Physical Activity and the Intertwine:
A Public Health Method of Reducing Obesity and Healthcare Costs

A Report to the Intertwine Alliance Partners

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Executive summary

The Intertwine is a large interconnected grey/green infrastructure system containing thousands of miles of biking and pedestrian trails and tens of thousands of acres of parkland and natural areas throughout the Portland, Oregon metropolitan region. The region is home to 1.6 million people, many of whom use the Intertwine for active transportation and recreational purposes. As such, the Intertwine can be seen as a public health asset that provides opportunities for physical activity, as well as a host of other economic, social and environmental health benefits. The physical activities that result from use of the grey and green infrastructure of the Intertwine contribute to current public health efforts to reduce obesity and related diseases, decrease rising healthcare costs and improve overall population health.

This analysis estimated the amount of physical activity that occurs in the Portland Metro region as a result of using the Intertwine system. Subsequent estimates of obesity reduction, based on caloric expenditure, and resultant avoided healthcare costs were also conducted. These estimates are very rudimentary, but suggest that $155 million in healthcare costs may be averted annually as a result of the obesity prevention due to physical activity that occurs in the parks, trails and natural areas of the Portland metro region.

Introduction

An assessment was conducted of the physical activity that occurs in the Intertwine, the system of parks, trails and natural areas in the Portland Metropolitan area. This assessment was a part of a larger project by Metro to assess the holistic benefits of the Intertwine, including economic and environmental benefits to the region. The assessment was conducted to address how the Intertwine might be serving as a public health resource, by providing opportunities for residents to expend calories through physical activity, thereby reducing body mass index and subsequent risk of obesity. Other health benefits of physical activity such as cardiovascular health, bone and joint health, and mental health, were not considered as part of the analysis. Also not considered were other public health benefits of the Intertwine, such as opportunities for stress reduction, social interaction or community involvement. As such, this analysis provides a detailed but limited estimate of one aspect of the Interwine's function as a public health resource.

Project Description: The Intertwine

The Intertwine is an interconnected system of parks, trails and natural areas. It is composed of the natural and built infrastructure of the system, as well as multiple amenities. In the system there are 1,250 miles of designated bicycle and pedestrian trail, 12,000 acres of developed parks and 24,000 acres of maintained natural area. It is estimated that 8.3 million user visits to the parks and natural areas occur each year.

The Intertwine has the capacity to act as a public health resource. Primarily this function is served by providing opportunities for physical activity. Physical activity is useful for reducing the prevalence and risk of many common and costly chronic diseases, including cardiovascular disease, hypertension and diabetes. One of the principle ways that physical activity reduces the prevalence and risk of chronic disease is via reduction of body mass index (BMI) and subsequent occurrence of obesity.

Obesity & Physical Activity

Obesity is a major contributor to the costs of healthcare and is currently an epidemic in the United States. In the Portland Metro region, 24% of the population is obese. It is believed

that this level of obesity contributes $1 billion every year to the region's healthcare costs. There are currently major efforts to reduce the prevalence of obesity on a national and regional scale.

The promotion of physical activity is a major component of current public health campaigns to reduce the prevalence of obesity. Physical activity reduces BMI and decreases prevalence of obesity by increasing the caloric expenditure of the human body. Increased metabolism during physical activity utilizes calories and "burns" fat, reducing body weight and BMI. The relative amount of caloric expenditure for various physical activities is known and can be used to calculate how many pounds of body weight are lost for each activity during a given period of time.[1]

Methodology

Using data of some of the physical activity in the region's parks, trails, and natural areas, estimates were made of the total annual caloric expenditure that occurs through use of the Intertwine. By converting these calories into pounds, an approximation of the number of pounds of extra body weight avoided annually through use of the Intertwine was calculated. Using conversion factors approximated from the medical literature, the amount of averted annual healthcare costs was also calculated.

Results

It is estimated that use of the Intertwine is responsible for the avoided weight gain of 17 million pounds/year among Metro region residents. In healthcare dollars, this is the equivalent of $155 million in averted healthcare costs every year due to physical activity opportunities provided by the Intertwine.

