City of Tukwila
Community Storm Water Research

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Prepared by

HR² Research/Analytics

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Research Goals and Objectives

Research Goal

According to the NPDES Phase II permit, section S5.C.1, the goal of Tukwila's Storm Water Management Program (SWMP) is to increase citizen and business support with the best management practices (BMPs) that improve water quality in Tukwila, Washington. Specifically, the city's Storm Water Management Program was developed to mitigate polluted storm water in the Municipal Separate Storm Sewer System (MS4). Each permittee (City of Tukwila) is required to build the general awareness of target behaviors to its citizens and businesses and to affect behavior change through education and outreach efforts.

Through this research, HR² Research/Analytics conducted longitudinal research analyzing trend from previous reports (2011, 2012, 2013, and 2015). This research will assist the City of Tukwila in measuring current citizen and business compliance with Low Impact Development (LID) BMPs and other good wastewater management practices. This research also predicts how effective Tukwila's new storm water program is in reducing non-point water contamination. This year's research plan reflects the 2015 modifications to the NPDES permit requirements. Further changes to this research include a near three-fold increase in sample size to minimize margin of error and a longitudinal analysis comparing previous respondents' 2017 answers with their 2011, 2012, 2013, and 2015 ones. The purpose of the longitudinal research is to measure absolute behavior in Tukwila citizens, an analysis which requires no margin of error calculation and increases the study's precision.

Objectives:

Content areas for research include measuring:
- General knowledge of storm water and where it goes
- General knowledge of illicit storm water flow into surface waters
    - What it is and its impact
    - How to prevent it
    - How to report it
- Current citizen compliance with environmental standards and regulations
    - Groups of interest: the general public and businesses (land developers, landscapers, and property managers or owners)
    - Environmental stewardship actions to protect storm water quality
        - Pet waste clean-up
        - Automotive care
            - Maintenance, including the disposal of old motor oil
            - Cleaning, including the use of hazardous supplies and soaps (biodegradable and non)
            - Storage of vehicle parts and automotive fluids
        - Lawn care and pollution in the yard
            - Fertilizer and pesticide use and storage
            - Grass clippings and leaves
            - Natural yard care
        - Home maintenance
            - Chemical use, storage, and disposal (including wastewater)
- Awareness of source control storm water BMPs and LID Principles

- Home building practices, including installing green roofs
- Landscaping to redirect storm water away from drains such as rain gardens and bio-retention ponds
- Use of porous surfaces vs those impervious surfaces such as concrete and asphalt used in drive ways, block ways
- Downspout and roof drainage placement
- Waste management, including dumpster and trash compactor maintenance (for businesses)

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Research Methodology

Quantitative Research

In order to validate the findings and inferences of this project, HR2 Research/Analytics used interactive voice/web surveys and in-person intercept surveys. This supported the empirical findings with the hard data necessary to reach the goals of this project. The proposed survey research design involved a random total statistical sample. All persons who do not meet the survey criteria were screened out of the survey.

Sampling Frame

The sampling frame involved a stratified probability sample of respondents living within the zip code of City of Tukwila. The sampling frame for the intercept surveys included 250 residents and 50 businesses or home owner's association (HOA) directors for a total of 300 samples, an increase in the totals from previous years' research.

The following table represents the sample sizes for the previous research project years of 2011 through 2013, 2015 and 2017.

Sample Totals	
Year	**Sample Size**
2011	100
2012	100
2013	103
2015	105
2017	50 - Business
	250- Residential

2017 Sampling Frame

Survey Type	Type	Number of Respondents	Details
Interactive Voice and Web Survey	Residential	250	Residential respondents living within zip code of Tukwila

			Business respondents using stratified sampling using a list of businesses identified by the City of Tukwila as having the highest impact on improving storm water quality
Interactive Voice	Business	50	

Questionnaire

Research questions was developed by HR2 Research/Analytics with input from the City of Tukwila storm water management leaders, Greg Villanueva and Ryan Larson. The survey consists of up to 30 variables relating directly to knowledge about storm water issues and practices respondents had adopted which protect the quality of storm water. Additional questions address an overall assessment of surface water quality and where illicit discharges should be reported. In the questionnaire development process for 2017 it was determined that stewardship activities which Tukwila residents have heard of or participated in within last year would be removed from the 2017 research. New content for the 2017 survey includes an assessment of citizens' understanding of Low Impact Development (LID) techniques.

Statistical Weighting

Statistical weighting is a technique that is critical in longitudinal research. During the process of data collection, demographic data from the U.S. Census is obtained to provide a base for weighting each year. It is important to know that this was done for the purpose of conducting longitudinal research and not to derive a favorable result.

Sample demographics—specifically, gender—are compared with distributions in the population within the city. Using the same weighting methodology utilized for the survey of 2011, 2012, 2013 and 2015, the collected data was ran through a statistical procedure to determine that there is no significant difference between weighted and un-weighted data.

Research Controls

HR2 Research/Analytics applied a variety of controls to help ensure that the research and analysis reach the highest quality that can be provided. The primary research controls employed in this study include the following:

Research Assistant Training

All interviewers participated in a special training session for this study. During this training session, the questionnaire is read and a discussion is held regarding the

objectives of the study, screening questions, skip patterns and techniques for handling potential complications. Interviewers raised questions and provide their professional feedback regarding potential interviewing challenges.

Pre-test the Survey

After the questionnaire is programmed in our interviewing software system, it was rigorously tested to assure all questions are asked and that data is accurately recorded to deem the validity of the survey.

Conduct Data Collection

Following a successful pretest of the questionnaire, voice-interactive interviews were conducted using the Ci3 CATI software, a recognized leader in computer-aided interviewing. Potential respondents were contacted on weekdays at various times throughout the afternoon and evening. An appointment procedure is used when necessary to minimize refusals and allow respondents to complete the survey at a convenient time.

Monitoring

Interviews were monitored by the data collection supervisor to ensure they are properly conducted and meet the agreed-upon standards.

Internal Peer Review

HR2 Research/Analytics used an internal review process called "CERA" (create, edit, review, approve) which is similar to academic peer review to ensure that each study meets or exceeds rigorous quality control standards. Through this process, several analysts review the statistical findings and offer critical feedback designed to increase the utility of the research and produce a clear and insightful report.

Incidence and Response Rates

The incidence rate represents the percent of individuals spoken to who are qualified to take the survey, meaning they spoke English and reported living within the city. The response rate represents the percent of qualified individuals we spoke to who agreed to participate and who completed an interview. Response rates above 50.0% are higher compared to other community-wide surveys and serve to increase confidence in the survey's validity and reliability. The incidence rate of the previous Tukwila storm water surveys conducted by HR2 Research/Analytics was 57.22%; previous response rates were at 55.83 %.

