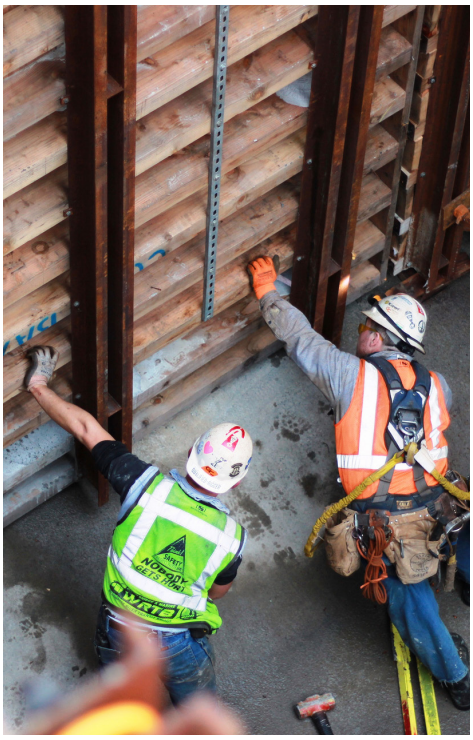
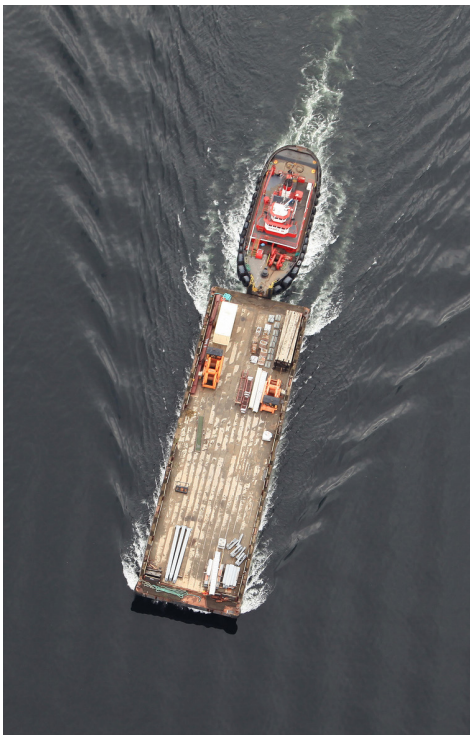
SR 520 Floating Bridge and Landings Project

Annual Sustainability Data Report

July 2013

Prepared for:
Washington State Department of Transportation





Washington State Department of Transportation

KGM

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Executive Overview

Project background

The Washington State Department of Transportation (WSDOT) has expressed a strong commitment to sustainability, which they define as a transportation system that preserves the environment, is durable, and takes into account how we build and the materials we use. The SR 520 Floating Bridge and Landings project represents an opportunity to pilot, test and create best practices that WSDOT can apply in future transportation projects, supporting the creation of globally responsible and locally responsive communities.

The SR 520 Floating Bridge and Landings project replaces the existing floating bridge and approaches from the future west approach structure east of Foster Island in Seattle to Evergreen Point Road in Medina. The project, which began construction in 2012, will deliver to travelers:

- A safer structure that is resistant to windstorms up to 89 miles per hour.
- Two general-purpose lanes and one transit/carpool lane in each direction.
- Wider, safer shoulders that will allow vehicles to pull over in the case of a breakdown.
- A 14-foot-wide bicycle and pedestrian path on the north side of the bridge.
- Ability to accommodate light rail if the region chooses to fund it in the future.

WSDOT required the winning design-build contractor – Kiewit/General/Manson, a Joint Venture (KGM) – to draft and implement a Sustainable Practices Plan for this project. The purpose of the plan was to describe and quantify the specific strategies and actions undertaken during design and construction to meet sustainability goals, as well as to lay a foundation for continuous improvement in sustainability throughout the life of the project.