Conclusion

This analysis is a first attempt to measure one of the benefits of the parks, trails and natural areas of the Intertwine, namely the ability to provide opportunities for physical activity. The contributions of the Intertwine toward reducing obesity and avoiding healthcare costs throughout the Metro region are substantial. Based on the general findings of this analysis, further investigation into the public health benefits of the Intertwine are warranted.

The opportunities to be physically active are just one of the many health benefits that the Intertwine provides. More extensive data collection would assist in quantifying the Intertwine's impact on the health and quality of life of Portland Metro area residents.

[1] It should be noted that physical activity provides a number of physical and mental health benefits independent of caloric expenditure and obesity/BMI reduction. While such benefits have significant ramifications on population health status and healthcare cost, they are beyond the scope of this analysis.

Intertwine: Physical Activity Assessment

Obesity

Obesity is a major burden to the American healthcare system. It contributes to a number of chronic diseases, including Coronary Heart Disease, Type 2 Diabetes, Cancer (i.e. Endometrial, Breast & Colon cancer), High Blood Pressure, High Cholesterol, Stroke, Liver & Gallbladder disease, Sleep apnea, Osteoarthritis, Infertility, Painful or Irregular Menstruation, and multiple hormonal disorders (CDC, 2009). In addition, it is known to contribute to mental health conditions such as depression, bipolar disorder and low self-esteem.

As a region, the population of the Portland Metro area is slightly less obese than the national average (CDC, 2008). Statistics on obesity show that 27% of the US population is obese. In the state of Oregon, 25% of the population is obese. In the Portland Metro region 24% of the population is obese, and another 36% is considered overweight (OHPR, 2010.) For a region of 1.6 million residents, this equates to 385,000 people are obese and another 575,000 people are overweight.

In terms of healthcare costs, obesity is a major contributor. It is believed that obesity is associated with 25% of the total costs of healthcare services (Anderson et al., 2005). The Centers for Disease Control and Prevention have reported that the epidemic of obesity costs $117 billion in national healthcare annually (CDC, 2009). This translates to roughly $2.1 billion annually for the state of Oregon, and about $1 billion annually for the Portland Metro region.

Physical Activity

Physical activity has a number of benefits, independent of the ability to reduce BMI via caloric expenditure. Regular physical activity strengthens the heart and improves oxygenation to various tissues, including muscle, joints, bones, and organs such as the brain, liver and kidneys. Physical activity also promotes healthy digestion, activation of the body's immune system, and movement of the lymph. These benefits contribute to the maintenance of positive health status, including various health conditions: improved cardiovascular health, reducing risk of conditions such as heart attack, stroke, and congestive heart failure; reduced risk of chronic diseases such as diabetes, metabolic syndrome, and certain forms of cancer; improved bone and joint health, leading to reduced risk of osteoporosis and arthritis; and improved mental health and psychological well-being, reducing risk for conditions such as depression and anxiety (USDHHS, 2002). Studies also demonstrate that regular physical activity reduces the risk for conditions of cognitive decline such as dementia and Alzheimer's disease in the elderly (Rovio et al, 2005). However, for the purposes of this analysis, only the direct benefits of physical activity on obesity and BMI reduction have been considered. [2]

[2] It should be noted that while this analysis focuses on obesity reduction, there remains significant overlap between the healthcare costs associated with obesity and those associated with other areas benefited by physical activity (e.g. cardiovascular health). Currently, it is not feasible to separate out the costs of obesity independent of physical activity effects. The estimates generated by this analysis should therefore be seen as including some, but not all, of the non-obesity related physical activity benefits. The savings estimates should therefore be viewed as a conservative estimate of the true total savings.

Promotion of physical activity is currently one of the 6 strategies recommended by the CDC for reducing obesity (2009). According to the Office for Oregon Health Policy and Research (2010), half of the residents in the Portland metropolitan area engage in no regular physical activity and a similar number are over-weight or obese. Only 55% of the population reports having met CDC recommendations of 150 minutes of moderate-intensity physical activity (MLPA) or 75 minutes of vigorous intensity physical activity (VIPA) per week. In contrast, 17% of the population reports regularly doing no level of leisure time exercise or physical activity (CDC, 2008). While this is below both National (24.6%) and Oregon (19.0%) averages, it is still a significant contributor to the prevalence of chronic disease.