Use of Findings

HR2 Research/Analytics has made every effort to produce the highest quality research product within the agreed specifications, budget and schedule. The City of

Tukwila understands that HR2 Research/Analytics uses those statistical techniques, which, in its opinion, are the most accurate possible. However, inherent in any statistical process is a possibility of error, which must be taken into account in evaluating the results. Statistical research can reveal information regarding community perceptions only as of the time of the sampling, within the parameters of the project, and within the margin of error inherent in the techniques used.

Evaluations and interpretations of statistical research findings and decisions based on them are solely the responsibility of the City of Tukwila and not HR2 Research/Analytics. The conclusions, summaries and interpretations provided by HR2 Research/Analytics are based strictly on the analysis of the data gathered, and are not to be construed as recommendations; therefore, HR2 Research/Analytics neither warrants their viability nor assumes responsibility for the success or failure of any customer actions subsequently taken.

Analysis and Reporting

Statistical Analysis

We performed statistical univariate and multivariate analyses and identified significant differences among respondents. This analysis was beneficial in identifying trends and levels of support among respondents. HR2 analyzed the effects of the independent variables on the dependent variable, demand.

Longitudinal Method

For Longitudinal analysis, hypothesis derived from last two studies was tested to analyze trends. Techniques such as repeated measures ANOVA, regression, and linear discriminant analysis were used. These tests conducted with 2011,2012,2013, 2015 data and 2017 data, and multivariate analysis will be used to determine whether observed changes between 2011,2012,2013,2015 data and 2017 the studies are statistically significant.

Univariate Analysis

Univariate analysis consists of describing and analyzing the responses by each variable and for each group or area. The responses are shown graphically in most cases or in table format in cases where a large number of different responses are listed. Univariates such as means, the observed variability, point estimates, standard deviation, kurtosis, skewness, and shape of the distribution are explained in a clear, understandable manner to aid in understanding the data and relating the findings to the research goals.

Multivariate Analysis

Multivariate analysis, including multiple correlation, multiple regression, Chi-squared and Analysis of Variance (ANOVA) were utilized for this project. Multiple correlation analysis is concerned with the associations that exist among several variables. Multiple regression analysis is concerned with the nature of the relationship between those variables. Regressions show how a dependent variable changes with respect to a change in independent variables. Regression models can be developed that predict the values of a single dependent variable, such as purchase intent, based on a set of predicting or independent variables. Models such as this can help clarify the relative importance of a range of influencing factors on the purchase decision. Chi-squared is concerned with measures of association between category-level variables. These types of analyses will be performed to identify differences and relationships between subgroups. The multivariate analysis will include:

- Test of Significance
- Correlations analysis
- Chi Square
- Partial correlations and matrixes
- Cross tabulation
- ANOVA
- Regression (if needed)

Residential Results

Respondent Profile

<u>Residential</u>

Multivariate analysis of of respondents gender by year depicted no significant difference (p value = .405)

Respondents by Gender

Gender	2017	2015	2013	2012	2011
Male	48.10%	42.0%	49.5%	53.8%	50.07%
Female	51.90%	58.0%	50.5%	46.2%	49.93%
Chi Square Test	P value = 0.713, Pearson x^2 = 2.215, Cramer's V = .059				

Respondents by Gender: 2011, 2012, 2013, 2015, 2017

Familiar with Storm Water

Respondents were asked if they were familiar with the term storm water and 93% respondents were found to be familiar with storm water, only 7% of respondents were not aware.

Familiar with Storm water

7%

93%

■ Yes ■ No
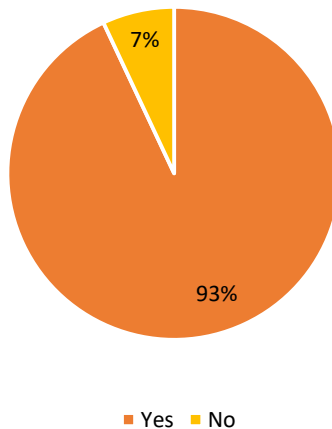
Years Lived in Tukwila

Analysis of water quality rating by number of years lived in Tukwila depicted highest mean of water quality rating of 7.33 by respondents who lived between 21 -30 years, followed by 31 -40 years in Tukwila.

Years Lived in Tukwila	Proportion	Mean Rating
<= 10	34.7%	6.27
11 - 20	31.3%	5.59
21 – 30	14.4%	7.24
31 - 40	6.2%	7.39
>= 41	13.4%	6.18

Number of Years in Tukwila
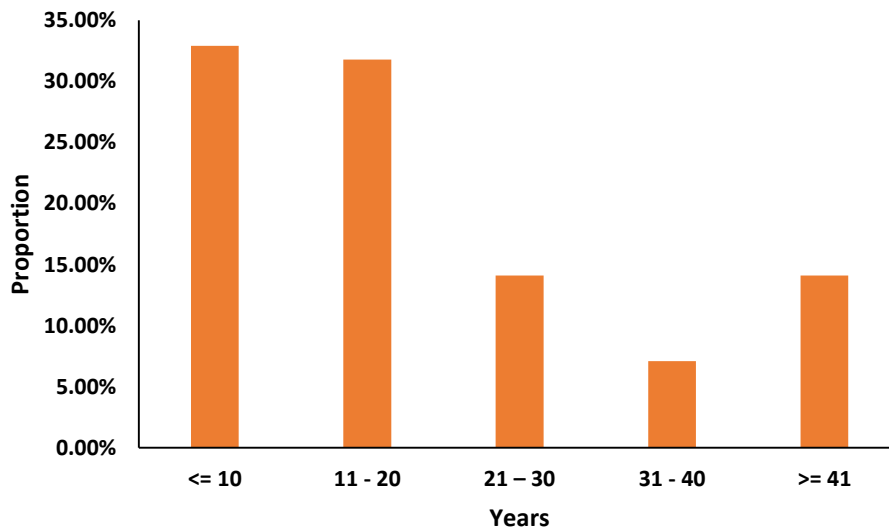
Proportion water quality ratings of respondents by number of years lived in Tukwila

Rating water Quality	< = 10	11 - 20	21 - 30	31 - 40	>= 41
0 – 3	10.2%	18.8%	-	-	5.3%
3 – 6	36.7%	33.3%	38.1%	30%	26.3%
7 - 10	53.1%	47.9%	61.9%	70%	68.4%

House Ownership: Rent or Own

Proportion of Owner Vs Rent

House ownership	Proportion	Mean
Rent	26.8%	6.71
Own	73.2%	6.08

Analysis of water quality rating by house ownership

Rating water Quality	Rent	Own
0 – 3	13.5%	9.2%
3 – 6	21.6%	39.4%
7 - 10	64.9%	51.4%
Test of Significance	P value = .311, Cramer's V = .127	

Research Findings

Respondents rated the quality of water in Tukwila's rivers, wetlands, and lakes on a 0-10 numeric scale where 0 meant "extremely polluted" and 10 meant "extremely clean."

