subareas with low school accessibility, whereas Alternative 1 has significant development in the same subareas, thus performing the worst.
Sc	Public Health	Area of residential development in previous industrial sites, proximity of residential to industrial, industrial square footage (heavy and light)											✓	-1	0	-1	Alternative 1 and 3 pose risks due to the development of residential on previous industrial sites, which have contamination risk. Alternative 2 poses less risk related redevelopment of brownfields, but the proximity of industrial to residential may have health implications due to air and water pollution.
LU	Housing Density	Dwelling units / acre, percent single-family residential compared to total residential (based on square foot)											✓	0	0	1	Alternative 3 has the highest residential density with approximately 44 dwelling units per acre, whereas Alternative 1 and 2 have relatively low density with 30-35 dwelling units per acre.
LU	Commercial and Industrial Density	Floor Area Ratio (FAR): Commercial and Industrial sf (converted to acre) divided by Commercial and Industrial acre											✓	0	0	1	Alternative 3 has the highest FAR (0.45) and thus provides the greatest opportunity for dense commercial development. Alternative 1 and 2 have lower FARs (around 0.42).
LU	Jobs/Housing Balance	Jobs to residents ratio, Mixed use + live/work as part of the overall program square footage, qualitative evaluation based on program plans											✓	0	-1	1	In terms of jobs to residents ratio, Alternative 3 is the best with 82 percent, Alternative 1 is second with 58 percent and Alternative 3 is last with 44 percent. Both Alternative 1 and 3 have portions of the site where there is a primarily residential waterfront development with little connectivity to commercial sites.

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LU	Spatial Separation of Industrial Uses	Qualitative evaluation based on program plans											✓	-1	1	-1	Alternative 2 probably provides the best separation by aggregating the majority of industrial uses on the eastern subarea and the rest of the programs in central and west subareas. Alternative 1 exhibits a reasonable separation with the industrial business park in Owens Brockway and Alternative 3 with Food Industrial East. However, both of these alternatives also have waterfront developments in proximity to industrial sites.
Tr	Trip Generation (absolute) and Congestion	Quantitative transport modeling			✓									0	0	1	Alternative 1 generates ~54K trips per year, implying that it has highest probability for congestion problems. Alternative 2 has 23 percent less trip generation rates and Alternative 3 16 percent less. On a per-service population basis, Alternative 3 performs the best due to its higher service population.
Tr	Vehicle Miles Travelled (VMT)	Quantitative transport modeling			✓									0	-1	1	Alternative 3 has the lowest VMT with ~384K miles. Alternative 1 has approximately 5 percent more VMT, and Alternative 2 has 20 percent more.
Tr	Vehicle Miles Travelled (VMT) per service population	Quantitative transport modeling			✓									0	-1	1	On a VMT per capita basis, Alternative 3 performs very high compared to other alternatives. It has the lowest VMT / capita with ~27 miles. Alternative 1 has more than 1.6 times the VMT, whereas Alternative 2 has 1.6 times the VMT.
Tr	Transit Suitability	Qualitative evaluation based on program plans			✓									1	0	2	
Tr	Connectivity to External Roadway Network	Qualitative evaluation based on program plans			✓									0	0	1	Alt 3 has much better connections (the most flexibility with regards to redevelopment/realignment of parcels). Alternatives 2 and 3 perform worse since they have less flexibility regarding the parcels.
Tr	Bicycle / Pedestrian Connections	Qualitative evaluation based on program plans			✓									0	0	1	
Ec	Jobs	Number											✓	-1	0	0	With its extensive industrial and commercial land use, Alternatives 2 and 3 provide large amount of jobs (~ 5,450 each). Alternative 1 provides only ~5,150 jobs.