Natural and Built Environments

One of the best methods for promoting physical activity is providing access to environments where physical activity can occur. The creation of physical infrastructure that facilitates easy access to opportunities to be physical active is currently one of the top priorities of many public health organizations. Proximity and accessibility to parks and trails are two of the largest determinants of use, and have a direct impact on physical activity. One study has found that every park within 0.62 mile (1 km) of the primary living residence increases a person's likelihood of meeting minimum physical activity guidelines by 17% (Kaczynski, 2009). Similar studies have demonstrated the importance of proximity to bike trails on physical activity (Troped et al., 2001; Pierce et al., 2006). Other infrastructure attributes that influence physical activity include cleanliness, naturalness, aesthetics, safety, and appropriateness (Gobster & Westphal, 2004).

The increase in physical activity due to proximity to accessible infrastructure is a recognized method for reducing obesity (Feng et al, 2010; ALR, 2010). The Intertwine provides Metro region residents with a variety of opportunities to be physically active, through recreational sports, hiking, and active transportation. Currently, sparse data exists to calculate how much physical activity the Intertwine facilitates. What follows is an attempt to quantify the amount of physical activity that occurs via the Intertwine and its' impacts on obesity using existing data.

Methodology

Estimates of physical activity benefits of the parks, trails and natural areas of the Intertwine on caloric expenditure, obesity reduction and avoided healthcare costs ere based on the following calculations:

- Trail lengths were calculated by summing values for each section of trail as provided by Metro (Spurlock, 2010). Trails were divided into designations of 1) Mixed Use (i.e. Bike and Pedestrian combined) and 2) Pedestrian only, to reflect the distinction between multi-purpose and single purpose (e.g. hiking path) trails.

- The caloric expenditure of physical activities are known and measured relative to their resting metabolic equivalent (i.e. MET). The MET refers to the number of Calories utilized per kilogram of body weight per hour (kcal/kg-hr) for each activity. The METs of various representative physical activities (e.g. biking, walking, running) for the Intertwine were included in the calculations. Due to different METs for different intensities of physical activity (e.g. walking 2mph vs. walking 6mph), a generalized MET

for each activity was used. In addition, the population average body weight of 176 pounds (80kg) was used for calculating caloric expenditure (CDC, 2010).

- Body fat reduction through the use of caloric expenditure occurs at the known rate of 1lb body fat per 3500kcal used (Mayo Clinic, 2009)

- Healthcare costs due to weight gain have been calculated at $28 per pound over a three-year period, or approximately $9 per pound annually (Elmer, Brown, Nichols & Oster, 2004)

- Calculations for the amount of physical activity that occurred in the Metro region's parks and natural areas were based on an estimated 8.3 million visits/year (Bebb, 2010). Participation in park-based physical activity was separated into three sections: Sedentary, Mobile and Team-based activities. These categories were selected to match those identified in a summary of studies measuring park-based physical activity (Godbey, 2005). Ranges of the proportion of these categories of activities were determined from the summary as follows: Sedentary 49-72%, Mobile 20-60%, Sports 8-23%

- Calculation of the metabolic expenditure (MET) for each category of activity was listed in a range according to typical activities for each category (See Appendix A). The ranges within each category were: Sedentary 1-3 METs, Mobile 3-10 METs, Sports 4-10 METs

- Values for these ranges were used to calculate the total caloric expenditure due to park-based physical activity for each category. These caloric expenditures were converted into pounds of body weight, and subsequently healthcare expenditure ($), as described above.

Intertwine: Results

Trails

Mid-week, Mixed-Use

Analysis of the September 2009 Trail Count data shows a total of 5,411 bicyclists and 3,078 pedestrians using 329,584 feet (62 miles) of surveyed trail. There were an average of 193 bicyclists and 110 pedestrians per 11,770 feet of trail. Using a weighted average, there were approximately 0.0325 bicyclists and 0.0171 pedestrians per foot (172 bicyclists per mile, 90 pedestrians per mile) of trail. For the entire Intertwine system of 653 miles of mixed-use trail this averages out to 112,140 bicyclists and 59,044 pedestrians using the system during the two-hour afternoon rush period. Using a K-factor of 10% for the afternoon rush hour, the total daily mid-week user volume is 560,702 bicyclists and 295,221 pedestrians. After adjusting for seasonal and weather effects on user volume, the calculated total annual user load of the Intertwine is estimated to be 72,891,226 bicycle trips and 38,378,716 pedestrian trips during regular mid-week business days. (See Appendix A - Table 1)