Surface water Quality Rating	2017	2015	2013	2012	2011
0 - 3	10.6%	3.3%	13%	8.7%	10.8%
4 - 6	34.3%	37.8%	39.8%	49.0%	51.5%
7 - 10	55.1%	58.9%	47.2%	42.4%	37.7%

Respondent Rating of Surface Water Quality by Year

Surface water Quality	2017	2015	2013	2012	2011
Mean Rating	6.24	6.62	5.94	5.97	5.82
Standard deviation	2.162	1.687	2.026	1.878	1.87
Kurtosis	.003	.299	-.011	.564	.775
Skewness	-.549	-.691	-.549	-.335	-.398
Test of Significance Water Quality Rating By Year	P value: 0.038, f = 2.55, eta^2 = .018				

Hypotheses were tested using the 0.05 level of significance as the criterion value for the chi-square analysis. When differences between groups reached this value, the finding is reported along with its level of significance which is stated as a p-value (e.g., $p = 0.04$). Chi-square test results that reach the 0.05 level of significance indicate there is at least a 19-out-of-20 likelihood that the finding is true. This is a generally accepted level of reliability for public surveys. Findings of no significance are also reported to provide the basis for conclusions regarding the uniformity of opinion across the sample.

Cramer's *V* is a statistical test that measures the degree of association between two categorical variables. For statistical tests that reach significance using chi-square, Cramer's *V* values are provided to describe the strength of the association between the variables. This measurement ranges between 0.0 and 1.0. The higher the level of association, the greater is the probability that the independent variable is causing an effect on the dependent variable. A measurement of 0 indicates there is no association between the two, meaning it is likely the independent variable has no systematic effect on the

dependent variable. A measurement of 1.0 indicates that variations in the independent variable completely match variations in the dependent variable.

Surface water Quality Rating	Test of Significance Water Quality Rating
By Gender	F = 2.084, p value = .151, eta^2 = .016
By house ownership (Rent or owner)	F = 1.258, p value = .287, eta^2 = .017
By number of Years lived in Tukwila	F = 3.305, p value = .019, eta^2 = .079

Difference in water Quality by Year

Surface water Quality Difference	p-value (Sig)				
	2017	2015	2013	2012	2011
2011	.470	.047	.994	.976	-
2012	.749	.096	1.000	-	.976
2013	.759	.130	-	1.000	.994
2015	.605	-	.130	.096	.047
2017	-	.605	.759	.749	.470

To analyze significant difference in water quality rating by year post-hoc multivariate tests of water quality by year depict significant difference in water quality. It was further analyzed that there was significant difference in water quality in year 2015 as compared to year 2011 (p value 0.047).

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Overall Trend of Water Quality Rating

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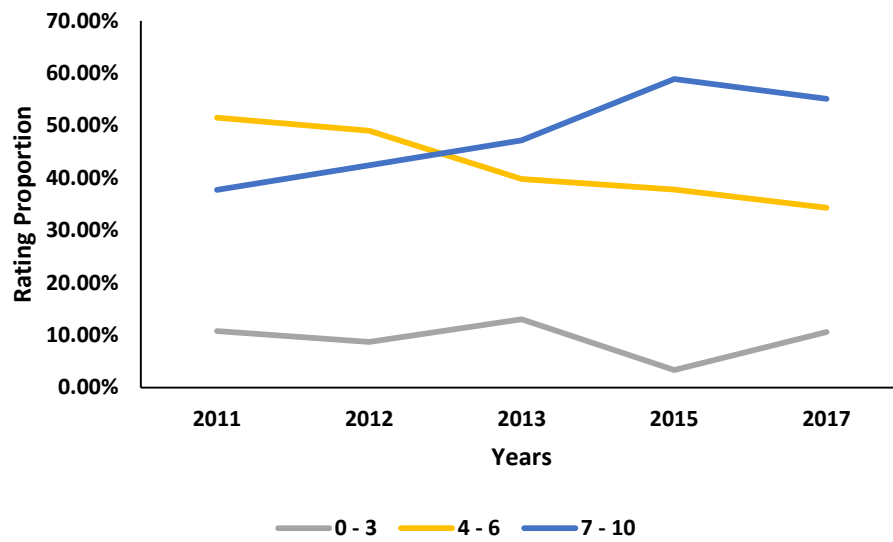
Opportunities for Expansion and Focus of Education Programs

The two main purposes of this survey were to assess changes in the public's storm water knowledge and related behavior from 2011, 2012 and 2013 to 2015. These comparisons are needed because of the city's educational program and to develop priorities for future storm water public education and outreach.

As in the baseline study, the results are organized by the percent of the respondents who provided a correct answer for the current survey—the lower the percent of correct answers given by the sample, the higher the priority for education:

Priority 1 Issues: Less than 50% correct answers
Priority 2 Issues: From 50 to 80% correct answers
Priority 3 Issues: Over 80% correct answers

In administering the questionnaire, respondents were presented with statements that were either true or false and were asked if they agreed or disagreed with the statement. Each of the statements in the tables appearing below include a letter indicating the correct answer for that statement, an **A** for "Agree" and a **D** for "Disagree. Responses for the knowledge questions were first categorized as being either a correct response or an incorrect response. The incorrect response category was made up of wrong answers plus responses classified as "need more information," "don't know/refused," and "not applicable."

Priority 1 Issues

Priority 1 issues represent areas of knowledge and behavior where less than half of the respondents provided the correct or desired response. Table 1 shows the percent of correct answers for Priority 1 issues in 2011, 2012, 2013, 2015, and 2017.

Priority 1 Issues (based on 2011 results)					
Statement	**% Correct**				
	2011	**2012**	**2013**	**2015**	**2017**
Q.12 The runoff from washing a car with biodegradable soap is safe in storm water drains. **D**	30.20%	31.00%	38.81%	28.00%	21.2%
Q.7 Pollution in our rivers, wetlands and lakes is more the result of commercial discharge practices than individual human activity. **D**	35.00%	43.60%	45.86%	20.79%	19.4%
Q.22 Bricks or pavers offer no advantage for reducing runoff over concrete or asphalt pavement. **D**	38.50%	42.10%	45.91%	42.00%	67.5%
Q.17 Sediment or dirt in storm water is natural and not regarded as pollution. **D**	48.00%	53.30%	48.72%	39.00%	30.4%
Q.22 Impervious surfaces and streets are better for managing runoff than porous ones. **D**	N/A	N/A	N/A	39.00%	22.5%
Q.16 Pesticides, fertilizers, and weed control chemicals add to storm water pollution. A	N/A	N/A	N/A	N/A	29.1%
Q.23 Use organic fertilizer for lawn care. **A**	N/A	N/A	N/A	N/A	23.3%

Related Multivariate Analysis Findings

The question where the public showed a statistically significant difference between the benchmark year 2015 and 2017 was:

1. Bricks or pavers offer no advantage for reducing runoff over concrete or asphalt pavement. The percent of correct responses increased from 42% in 2015 to 67.5%% in 2017. (p-value = 0.001, Cramer's = 0.314)

Statistically Significant Differences

There were no statistically significant differences in responses to Priority I issues when analyzed by Gender, by years in Tukwila and by home ownership.