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Ec	Infrastructure Cost	Percentage land area "improved" (based on acreage)											✓	0	1	-1	Alternative 2 proposes least change in land uses thus requiring less infrastructure investment. On the other hand, Alternative 1 and 3 require more land use changes. Please note that this analysis does not account for specific spatial interventions on site, which may shift the results based on the specific conditions at various zones of the site.
Ec	Retaining Light Industrial Uses	Light industrial square footage (alternative) compared to existing conditions	✓		✓									-1	1	-1	Alternative 2 is the only alternative where the square footage of "light industrial" land use is actually expanded from ~550K sf. to ~785K sf. Alternative 1 reduces the light industrial use by 54 percent, whereas Alternative 3 reduces it by 16 percent. Please note that this analysis excludes the Business Park, Incubator and R&D land uses, all of which contain a "light industrial" land use component. When including all these land use types, Alternative 2 still performs the best with ~1.3M sf light industrial total, followed by ~780K sf for both Alternative 1 and 3.
Ec	Green R&D Availability	Areas in project alternatives' plans highlighted as "Green R&D"	✓		✓									0	1	1	Alternative 2 and 3 explicitly state land use categories with a "Green R&D" emphasis. Alternative 1 has an Industrial Business Park component; however, it does not highlight it as an exclusively green industrial park.
En	Energy Consumption (absolute, elec + natural gas)	kWh / yr						✓	✓	✓			✓	0	1	-1	Alternative 3 has significantly higher total energy consumption due to its larger residential and commercial + industrial programs. Alternative 1 uses 70 percent and Alternative 2 uses 60percent of Alternative 3's projected energy use.
En	Energy Consumption (per service population, elec + natural gas)	kWh / service population/ yr											✓	0	-1	1	Similar absolute energy consumption, Alternative 2 performs the best with 8,400 kWh per service population per year. Both Alternative 1 and 3 consume 5-6 percent more on a per capita basis.
En	Electricity Demand (absolute)	KW						✓	✓	✓			✓	-1	1	-1	Electricity demand follows a similar pattern to energy consumption. Alternative 3 has the highest demand, whereas Alternative 1 has 80 percent of the demand and Alternative 2 only 50percent.
En	District Energy Systems	Ratio of commercial to industrial square footage, total energy demand						✓	✓	✓			✓	1	0	1	Alternatives 1 and 3 are more conducive to district systems because of their diverse land use, higher density and high peak demand. Alternative 2 is still suitable for district systems due to its large green industry cluster.

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En	Renewables	Industrial acreage for PVs and biofuels, residential acreage for solar hotwater						✓	✓	✓			✓	0	1	0	Alternative 2 performs marginally better with its extensive industrial land use. However, with the use of a district energy system and with careful planning, renewables has equal potential in all three alternatives.
Wa	Water Consumption (absolute)	gallons / day									✓		✓	0	1	-1	Similar to absolute energy consumption, Alternative 2 has low absolute water consumption assuming that the development does not include particularly high-water-consuming industries. Alternative 1 and 3 consume more water due to their density and residential land uses.
Wa	Water Consumption (per service population)	Gallons / service population / day									✓		✓	-1	-1	0	Unlike the absolute value, the water consumption per person does not differ significantly among the different alternatives. Both Alternative 1 and 2 have 69 gallons/service pop/day, whereas Alternative 3 has its value 5 percent lower.
Wa	Recycled Water Utilization	Industrial square footage, park acreage									✓		✓	-1	1	0	Alternative 2 performs the best with its extensive industrial use and availability of parks.
Wa	Stormwater Runoff Reduction	Percentage land area improved (based on acreage)			✓	✓					✓		✓	0	-1	0	Alternative 1 and 3 perform relatively better due to their relatively large pervious land area that will be improved (~35 acres). On the other hand, Alternative 2 only has ~29 acres of pervious land area that will be improved.
M+W	Waste Generation (absolute)	Tons solid waste / year			✓							✓	✓	1	0	-1	The absolute solid waste generation values do not vary significantly across the alternatives. Alternative 3 performs a bit worse due to its high residential density, and Alternative 1 due to its relatively low industrial and residential land uses.
M+W	Waste Generation (per service population)	Tons solid waste / service population / year											✓	0	-1	1	On a per capita basis, Alternative 3 generates ~30 percent less waste per resident compared to Alternative 2 and ~12 percent less compared to Alternative 1. This is related primarily to the lower residential densities in Alternative 1 and 2.
M+W	Organic Waste Generation (absolute)	Residential sf, absolute waste generation mass, park acreage, food manufacturing and retail sf											✓	0	-1	1	Alternative 3 has the highest percentage of residential land use and food-related industrial use; all three options have similar park acreage. Options that favor industrial could score higher if food-related industries are selected. The extent of food retail could also influence this indicator at future phases of the project.

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M+W	Existing Buildings Adaptation Potential	Percentage sf of buildings retained (based on sf of "old and retained" buildings compared to "total sf" of existing site)			✓								✓	0	1	0	Alternative 2 is likely to have the least embodied carbon for materials due to its low need for building demolition.
Ca	Carbon Footprint (absolute)	tons CO2e / year (includes CO2, N2O and CH4)											✓	0	0	0	All alternatives have between 93K and 108K metric tons CO2e emissions per year, although the breakdown of this total number is different. In particular, transport has a larger portion of the emissions in Alternative 1 and 2. On the other hand, Alternative 3 has more emissions from building's energy consumption.
Ca	Carbon Footprint (per service population)	tons CO2e / resident / year (includes CO2, N2O and CH4)											✓	0	-1	1	Alternative 3 performs the best for this combined resource consumption indicator mainly due to its high residential population.