Weekend, Mixed-Use

Analysis of the September 2009 Trail Count data shows a total of 1067 bicyclists and1637 pedestrians using 272,895 feet (52 miles) of surveyed trail. There were an average of 48 bicyclists and 75 pedestrians per 16,053 feet of trail. Using a weighted average, there were approximately 0.009 bicyclists and 0.014 pedestrians per foot (48 bicyclists per mile, 75 pedestrians per mile) of trail. For the entire Intertwine system of 653 miles of mixed-use trail this averages out to 31,285 bicyclists and 49,249 pedestrians using the system during the two-hour afternoon period. Assuming a K-factor-type effect of 10% for the afternoon hour, the total daily weekend user volume is 156,424 bicyclists and 246,246 pedestrians. After adjusting for seasonal and weather effects on user volume, the calculated total annual user load of the Intertwine is estimated to be 8,134,065 bicycle trips and 12,804,814 pedestrian trips during regular weekend days. (See Appendix A - Table 2)

Pedestrian Weekday Trail

Analysis of the September 2009 Trail Count data shows a total of 121 pedestrians using 178,491 feet (34 miles) of surveyed trail. There were an average of 30 pedestrians per 44,623 feet of trail. Using a weighted average, there were approximately 0.006 pedestrians per foot (29 pedestrians per mile) of trail. For the entire Intertwine system of 339 miles of pedestrian-use trail this averages out to 9,901 pedestrians using the system during the two-hour afternoon period. Assuming a K-factor-type effect of 10% for the afternoon hour, the total daily weekend user volume is 49,503 pedestrians. After adjusting for seasonal and weather effects on user volume, the calculated total annual user load of the Intertwine is estimated to be 6,435,435 pedestrian trips during regular weekend days. (See Appendix A - Table 3)

Pedestrian Weekend Trail

Analysis of the September 2009 Trail Count data shows a total of 83 pedestrians using 162,144 feet (31 miles) of surveyed trail. There were an average of 28 pedestrians per 54,048 feet of trail. Using a weighted average, there were approximately 0.006 pedestrians per foot (28 pedestrians per mile) of trail. For the entire Intertwine system of 339 miles of pedestrian-use trail this averages out to 10,157 pedestrians using the system during the two-hour afternoon period. Assuming a K-factor-type effect of 10% for the afternoon hour, the total daily weekend user volume is 50,787 pedestrians. After adjusting for seasonal and weather effects on user volume, the calculated total annual user load of the Intertwine is estimated to be 2,640,944 pedestrian trips during regular weekend days. (See Table Appendix A - 4)

Trail Total

Combining mid-week and weekend trips for both mixed-use and pedestrian-only trails leads to an estimated 81,025,291 bicycle and 60,259,909 pedestrian trips annually. Assuming an average of 5 miles per bicycle trip and 2 miles per pedestrian trip, 405,126,455 bicycle trip miles and 120,519,818 pedestrian trip miles occur annually. Using the MET calculation of 53 Calories per bicycle-mile and 84 Calories per pedestrian mile leads to 21,471,702,093 Calories (bicycle) and 10,123,664,681 Calories (pedestrian) annually. Given the scientific standard of one pound of fat metabolized for every 3,500 Calories expended provides an estimated 6,134,772 pounds (bicycling) and 2,892,476 pounds (pedestrian) of avoided or lost body weight annually. Using the derived estimate of $9 of healthcare costs for every pound of weight, this provides $55,212,948 (bicycling) and $26,032,281 (pedestrian) in savings, for a total annual healthcare cost savings of $81,245,229 due to use of the Intertwine trail system. (See Appendix A - Table 5)

Parks and Natural Areas

An estimated 8.3 million visits occur annually to the Intertwine's parks and natural areas. The physical activity that occurs in these places can be divided into three categories: Sedentary, Mobile, and Sports-related. Each activity is assumed to occur for one hour per park visit.