Priority 2 Issues

- Priority 2 issues represent areas of knowledge and behavior where 50% to 80% of the respondents provided the correct response. Table 2 shows the percent of correct answers for Priority 2 issues in 2011, 2012, 2013, 2015 and 2017.

Priority 2 Issues (based on 2011 results)					
Statement	**% Correct**				
	2011	**2012**	**2013**	**2015**	**2017**
Q.12 When I wash motor vehicle at home, the biodegradable soap is safe in storm water drains. **D**	51.20%	45.80%	46.47%	39.24%	21.2%
Q.6 Drains on city streets for storm water are connected to the same sanitary or sewage system for waste. **D**	54.80%	46.50%	47.30%	42.16%	38.8%
Q.14 The best place to dispose of water from cleaning a Latex paint brush is in a sink inside, not outdoors. **A**	60.30%	64.00%	77.35%	49.00%	56.4%
Q. 7 Non-Point storm water runoff is the leading cause of pollution in rivers, wetlands and lakes. **A**	62.30%	60.70%	73.08%	56.86%	50.0%
Q.15 Chemical treatments to kill moss on roofs pose little risk for polluting storm water. **D**	63.20%	61.50%	77.05%	54.00%	45.6%
Q.20 An *illicit* or *unlawful storm water discharge* is primarily defined as anything that enters a storm drain system that is not made up entirely of storm water. **A**	64.30%	58.50%	65.46%	68.00%	60.0%
Q.13 Washing a vehicle at a commercial car wash causes less pollution than washing a vehicle on the street using a biodegradable soap. **A**	67.40%	62.50%	73.67%	68.00%	56.5%
Q.22. Unlike porous surfaces such as gravel and brick, impervious surfaces such as concrete and asphalt prevent water from passing through to be absorbed by the underlying soil. **A**	71.60%	71.90%	71.47%	53.00%	67.5%
Q.18 The downspouts at my house convey the water to an area where it is absorbed by the ground. **A**	79.90%	85.60%	78.29%	77.08%	67.1%
Q.26 Disconnecting roof drains from the storm water system and allowing the runoff to flow into the rain gardens and the landscape is a low impact development technique. **A**	NA	NA	NA	NA	63.3%
Q.28 Infiltration trenches, drywells, and other features store storm water runoff and allow it to soak into the ground over time	NA	NA	NA	NA	45.6%

Priority 3 Issues

Priority 3 issues represent areas of knowledge or behavior where more than 80% of the respondents provided the correct response. Table 3 shows the percentage of correct answers for Priority 3 issues in 2011, 2012, 2013, 2015 and 2017.

Priority 3 Issues					
Questions	**% Correct**				
	2011	**2012**	**2013**	**2015**	**2017**
Q.10 Oil changed by auto shop. **A**	NA	NA	NA	NA	79.5%
Q.29 Price of protecting our water ways from pollutants compared to cleaning contaminated water is less **A**	NA	NA	NA	NA	76.4%
Q.11 My family stores auto fluids and other chemicals under a cover away from weather. **A**	92.60%	93.20%	97.92%	91.01%	84.7%

Multivariate Analysis Findings

Multivariate Analysis depicted significant differences in the following responses

1. The downspouts at my home convey the water to an area where it is absorbed by the ground so it doesn't flow into the road. By number of years in Tukwila depicted significant difference p value = .035, Cramer's V= .298

Downspouts helps to absorb water by number of years in Tukwila

Q.18 The downspouts at my home convey the water to an area where it is absorbed by the ground so it doesn't flow into the road.	Years in Tukwila				
	< = 10	11 - 20	21 - 30	31 – 40	>= 41
Agree	50%	62.5%	90.0%	100%	81.8%
Disagree	17.9%	29.2%	10.0%	0%	0%
Others (Need more info., uncertain)	32.10%	8.30%	0%	0%	18.28%

2. Familiar with the term: Storm water runoff By gender depicted significant difference p value = .001, Cramer's V= .278

Familiar with the term: Storm water runoff by gender

Q. 5 Familiar with the term: Storm water runoff	Gender	
	Male	Female
Yes	98.4%	84.7%
No	1.6%	15.3%

3. Yard care methods by house owners depicted significant difference p value = .022, Cramer's V = .345

Yard care by house ownership

Q.23 Select from the following all the yard care methods you use	House Ownership	
	Rent	Own
Apply inorganic fertilizer (standard commercial grade)	15.8%	13.1%
Apply organic fertilizer	0%	32.8%
Use de-moss treatment	5.3%	6.6%
Use pest control	10.5%	9.8%
None	26.3%	29.5%
N/A	42.1%	8.2%

4. Heard of Low Impact Development, also known as LID depicted significant difference by house ownership (p value = .045, Cramer's V = .289)

Heard of Low Impact Development by house ownership

Q.23 Select from the following all the yard care methods you use	House Ownership	
	Rent	Own
Yes	78.9%	50.0%
No	21.1%	50.0%

5. Installing brick, pavers, or pervious pavement is a low impact development technique depicted significant difference by gender(p value = .002, Crammers V = .427)

Installing brick, pavers, or pervious pavement is a low impact development technique by Gender

Q.25 Installing brick, pavers, or pervious pavement is a low impact development technique	Gender	
	Male	**Female**
Agree	42.1%	46.3%
Disagree	5.3%	9.8%
Need More Information	36.8%	4.9%
Uncertain	15.8%	39.0%

6. Drains on city streets for storm water are connected to the same sewage system and treatment centers as for regular household wastewater by House ownership. P value (.000, Cramer's V = .345) and by Gender (p value .032, Cramer's V = .311)

Drains on city streets for storm water are connected to sewage system by House ownership

Q. 6 Drains on city streets for storm water are connected to the same sewage system and treatment centers as for regular household wastewater	House ownership	
	Rent	**Own**
Agree	53.8%	14.0%
Disagree	5.1%	48.6%
Need More Information	20.5%	15.9%
Uncertain	20.5%	21.5%

Drains on city streets for storm water are connected to sewage system by House ownership