Since adopting the plan in April 2012, the team has collected and analyzed data intended to measure baseline levels and, ultimately, progress toward established sustainability goals. These sustainability goals include:

- Reducing overall energy and water use during construction
- Maximizing recycling and the use of recycled materials
- Reducing the total carbon footprint of the project
- Reducing the project's impact to habitat and the surrounding community.

Throughout the life of the project, a standard monthly report communicates these results to a Floating Bridge and Landings Sustainability Task Force composed of KGM and WSDOT project staff. The task force works collaboratively to hit the targets described in the plan and to achieve overall continuous improvement.

The task force will produce annual reports of project performance data for the previous year's operations and a final, end-of-project report documenting measurements for the entire life of the project, including a full analysis of the impact of sustainable practices on project performance. This summary document encapsulates the sustainability data from the first year of the project.

What does the 2013 Annual Data Report contain?

This report provides an overview of the cumulative results from the first year of SR 520 Floating Bridge and Landings project data and presents stories of success. This report also provides an introduction to the overall process of collecting and reporting data, and measuring sustainability performance.

The 2013 annual report is a roll-up of the same data that is gathered and analyzed in standard monthly reports. The data reported monthly to WSDOT are ongoing measurements, such as monthly energy use or job site recycling rates.

The monthly and annual roll-up reports contain results from this ongoing data only. The monthly and annual reports are intended to capture performance trends over time, rather than one-time changes.

The team also tracks and analyzes static or one-time measurements, such as the total reduction in concrete usage resulting from a certain design decision. The final, end-of-project report will communicate results from these static or one-time measurements, in addition to all of the ongoing data.

Stories of success

The Sustainable Practices Plan emphasizes continuous improvement in construction methods and management practices. The following examples demonstrate how KGM consistently examines design and construction decisions and seeks new opportunities to improve the sustainable performance of the SR 520 Floating Bridge and Landings Project.

Design innovations

KGM proposed several changes to the design of the bridge that reduce the overall amount of materials required and the overall amount of work done on Lake Washington. These design changes include:

Low-rise column spacing: By reducing the spacing of the low-rise columns along the pontoons from 90 feet to 30 feet, KGM can use a thinner bridge deck. This approach reduces overall material use, and significantly reduces on-water concrete work, providing benefits both to habitat and water quality. This column spacing also allows KGM to use concrete columns instead of exposed structural steel. Concrete columns are more resistant to weathering and require less maintenance, reducing maintenance requirements over the lifetime of the bridge.

Footing design: Use of a new footing design allows KGM to eliminate the need for drilled shafts. This approach reduces concrete requirements by an estimated 12,500 cubic yards and also allows the footing to be buried below the mudline, reducing impacts to aquatic habitat.

High-strength rebar: Use of high-strength reinforcing bar ("rebar") has recently been approved for use in all WSDOT construction projects and is being incorporated into the bridge design. Current estimates show this approach may reduce the amount of rebar needed during construction by as much as 260 tons. Rebar used by crews has a cumulative 99 percent recycled content make-up across all job sites.

At left: crews tie rebar for pontoon construction in Tacoma.

Minimized grinding: The protective system for the bridge deck is designed to require only one grinding during construction, instead of the two grindings required in the WSDOT conceptual design. Grinding the road surface after construction removes irregularities, creating a smoother, quieter, and more skid-resistant surface. This approach offers significant benefits to Lake Washington and to local air quality. This design may also minimize the need for future roadway resurfacing.

East approach design: KGM made several design changes to the East Approach structure to reduce resource consumption. One change was elevating piers, which reduces concrete and steel use and also minimizes shading, which can impact salmon. Another change was shifting one pier abutment to the west. This shift decreases the amount of excavation and support structure required, as well as the amount of materials required for the bridge as a whole, resulting in a significant reduction in concrete, structural steel, rebar, and water.

Stormwater mitigation on new bridge: In a significant design innovation, the new SR 520 Floating Bridge will employ high-efficiency sweepers, modified catch basins, and mixing lagoons to limit pollution from vehicles entering Lake Washington.