Sedentary

It is estimated that 49-72% of park visitors engage in sedentary activities. This suggests 4- to 6 Million person-visits annually. Sedentary activities utilize between 1-3 METs, or between 80 and 240 Calories per hour. This provides a range of 324 Million to 1.4 Billion Calories expended annually due to sedentary park-based activity. Given the scientific standard of one pound of fat metabolized for every 3,500 Calories expended provides an estimated range of 93,000 to 408,000 pounds of body weight averted annually (See Appendix A - Table 6).

Mobile

It is estimated that 20-60% of park visitors engage in mobile physical activities. This suggests 1.7 to 5 Million person-visits annually. Mobile activities utilize between 3-10 METs, or between 240 and 8,000 Calories per hour. This provides a range of 397 Million to 39.7 Billion Calories expended annually due to mobile park-based activity. Given the scientific standard of one pound of fat metabolized for every 3,500 Calories expended provides an estimated range of 60,000 to 4.3 Million pounds of body weight averted annually (See Appendix A - Table 6).

Sports

It is estimated that 8-23% of park visitors engage in sport-related activities. This suggests 660,000 to 1.9 Million person-visits annually. Sports-related activities utilize between 4-10 METs, or between 320 and 8,000 Calories per hour. This provides a range of 211 Million to 15.2 Billion Calories expended annually due to sports-related park-based activity. Given the scientific standard of one pound of fat metabolized for every 3,500 Calories expended provides an estimated range of 60,000 to 4.3 Million pounds of body weight averted annually (See Table 6).

Total Parks & Natural Areas

Combing the ranges of sedentary, mobile and sport-related physical activity gives a total range of potential body weight averted due to park-based physical activity at 266,413 to 16.1 million pounds annually. Using the derived estimate of $9 of healthcare costs for every pound of lost or averted body weight, this provides a savings of $2.3 to $145 million annually, with a mean estimated savings of $73.6 Million. (See Appendix A - Table 7)

Total Benefits of the Intertwine: Trails & Parks & Natural Areas

Combining the totals for trail- and park-based physical activity suggests between 9 and 25 million pounds of body weight are lost or avoided annually while using the Intertwine for physical activity. Using the mean as an estimated true value, 17.2 million pounds of body weight are lost or avoided annually. The healthcare cost savings of this avoided body weight is between $84 and $226 million annually. Using the mean as an estimated true value, this suggests $155 million annually in averted healthcare costs is saved due to lost or avoided body weight as a result of physical activity occurring in the parks, trails and natural areas of the Intertwine.

Conclusion

Obesity is a major cause of healthcare expenditures, resulting in $1 billion of healthcare costs in the Portland Metro region. Currently the opportunities for physical activity provided by the Intertwine act as a preventive measure against obesity. The physical activity conducted via the Intertwine cause the caloric expenditure equivalent of 16 million pounds of weight loss annually, or approximately 10 pounds per resident of the Metro region every year. This results in $155 Million of avoided healthcare costs annually, or approximately 15% of the amount spent on obesity related conditions. Despite significant limitations in data availability, this amount can be seen as a modest estimation of the beneficial impact that the Intertwine has on obesity prevalence and health status throughout the region.

Limitations

Lack of concrete data is a significant limitation of this analysis in a number of key areas:

- The generalization of regional data for use of the Intertwine does not permit an analysis of true user experience. The extrapolation of user counts of specific parks and trails for system-wide participation may not accurately reflect actual usage rates. In addition, generalization of aggregated data supports the false assumption that usage patterns and rates of physical activity are homogeneous throughout the region. This is known to be otherwise due to accessibility and demographic (e.g. age, race/ethnicity, gender, socio-economic status) factors (Floyd M, Spengler J, Maddock J, Gobster P, Suau L, 2008).

- Tallies of user rates may not accurately represent the population of Metro area residents. Users of the Intertwine system may not all live within the Metro region. Oregon & Washington state residents living in close proximity to the region may use the Intertwine, and therefore be included in estimates of trail & park usage. Visiting tourists from other states and/or countries may similarly utilize the Intertwine infrastructure and contribute to the user rates.

- The proportion of park-based sedentary, mobile and sports-related physical activities used for calculations is based on a small number of observations in other locations and may not be representative of the distribution of activities that occurs in the Portland Metro region. In addition, the mid-point MET within each category is an estimate may not accurately represent the median category MET. MET calculations based on an assumption of 1 hour of physical activity per park visit may also be inaccurate. Lack of available representative data pertaining to the variety, frequency and duration of physical activity occurring in the parks and natural areas of the Intertwine makes such calculations impossible at the current time.