Q. 6 Drains on city streets for storm water are connected to the same sewage system and treatment centers as for regular household wastewater	Gender	
	Male	**Female**
Agree	24.7%	25.00%
Disagree	45.2%	31.9%
Need More Information	19.4%	15.3%
Uncertain	8.1%	27.8%

7. Oil change by Gender p value = .027, Cramer's V = .234

Oil change by gender

Q.10 Oil Change	Gender	
	Male	**Female**
NA	0%	4.1%
Auto shop	70.0%	82.2%
Myself	30.0%	13.7%

8. The runoff from washing a vehicle with biodegradable soap is safe in storm water drains by Gender (p value = .000, Cramer's V .511)

Runoff from washing a vehicle with biodegradable soap is safe in storm water by gender

Runoff from washing a vehicle with biodegradable soap is safe in storm water	Gender	
	Male	**Female**
Agree	35.5%	43.8%
Disagree	29.0%	12.3%
Need More Information	24.2%	0.0%
Uncertain	11.3%	43.8%

9. Where do you wash your car by house ownership p value = .006, Cramer's V = .223 and by years in Tukwila p value = .004, Cramer's V = .333

Carwash by house ownership

Q.13 Car wash	House ownership	
	Rent	**Own**
NA	17.9%	4.8%
Carwash	66.7%	53.3%
Home	15.4%	41.9%

Carwash by years in Tukwila

Q. 13 Car wash	Years in Tukwila				
	<= 10	11 - 20	21 - 30	31 - 40	41+
NA	13.7%	2.1%	5.3%	37.5%	0.0%
Carwash	72.5%	55.3%	47.4%	0.0%	52.6%
Home	13.7%	42.6%	47.4%	62.5%	47.4%

10. If you witnessed someone pouring a gallon of used paint thinner into a storm water drain, which agency would you call first to report it by house ownership p value = .000, Cramer's V=.399 and by gender p value = .031, Cramer's V = .320

Report storm water violation By House ownership

Q.21 If you witnessed someone pouring a gallon of used paint thinner into a storm water drain, which agency would you call first to report it?	House ownership	
	Rent	Own
The Washington Department of Ecology	35.1%	10.0%
The police Department	5.4%	10.0%
The city Public Works Department	21.6%	39.0%
911	5.4%	2.0%
Need more info	16.2%	15.0%
I would not report it	5.4%	2.0%
Don't know	10.8%	22.0%

Report storm water violation By Gender

Q.21 If you witnessed someone pouring a gallon of used paint thinner into a storm water drain, which agency would you call first to report it?	By gender	
	Male	Female
The Washington Department of Ecology	17.5%	16.4%
The police Department	6.3%	12.3%
The city Public Works Department	39.7%	26.0%
911	6.3%	0.0%
Need more info	17.5%	13.7%
I would not report it	3.2%	4.1%
Don't know	9.5%	27.4%

11. Infiltration trenches, drywells, and other features store storm water runoff and allow it to soak into the ground over time. P value .004, Cramer's V = .311

<u>Infiltration trenches, drywells and other helps to soak storm water by house ownership</u>

Q.28 Infiltration trenches, drywells, and other features store storm water runoff and allow it to soak into the ground over time	House ownership	
	Rent	**Own**
Agree	35.1%	52.6%
Disagree	0.0%	13.4%
Need more info	16.2%	17.5%
Uncertain	43.2%	15.5%
Refused	5.4%	0.0%
Doesn't Apply	0.0%	1.0%

Lawn and Moss Care

Q.19.a Get lawn professionally fertilized				
Yard care method	**How often fertilize**			
	Monthly	**Less than a month**	**Annually**	**NA**
Inorganic fertilizer (standard commercial grade)	75%	0.0%	0.0%	25%
Organic Fertilizer	0.0%	0.0%	66.7%	33.3%
Use de-moss treatment	0.0%	0.0%	100%	0.0%
Pest Control	0.0%	0.0%	100%	0.0%

Q.19. b Lawn not fertilized professionally				
Yard care method	**How often fertilize**			
	Never	**Less than a month**	**Annually**	**NA**
Inorganic fertilizer (standard commercial grade)	20%	20%	60%	0.0%
Organic Fertilizer	35.7%	14%	28.6%	21.4%
Use de-moss treatment	0.0%	0.0%	100%	0.0%
Pest Control	49.2%	0.0%	14.3%	42.9%

Reporting Storm water Violations

Respondents were asked the following question: *"If you witnessed someone pouring a gallon of used paint thinner into a storm water drain, which agency would you call first to report it?"* A variety of options were given as choices.

Q.21 If you witnessed someone pouring a gallon of used paint thinner into a storm water drain, which agency would you call first to report it	Proportion
The Washington Department of Ecology	17.3%
The police Department	9.9%
The city Public Works Department	34.6%
911	2.5%
Need more info	16.0%
I would not report it	3.7%
Don't know	16.0%

<u>Multivariate analysis of storm water violation</u> by gender, years lived in Tukwila and house ownership depicted no significant differences.

Multivariate test of storm water reporting violation reporting depicted significant differences by years 2011, 2012, 2013, 2015, 2017 (Chi square = 91.065, p value = .000, Cramer's V = .241)

<u>Reporting Storm water violation by Year</u>

Q. 21 If you witnessed someone pouring a gallon of used paint thinner into a storm water drain, which agency would you call first to report it	2011	2012	2013	2015	2017
The Washington Department of Ecology	34.0%	23.0%	16.7%	37.9%	17.3%
The police Department	8.0%	7.0%	16.7%	10.3%	9.9%
The city Public Works Department	23.0%	16.0%	50.0%	26.4%	34.6%
911	13.0%	28.0%	16.7%	23.0%	2.5%
Need more info	17.0%	15.0%	0.0%	0.0%	16.0%
I would not report it	2.0%	4.0%	0.0%	2.3%	3.7%
Don't know	2.0%	5.0%	0.0%	0.0%	16.0%

Major Causes of pollution in and around Tukwila

Respondents were asked what they think are the major causes of pollution. Following are the responses:

- People and littering

- Industrial wastes such as lubricating oils and oil spills from cars

- The mall. It attracts cars, has multiple restaurants, etc.

- Septic tanks not operating correctly, storm water runoff.

- Carbon monoxide from vehicles

- Businesses closer to the port

- Industrial, citizens improperly disposing of pollutants

- Misuse of storm water drains.

- Runoff from human and business activities

- Improper disposal of poisonous chemicals

- Boeing

- Ignorance of pollution laws, industrial runoff, ambivalence of population

- Highway traffic/ carbon pollution. BNSF railway pollution/ industry

- Lawn and auto runoff

- Cars, residential and commercial property runoff.

- Pesticides, soap from car washing.