The following table provides the quantitative metrics that are used in the Plan Alternative Analysis.

	<b>Alternative 1</b>	<b>Alternative 2</b>	<b>Alternative 3</b>
<b>Sc - Open Space Availability</b>			
Park acres per 1000 residents	7.214	11.431	4.966
<b>Sc - Housing Diversity</b>			
Simpson index (LEED ND)	0.28	0.53	0.22
<b>Sc - Historic Preservation</b>			
Percentage sf of buildings retained (based on sf of "old and retained" buildings compared to "total sf" of existing site)	58%	63%	54%
<b>Sc - Connectivity to Retail Services</b>			
Retail sf per resident	147	76	35
<b>Sc - Public health</b>			
light+heavy industrial sf	452,765	893,758	567,256
<b>LU - Housing Density</b>			
Dwelling units per acre	34.0	31.9	43.4
FAR: Residential sf (converted to acre) per residential acre	7.4	7.1	9.1
% Single-family residential compared to total residential (based on sf)	7%	9%	7%
<b>LU - Commercial Density</b>			
Commercial + industrial sf per commercial + industrial acre	0.42	0.42	0.45
<b>LU -Jobs/Housing Balance</b>			
Mixed-use + live/work as part of the overall program square footage	5%	10%	4%
Job housing balance	58%	44%	82%



	<b>Alternative 1</b>	<b>Alternative 2</b>	<b>Alternative 3</b>
<b>Tr - Trip generation</b>			
Number of trips per year	54,089	41,484	45,287
Trips / service population	5.5	4.6	3.2
<b>Tr - Vehicle miles travelled (VMT)</b>			
VMT	458,210	398,724	383,778
VMT per service population	46	44	27
<b>Ec- Number of Jobs</b>			
Number of Jobs	5,157	5,493	5,414
<b>Ec- Additional Infrastructure Cost</b>			
Total "improved" area (percentage, based on acreage of land)	44%	34%	48%
<b>Ec - Retaining light industrial uses</b>			
sf light industrial	228,351	784,566	458,064
sf light industrial + business park	777,556	1,333,771	458,064
sf light industrial + business park + rd	777,556	1,333,771	782,964
<b>Ec - Green r&amp;d availability</b>			
sf of industrial r&d, r&d incubator	0	0	324,900
<b>En - Energy consumption</b>			
kWh/yr (Natural gas and elec combined)	91,306,659	78,332,139	122,760,427
kWh/service population/yr (Natural gas and elec combined)	9,234	8,681	8,842
<b>En - Energy demand</b>			
kW	8,833	6,311	11,043
<b>En - District energy systems</b>			
(commercial + mixed-use comm sf) / industrial sf	0.34	0.18	0.28
Total energy demand (kW)	8,833	6,311	11,043
<b>En - renewables</b>			
Industrial acreage (to determine roof area) - assume same FAR	105	152	92
Industrial sf/acre	0.51	0.43	0.52

	<b>Alternative 1</b>	<b>Alternative 2</b>	<b>Alternative 3</b>
<b>Wt - Water consumption</b>			
Indoor + Irrigation gallons/day	662,578	598,039	874,225
Indoor + Irrigation gallons/service pop/day	67	66	63
<b>Wt - Recycled water utilization</b>			
Recycled water demand percentage	47%	47%	42%
Industrial sf	2,317,742	2,861,325	2,106,043
Park acreage	34	40	42
<b>Wt- Stormwater runoff reduction</b>			
Improved pervious landscape area	35	29	34
Total "improved" area (percentage, based on acreage of land)	44%	34%	48%
<b>M+W - Existing buildings renovation</b>			
Total "improved" area (percentage, based on acreage of land)	44%	34%	48%
Percentage sf of buildings retained (based on sf of "old and retained" buildings compared to "total sf" of existing site)	58%	63%	54%
<b>M+W - waste generation</b>			
solid waste tons/yr	7,933	7,519	9,093
solid waste tons/service population/yr	0.80	0.83	0.65
<b>M+W- Organic Waste Generation</b>			
Residential sf	2,306,978	1,732,912	4,027,645
solid waste tons/yr	7,933	7,519	9,093
Park acreage	34	40	42
<b>Ca - Carbon footprint</b>			
mtons CO2e/year	107,932	93,379	103,169
mtons CO2e/service population/year	10.91	10.35	7.43