- Full accounting of the number and length of trails in the Intertwine system is ongoing and incomplete (Spurlock, 2010). The current estimate of 1,253 miles of trail represents the majority, but not the totality, of trails in the system.

- Usage of trail-based physical activity is calculated from one set of observations conducted during a single week in Mid-September 2009. These rates were adjusted to account for yearly seasonal & weather-based variations when determining the annual average user rate. It is possible that the adjustment rate used is not representative of the

true annual average user rate. In addition, the generalization of trail count data from isolated or sporadic collection days may not accurately reflect the complete usage pattern for an average week.

- Sections of trail were included based on data providing total calculated trail length. Information allowed only the calculation of trail length for each trail in the system, not trail length utilized per user. Calculation of a user's true utilization of trail length is not possible using currently available data. Assumptions of 5 miles per bicycle trip and 1 mile per pedestrian trip may not accurately reflect actual usage patterns. In addition, it is unknown how much user tally overlap occurred between contiguous sections of trail in the Intertwine system. As a result, correction for double counting of users could not be performed.

- The method of averaging number of users per unit length of trail based on single point observations on each trail may not be accurate for all trails. In particular, the extremely long trails (e.g. Springwater Corridor, Columbia Slough Trail, Rock Creek Trail) most likely do not provide a consistent user density across their entire length. Future data collections with multiple observation points may help account for this.

- Physical activity has multiple benefits for cardiovascular health independent of obesity and BMI. Physical activity also benefits hormonal- and neuro-psychological disorders that are not addressed by metabolic caloric expenditure from physical activity. The economic advantages of avoided healthcare costs due to these contributions of physical activity were not assessed.

- Mental and social health benefits of exposure to natural green spaces can be substantial, but do not lend themselves to quantitative analysis at this time (Harnik & Welle, 2009). Regardless, their impacts are thought to be significant and should be included in a complete green space HIA at some future time.

- Caloric expenditure due to physical activity using METs is variable and dependant upon body weight, BMI and body mass composition. Use of the US national average body weight of 176 pounds (80 kg) may not accurately reflect the population average for the Metro region as a whole, or the average trail or park/natural area user. Differences between these population means body would alter calculated total annual caloric expenditures.

- The estimated healthcare cost per pound of body weight used in this analysis is derived from one study following 15,000 people over three years (Elmer et al, 2004); while this study was conducted in the Portland Metro area, the findings may not accurately represent the obesity costs of the entire region. In addition, this study investigated the effect of weight gain on costs within a managed care system, and may not adequately reflect the total relationship between body weight and healthcare cost.

- The estimated healthcare cost per pound of body weight averted is calculated from medical insurance billing records of incurred costs resulting from additional weight gained by people already classified as obese, i.e. BMI $\geq$ 30. It is possible that the marginal utility of each additional pound of gained body weight, or conversely each

additional pound avoided, may decline as BMI decreases below obesity-defining levels. The lack of available supportive medical records billing data makes true determination of such costs inaccessible at this time.

- The methodology used in this analysis is observational and suggests an estimated effect. Predictive or correlative models using current data are not possible at this time.

Commentary

The grey/green infrastructure of the Intertwine provides many opportunities for physical activity. Caloric expenditure and reduction of obesity are just two of many health benefits that physical activity provides. As such, the calculated health benefits and healthcare cost savings created by use of the Intertwine system are presumably much greater than the estimated $155 Million/year presented in this analysis. In should be noted that while these benefits are aggregated for the entire region, unequal distribution of access to the Intertwine may be limiting the availability of such benefits for residents of certain areas. Efforts to ensure equitable user experience and access through future planning and development will help reduce health disparities in affected neighborhoods. Despite its' limitations, this report suggests that the Intertwine acts as a significant public health resource for the Portland metropolitan region. More research, including increased on-site user observation and data collection, is necessary to produce a more accurate and useful prediction of current and potentially future benefits.