- Careless dumping of pollutants

- Leaking septic tanks, DIY mechanics illegally disposing of oil, fluids,

Business Results

HR² Research/Analytics

ASSESSMENT OF CITIZEN AND BUSINESS
UNDERSTANDING AND ADOPTION OF TARGETED
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CITY OF TUKWILA

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Respondent's profile

Business Category

Business	2017
Restaurant	36.7%
Property Owner/Manager	53.3%
Automotive Company	3.3%
Other	6.7%

Business Categoty: 2017
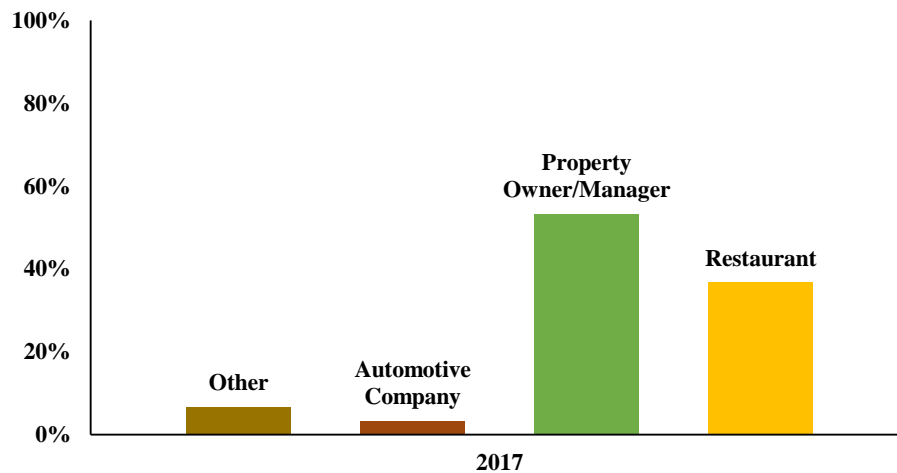
Water Quality Rating

Rating of water quality in 2017

Surface water Quality	2017
Mean Rating	6.67
Standard deviation	2.952
Kurtosis	.478
Skewness	-1.167
Test of significance by business category	F = 3.259, p value = .038

Rating of water quality in 2017 by business category

Surface water Quality	Mean
Restaurant	5.27
Property Owner/Manager	7.94
Automotive Company	8.00
Other	3.50

Research Findings

Statement	Agree	Disagree	Don't Know	No Response
Q.17 Sometimes wash or wastewater from our business ends up in the parking lot	33.3%	6.7%	0.0%	60.00%
Q.18 Wash water is disposed of into an internal building drain connected to the sanitary sewer system and not into the exterior storm water system.	36.7%	3.3%	0.0%	60.00%
Q.19 Wet mops are properly cleaned and stored.	36.7%	3.3%	0.0%	60.00%
Q.20 The dumpster at my restaurant is always closed after use.	33.3%	3.3%	3.3%	60.10%
Q.21 A proper way of disposing cooking oil and grease is through the storm water system.	30.0%	6.7%	3.3%	60.00%
Q.22 External wash water disposal is an illicit discharge.	36.7%	3.3%	0.0%	60.00%
Q. 23 Resident car washings are discouraged on site and suggested alternatives are provided.	46.7%	6.7%	0.0%	46.60%
Q.24 My complex has a designated area for residential car washing.	33.3%	16.7%	0.0%	50.00%
Q.25 In the last 12 months, my complex has implemented landscaping techniques to improve the absorption of rainwater.	3.3%	3.3%	0.0%	93.40%
Q. 26 Chemical treatments to kill moss on roofs pose little risk for polluting storm water.	50.0%	0.0%	3.3%	46.70%

Statement	Agree
Q. 4 Yes I am familiar with storm water runoff is rain that falls on streets, parking areas, sports fields, gravel lots, rooftops or other developed land and flows through pipes or other water conveyance into nearby lakes, rivers and the Puget Sound.	73.3%
Q. 6 Drains on city streets for storm water are connected to the same sanitary sewer system used for treating human waste	80.0%
Q. Non-Point Storm water runoff is the leading cause of pollution in rivers , wetlands, or lakes	93.3%
Q. 9 Non-toxic, biodegradable soaps do not pollute storm water runoff	90.0%
Q. 10 My employees have been trained properly on how to clean up hazardous spills.	80.3%
Q.11 My business has spill kits readily available in case of a hazardous spill.	83.3%
Q.12. a Contracted to clean parking lot and other hard surfaces	66.7%
Q.13 The trash container outside is in a contained area and does not leak	95.2%
Q.14 Sediment in storm water is natural and not regarded as pollution.	94.6%
Q.15 Planted vegetation in the landscape reduces storm water pollution?	96.1%
Q.16 A key principle for effective storm water management is to reduce the amount of storm water runoff.	96.7%

Residential questionnaire

Hello, this is _____ from HR² Research/Analytics on behalf of the City of Tukwila. We are asking residents about important storm water issues and we would like to include your opinions. All your answers are strictly confidential and will not be connected to your name.

1. Would you be interested in participating?
    a. Yes **(continue with survey)**
    b. No **(Thank and terminate)**
2. How many years have you lived in Tukwila? **[Record Number]**
3. Do you rent or own your apartment or home?
    a. Rent
    b. Own
4. My first research question is about the water in Tukwila. I'd like you to rate your perception of the overall quality of the water in our city's rivers, wetlands and lakes. By "quality of water" I mean how absent it is from pollution. Could you please rate Tukwila's water quality on a 0 to 10 scale where "0" means the water is "extremely polluted" and 10 means the water is "extremely clean." **[RECORD NUMBER]**
5. Are you familiar with the term 'storm water runoff'?
    a. Yes
        i. How would you describe storm water runoff to your neighbor? **[Evaluate their response. If it does not match the following definition, then read the "King County" definition of storm water runoff. Ask them if this definition better reflects their understanding of storm water runoff.]**
    b. No [Read the following definition.]
        i. *Storm water runoff is rain that falls on streets, parking areas, sports fields, gravel lots, rooftops or other developed land and flows through pipes or other water conveyance into nearby lakes, rivers and Puget Sound.* [Definition adapted from kingcounty.gov]

[READ]

I will now be reading a number of statements regarding storm water. Some of these statements may be true, some may be false, they all may be true, or they all may be false. Unless indicated otherwise, the responses for each question are as follows: Agree, Disagree, Need more information, Uncertain, Don't Know, Doesn't Apply, *or* Refuse to Answer.

If you believe that a statement is true, please say 'Agree'. If you believe the statement is false, say "Disagree." If you are not certain about the statement and need more information, you can answer with "Need more information". If the question does not apply to you or your family, say "Doesn't Apply". Here is the first one. Do you Agree, Disagree, or Need more information about the following statement:

6. Drains on city streets for storm water are connected to the same sewage system and treatment centers as for regular household wastewater.
7. Non-point storm water runoff, or polluted water that can't be traced to specific culprits, is the leading cause of pollution in rivers, wetlands and lakes.