Appendix A: Tables of Physical Activity

TRAILNAME	LENGTH (Ft)	Time of Week	Time of Day	Bike Total	Ped Total
Broadway Bridge Total	3,766	MW	ER	787	76
Columbia Slough Trail Total	23,374	MW	ER	34	9
Eastbank Esplanade Total	9,465	MW	ER	695	372
Fanno Creek Trail (Tigard)	8,345	MW	ER	69	54
Fanno Creek Trail (Tigard)	8,345	MW	ER	2	14
Gresham / Fairview Trail	20,151	MW	ER	22	36
Hawthorne Bridge	4,883	MW	ER	1,755	614
Hwy 26 Bike Path	21,699	MW	ER	147	29
I-205 Bikepath	2,496	MW	ER	37	0
Irving Park Path	4,569	MW	ER	29	75
North Portland Willamette Greenway	7,303	MW	ER	13	19
Northwest Willamette Trail	5,556	MW	ER	29	110
Padden Parkway Trail	30,675	MW	ER	53	16
Pathfinder Genesis Trail	7,020	MW	ER	27	26
Salmon Creek Greenway Trail	17,709	MW	ER	9	69
Springwater Corridor	6,541	MW	ER	42	19
Springwater Corridor (Portland)	3,885	MW	ER	142	57
Springwater On The Willamette	18,239	MW	ER	450	93
Terwilliger Trail	41,269	MW	ER	217	133
Trolley Trail	7,010	MW	ER	6	15
Tualatin River Trail	5,384	MW	ER	32	79
Waterfront Park Trail	6,291	MW	ER	631	677
Waterfront Park Trail (568)	6,291	MW	ER	56	282
Wildwood Trail	1,712	MW	ER	2	43
Fanno Creek Trail	8,345	MW	ER	38	78
I-205 Bikepath (586)	2,496	MW	ER	52	7
Rock Creek Trail	26,952	MW	ER	32	43
Waterhouse Trail	19,813	MW	ER	3	33
SUM	329,584			5,411	3,078
MEAN	11,771			193	110
People/foot				0.033	0.017
People/mile				172	90
People (rush hour)				112,140	59,044
People (day)				560,702	295,221
People (week)				2,803,509	1,476,104
People (year)				145,782,451	76,757,433
People (year) adjusted				**72,891,226**	**38,378,716**

TABLE 1 – CALCULATIONS OF WEEKDAY PHYSICAL ACTIVITY ON THE INTERTWINE FOR MIXED (BIKING AND PEDESTRIAN) USE

TRAILNAME	LENGTH (Ft)	Time of Week	Time of Day	Bike Total	Ped Total
Boones Ferry Horse Trail Total	1,883	WND	N	58	29
Fanno Creek Trail	8,345	WND	N	75	50
Fanno Creek Trail (Tigard)	8,345	WND	N	80	20
Fanno Creek Trail (Tigard)	8,345	WND	N	3	8
Hwy 26 Bike Path	21,699	WND	N	73	18
Padden Parkway Trail	30,675	WND	N	25	11
Pathfinder Genesis Trail	7,020	WND	N	5	8
Rock Creek Trail	26,952	WND	N	14	68
Salmon Creek Greenway Trail	17,709	WND	N	58	68
Springwater Corridor	6,541	WND	N	42	13
Springwater Corridor (Gresham)	88,880	WND	N	96	55
Trolley Trail	7,010	WND	N	4	7
Tualatin River Trail	5,384	WND	N	48	69
Waterfront Park Trail	6,291	WND	N	397	999
Waterfront Park Trail (568)	6,291	WND	N	84	181
Waterhouse Trail	19,813	WND	N	1	26
Wildwood Trail	1,712	WND	N	4	7
SUM	272,895			1,067	1,637
MEAN	16,053			63	96
People/foot				0.009	0.014
People/mile				48	75
People				31,285	49,249
People (day)				156,424	246,246
PEOPLE (WEEKEND)				312,849	492,493
PEOPLE (YEAR)				16,268,131	25,609,627
PEOPLE (YEAR) ADJUSTED				8,134,065	12,804,814

TABLE 2 – CALCULATIONS OF WEEKEND PHYSICAL ACTIVITY FOR MIXED (BIKING AND PEDESTRIAN) USE

TRAILNAME	LENGTH (Ft)	Time of Week	Time of Day	XX Bike Total XX	Ped Total
Columbia Slough Trail Total	16,347	MW	ER	XXXX	9
Pathfinder Genesis Trail	1,983	MW	ER	XXXX	26
Wildwood Trail	154,908	MW	ER	XXXX	43
Rock Creek Trail	5,253	MW	XER	XXXX	43
SUM	178,491			0	121
MEAN	44,623				30
People/foot					0.006
People/mile					29
People					9,901
People (day)					49,503
PEOPLE (WEEK)					247,517
PEOPLE (YEAR)					12,870,870
PEOPLE (YEAR) ADJUSTED					**6,435,435**

TABLE 3 – CALCULATIONS OF WEEKDAY PHYSICAL ACTIVITY FOR PEDESTRIAN-ONLY USE

TRAILNAME	LENGTH (Ft)	Time of Week	Time of Day	XX Bike Total XX	Ped Total
Pathfinder Genesis Trail	1,983	WND	N	XXXX	8
Rock Creek Trail	5,253	WND	N	XXXX	68
Wildwood Trail	154,908	WND	N	XXXX	7
SUM	162,144			0	83
MEAN	54,048				28
People/foot					0.006
People/mile					30
People					10,157
People (day)					50,787
PEOPLE (WEEKEND)					101,575
PEOPLE (YEAR)					5,281,887
PEOPLE (YEAR) ADJUSTED					**2,640,944**

TABLE 4 – CALCULATIONS OF WEEKEND PHYSICAL ACTIVITY FOR PEDESTRIAN-ONLY USE

				Bike Total	**Ped Total**
Total People (Mixed-use)/Year				81,025,291	51,183,530
Total People (Ped only)/Year				0	9,076,379
TOTAL PEOPLE/YEAR				81,025,291	60,259,909
Miles/year				405,126,455	120,519,818
Cal/year				21,471,702,093	10,123,664,681
lb/year				6,134,772	2,892,476
$/yr				55,212,948	26,032,281
Total Trail $$					**81,245,229**

TABLE 5 – CALCULATIONS OF TOTAL ANNUAL USERS, MILES TRAVELED, CALORIES EXPENDED AND HEALTHCARE DOLLARS AVOIDED VIA BICYCLE AND PEDESTRIAN USE OF THE INTERTWINE

	Sedentary	Mobile	Sports
Population (min)	4,050,517	1,653,272	661,309
Population (max)	5,951,780	4,959,816	1,901,263
Calories/hr (min)	80	240	320
Calories/hr (max)	240	8,000	8,000
Annual Calories (min)	324,041,332	396,785,304	211,618,829
Annual Calories (max)	1,428,427,095	39,678,530,425	15,210,103,330
Annual Lb (min)	92,583	113,367	60,463
Annual Lb (max)	408,122	11,336,723	4,345,744

TABLE 6 – CALCULATIONS OF TOTAL ANNUAL PARK USE

TOTALS				
Total Park Lb (min)	266,413		Total Park $ (min)	2,397,717
Total Park Lb (max)	16,090,589		Total Park $ (max)	144,815,299
Total Park Lb (mean)	**8,311,707**		**Total Park $ (mean)**	**73,606,508**

TABLE 7 – CALCULATIONS OF TOTAL ANNUAL BODY WEIGHT (LBS) AND HEATHCARE COSTS ($) AVERTED FROM PARK USEAGE

Appendix B: Use of METs in Park-based Physical Activity

The following activities were considered when determining the range of relative metabolic equivalents (METs) for each category of park-based physical activity. (Ainsworth et al, 2000)

Sedentary (1-3 METs)
Sitting quietly 1.0
Sitting, reading 1.3
Standing, drawing, 2.3
Standing, playing with children 2.8
Standing, playing with animals 2.8

Mobile (3-10 METs)
Walking the dog 3.0
Walking, for pleasure 3.5
Jogging, general 7.0
Bicycling general, 8.0
Running on a track, 10.0

Sports (4-10 METs)
Hackysack 4.0
Basketball (Shooting baskets) 4.5
Softball/Baseball 5.0
Kickball 7.0
Tennis 7.0
Basketball (game) 8.0
Football (Touch/Flag) 8.0
Ultimate Frisbee 8.0
Soccer 10.0

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