8. What do you think are the major causes of pollution in and around Tukwila? **[Verbatim]**

[ROTATE Q9-Q23] [NOTE: These questions will be asked in a random order to prevent sequencing bias.]

9. What is the acceptable method to clean up spilled oil on driveways? **[Verbatim]**
10. Do you get your oil changed at an auto shop or do you change it yourself?
    a. Go to an auto shop
    b. Change it myself
        A. What do you do with your car oil when you change it yourself? **[Verbatim]**
    c. Not applicable
11. My family stores all containers holding oil, antifreeze, transmission oil or other chemicals under a cover away from the weather.
12. The runoff from washing a vehicle with biodegradable soap is safe in storm water drains.
13. Do you wash your car at home or do you go to a car wash facility?
    a. Go to a car wash facility
    b. Wash at home
        A. What happens to the soapy water when you wash your car at home? **[Verbatim]**
    c. Not applicable
14. The best place to dispose of wastewater is in a sink inside, not outdoors.
15. Do you consider chemical treatments used to kill moss on roofs, decks, driveways or walks to be unharmful, a minor or a major cause of storm water pollution?
    a. Unharmful/Neutral
    b. Minor
    c. Major
    d. Need more information
16. Do you consider pesticides, fertilizers and weed control chemicals used in lawn care and landscaping to be unharmful, a minor, or a major cause of storm water pollution?
    a. Unharmful/Neutral
    b. Minor
    c. Major
    d. Need more information
17. Sediment or dirt in storm water is natural and not regarded as pollution.
18. The downspouts at my home convey the water to an area where it is absorbed by the ground so it doesn't flow into the road.
19. [Three-part question]
    a. Do you get your lawn professionally fertilized?
        i. Yes **[Record answer]**
        ii. No **[Continue to next part]**
            1. How often do you fertilize your own lawn?
                a. Monthly or more frequently
                b. Less than monthly
                c. Annually

d. Never
e. Not applicable
2. [If answer to part 1 was a, b, or c, ask:] The last time you used fertilizer, how did you determine the amount to apply to your lawn? **[Verbatim]**
20. *Illicit* or *unlawful storm water discharge* is primarily defined as anything that enters a storm drain system that is not made up entirely of storm water.
21. If you witnessed someone pouring waste materials into a storm water drain, which agency would you call first to report it? **[READ a-e]**
    a. The Washington Department of Ecology
    b. The police department
    c. The city Public Works Department
    d. 911
    e. Need more information
    f. I would not report it
    g. Don't Know
    h. Refused
22. Unlike porous surfaces such as gravel and brick, impervious surfaces such as concrete and asphalt prevent water from passing through to be absorbed by the underlying soil.
23. Select from the list all of the yard care methods you use
    a. Apply inorganic fertilizer (standard commercial)
    b. Apply organic fertilizer
    c. Use de-moss treatment
    d. Use pest control
    e. None
    f. Not applicable

[READ]
To conclude the survey, we would like to include questions about your knowledge of Low Impact Development.

24. Have you heard of Low Impact Development, also known as LID?
    a. Yes
        i. How would you describe LID to your neighbor? **[Evaluate their response. If it does not match the following definition, then read the Wikipedia definition of LID. Ask them if this definition better reflects their understanding of LID.]**
    b. No [Read the following definition.]
        i. *Low Impact Development (LID) is a term used to describe land planning and design approaches to manage storm water runoff. LID emphasizes conservation and the use of on-site natural features to minimize downstream runoff [adapted from Wikipedia.org].*
25. Installing brick, pavers, or pervious pavement is a low impact development technique.
26. Disconnecting roof drains from the storm water system and allowing the runoff to flow into rain gardens and the landscape is a low impact development technique.

27. To what degree does storm water collection through rain gardens reduce the amount of pollutants absorbed into the ground?
     a. Slightly Reduces Pollutants
     b. Significantly Reduces Pollutants
     c. Completely Reduces Pollutants
     d. Need more information
28. Infiltration trenches, drywells and other features store rainwater runoff and allow it to soak into the ground over time.
29. Do you think that protecting our streams, rivers and the Puget Sound from pollutants is less expensive, more expensive or about the same as cleaning contaminated water?
     a. More Expensive
     b. Less Expensive
     c. About the Same
     d. Need more information

[READ]
That concludes our survey. I want to thank you very much for your time and cooperation.
You have been very helpful. Have a good day!

Thank them and ask if they would like to be included in future Tukwila storm water surveys.
30. POSTCODE GENDER:
     e. MALE
     f. FEMALE
31. DATE: _____ Research Assistant:
     _____
32. PANEL: Yes/No

HR² Research/Analytics   ASSESSMENT OF CITIZEN AND BUSINESS
UNDERSTANDING AND ADOPTION OF TARGETED
STORMWATER BEHAVIORS   CITY OF TUKWILA

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Business Storm water Research Questionnaire
TUKWILA
QUESTIONNAIRE:
PROJECT #*1707040*

Initial Target Quota Cells

#	Sample Category	Completes	# of Questions
1	Restaurants	15	20
2	Property Owners/ Managers	20	20
3	Automotive Companies	15	20

Hello, may I speak to **[INSERT NAME ON SAMPLE]**?

IF NOT AVAILABLE, ARRANGE A CALLBACK.

Hello, my name is _____ and I am conducting research on behalf of the City of Tukwila. We are asking businesses to provide input on important environmental issues and would like to include your opinion. We would like to speak to the individual in your business who is most knowledgeable about your business.

S1. May I speak to the person responsible for this?
1. Yes
2. No   **[SCHEDULE A CALLBACK]**
3. Don't Know/Refused   **[SCHEDULE A CALLBACK]**

S2. Good! Your input is strictly confidential and will not be attached to your name or business. **[SHOW NAME OF BUSINESS CATEGORY ON SCREEN]**
[ENTER NUMBER FOR BUSINESS CATEGORY] You will be in our category labeled:
1. Restaurant
2. Property Owner/Manager
3. Automotive Company

1. What is your title? **[Verbatim]**
2. For how long have you held this position at your company? **[Record number of years]**
3. My first question is about the water in our area. I'd like you to rate your perception of the overall quality of the water in our city's rivers, wetlands, and lakes. By "quality of

water" I mean how free it is from pollution. Rate it on a 0 to 10 scale where "0" means the water is "extremely polluted" and 10 means the water is "extremely clean."
[RECORD NUMBER]

4. Are you familiar with the term 'storm water runoff'?
   c. Yes
      i. How would you describe storm water runoff to your neighbor? **[Evaluate their response. If it does not match the following definition, then read the "King County" definition of storm water runoff. Ask them if this definition better reflects their understanding of storm water runoff.]**
   d. No   **[Read the following definition.]**
      i. *Storm water runoff is rain that falls on streets, parking areas, sports fields, gravel lots, rooftops or other developed land and flows through pipes or other water conveyance into nearby lakes, rivers and Puget Sound.* [Definition adapted from kingcounty.gov]

[READ]
I will now be reading a number of statements regarding storm water. Some of these statements may be true, some may be false, they all may be true, or they all may be false. Unless indicated otherwise, the responses for each question are as follows: Agree, Disagree, Need more information, Uncertain, Don't Know, Doesn't Apply, *or* Refuse to Answer.
If you believe that a statement is true, please say 'Agree'. If you believe the statement is false, say "Disagree." If you are not certain about the statement and need more information, you can answer with "Need more information". If the question does not apply to you or your family, say "Doesn't Apply". Here is the first one. Do you Agree, Disagree, or Need more information about the following statement:

5. Illicit or unlawful storm water discharge is primarily defined as anything that enters a storm drain system that is not made up entirely of storm water.
6. Drains on city streets for storm water are connected to the same sewage system and treatment centers as for regular household wastewater.
7. Non-point storm water runoff, or polluted water that can't be traced to specific culprits, is the leading cause of pollution in rivers, wetlands and lakes.
8. What do you think are the major polluters of water quality in and around Tukwila? **[Verbatim]**
9. Non-toxic, biodegradable soaps do not pollute storm water runoff.
10. My employees have been trained properly on how to clean up hazardous spills.
11. My business has spill kits readily available in case of a hazardous spill.
12. Does your own staff clean your parking lot and other hard surfaces or do you have it contracted?
    1. Have it contracted
    2. Clean yourself
       i. What is your process?
       ii. How often do you do this?
13. The trash container area outside is in a contained area and does not leak.
14. Sediment in storm water is natural and not regarded as pollution.
15. Planted vegetation in the landscape reduces storm water pollution.
16. A key principle for effective storm water management is to reduce the amount of storm water runoff.
17. Sometimes wash or wastewater from our business ends up in the parking lot, alley, street, or in a ditch.

[INFO: Examples of 'wash' or 'wastewater' are the soapy runoff from washing a car, the rinse water from mopping a floor, the dirty water from washing the paint out of a paint brush, water used in a manufacturing process--generally, water that has something additional in it beyond plain water that you want to dispose of.]

18. **[ASK ONLY IF RESTAURANT COMPANY]** Wash water is disposed of into an internal building drain connected to the sanitary sewer system and not into the exterior storm water system

19. **[ASK ONLY IF RESTAURANT COMPANY]** Wet mops are properly cleaned and stored.

20. **[ASK ONLY IF RESTAURANT COMPANY]** The dumpster at my restaurant is always closed after use.

21. **[ASK ONLY IF RESTAURANT COMPANY]** A proper way of disposing cooking oil and grease is through the storm water system.

22. **[ASK ONLY IF RESTAURANT COMPANY] [AFTER ANSWERING THIS QUESTION, SKIP TO Q 37]** External wash water disposal is an illicit discharge.

23. **[ASK ONLY IF PROPERTY OWNER/MANAGER]** Resident car washings are discouraged on site and suggested alternatives are provided.

24. **[ASK ONLY IF PROPERTY OWNER/MANAGER]** My complex has a designated area for residential car washing.

25. **[ASK ONLY IF PROPERTY OWNER/MANAGER]** In the last 12 months, my complex has implemented landscaping techniques to improve the absorption of rainwater.

26. **[ASK ONLY IF PROPERTY OWNER/MANAGER]** Chemical treatments to kill moss on roofs pose little risk for polluting storm water.

27. **[ASK ONLY IF PROPERTY OWNER/MANAGER]** What is the primary method for controlling storm water on your site? **[Verbatim] [AFTER ANSWERING THIS QUESTION, SKIP TO Q 37]**

28. **[ASK ONLY IF AUTOMOTIVE COMPANY]** When cleaning a vehicle, rinse water, having little soap and dirt, can be safely added to a storm water drain.

29. **ASK ONLY IF AUTOMOTIVE COMPANY]** My Company disposes of all oils, chemicals, and other fluids through an approved disposal facility.

30. **[ASK ONLY IF AUTOMOTIVE COMPANY]** The best way to clean up small quantities of spilled oil is to fully absorb it using kitty litter or absorbent pads and deposit this waste in a garbage can.

31. **[ASK ONLY IF AUTOMOTIVE COMPANY]** All mechanic work is done indoors and under cover.

32. **[ASK ONLY IF AUTOMOTIVE COMPANY]** Scrubbing oil and grease spots on concrete or asphalt with soap and hosing it off is a good way to prevent polluting storm water runoff.

33. **[ASK ONLY IF AUTOMOTIVE COMPANY]** The area where my business washes vehicles allows the rinse water to flow to the proper sanitary sewer system.

34. **[ASK ONLY IF AUTOMOTIVE COMPANY]** My business stores all oils, soaps, chemicals, and other materials (like batteries and car parts) under a roof or cover or in a containment area. **["Cover" means shielded from rain. A "containment area" is a space surrounded by a wall that is constructed to prevent any spilled fluid from passing beyond it.]**

35. **[ASK ONLY IF AUTOMOTIVE COMPANY]** If a car or truck in our business is dripping oil, the leak is always contained immediately and fixed in a timely manner.
36. **[ASK ONLY IF AUTOMOTIVE COMPANY]** In my business, all waste, such as the particle dust from sanding or grinding, and all worn out car parts, such as old transmissions, radiators or brake pads, are all stored in a covered area out of the rain until disposed of.
37. **[ASK ONLY IF AUTOMOTIVE COMPANY]** All vehicles, mechanical parts and equipment stored outside are checked for leaks at least once a month.

DEMOGRAPHICS
38. What is your first name? **[NAME IS CONFIDENTIAL AND NOT REPORTED WITH RESPONSES]**
39. Approximately how many employees work at your company currently? **[Record Number]**
40. In your opinion, what is most effective method for educating your employees? For example, some employers put pertinent information in the employee manual or on a bulletin board. **[Verbatim]**

[READ]
That concludes our survey. I want to thank you very much for your time and cooperation. You have been very helpful. Have a good day!

Thank them and ask if they would like to be included in future Tukwila storm water surveys.
41. POSTCODE GENDER:
     g.   MALE
     h.   FEMALE
42. DATE: _____ Research Assistant: _____
43. PANEL: Yes/No
     1.   Email: _____

That concludes our survey. On behalf of the City of Tukwila, I want to thank you very much for your time and cooperation. You have been very helpful. Have a good day!