Construction innovations

Increased materials reuse and recycling

Waste diversion and recycling: KGM recycles major construction materials, such as concrete, steel, rebar and wood, as well as comparatively smaller quantities of office and packaging items like paper and cardboard. So far, crews have recycled nearly 80 percent of the project's waste, preventing its diversion to a landfill.

At left: Crews use "skip" boxes to dispose of waste—the vast majority of which is recycled or reused.

Reduced fossil fuel use in transportation

Reduced travel distance for concrete trucks: KGM opted to locate one of the major project construction sites adjacent to the batch plant in Kenmore that provides concrete for the project. Compared to trucking the concrete from Kenmore to the bridge site on Lake Washington, this approach significantly reduces the project's impacts—both to regional traffic and to emissions. Over the lifetime of the project, this reduction in travel distance is estimated at nearly 200,000 fewer miles.

At left: The KGM construction site in Kenmore (top circle) is adjacent to KGM's primary cement supplier (bottom circle), reducing the project's trucking-related impacts to the environment.

Reduced water use in construction

Use of lake water for pontoon ballast: After crews float finished pontoons into Puget Sound, a barge fills the ballast cells of the pontoons with fresh water from Lake Washington. Using lake water rather than potable water for ballast results in significant water savings—estimated at around 1,765,850 gallons of potable water. That amount is roughly equivalent to 50 years of water use for a Puget Sound area resident.

At left: Kenmore crews load a truck with reclaimed stormwater collected on site.

Reduced energy use in construction

Use of electric power: Where feasible, KGM replaces fossil fuel-based power sources with electricity. One example of this switch is the use of electric tower cranes, which have significantly less impact than diesel-powered cranes with regard to noise, air pollution, and greenhouse gas emissions.

At left: Crews use electric tower cranes for building pontoons at the Tacoma work site.

Improved environmental quality for people and the natural environment

New stormwater infrastructure: In a permanent improvement as part of site preparation prior to construction work, KGM developed a stormwater system to capture, retain, and infiltrate water from typical storm events, and to provide improved on-site treatment and infiltration of water for significant storm events. There was previously no stormwater detention and treatment system on the Kenmore site.

At left: Crews survey the stormwater filtration system developed at the Kenmore site.

Year One Cumulative Results

For the first year of construction on the SR 520 Floating Bridge and Landings project, KGM gathered data on existing conditions in a number of categories, including total quantity of materials used, percentage of recycled materials used, energy and water consumed, and employee commute practices across all three job sites (Tacoma, Kenmore, and Medina). This section presents some of the results of this first year of data gathering.

Not all results are available after the first year of work. Some sustainability strategies had targets from the start, making it possible to track their performance in the first year and determine whether those targets are being met. However, some strategies do not yet have targets because there are currently no industry standards or metrics from which a target can be established. In these cases, the first year results become the baseline for future years.

For example, KGM is tracking energy use and water use during construction and will use this first year of data to set a baseline. In future years, it will be possible to compare performance against this baseline and assess the sustainable performance of various strategies KGM has put in place. For more information on setting targets and baselines, see the Next Steps section of this report.

Snapshot of Year One results

MATERIALS

Share of waste recycled/reused

80%
Overall rate

Measured by weight

Saves the equivalent of 44 garbage trucks filled with household waste from going to landfills each year

Recycled content of building materials

99% Rebar

84% Structural Steel

4% Concrete*

Measured by weight

**Structural requirements limit recycled concrete use*

REGIONAL SOURCING

Average distance traveled

0.18 miles

Distance between source of materials and job site per cubic yard of concrete poured

This metric allows us to make a useful comparison across sites.

Percentage of materials sourced within 500 miles

38% Rebar

62% Structural Steel

85% Concrete

Measured by weight

Exceeding target

Target in development

Observations from Year One

Recycling and reuse rates across all job sites are exceeding targets.

Project-wide target: Reuse or recycle 75 percent of all major construction materials.

- Cumulative recycling rate to date (all job sites): 80 percent.
- Major construction materials recycled: Concrete, steel, rebar and wood.
- Other materials recycled: Office and packaging items, such as paper and cardboard.
- KGM created a repetitive design allowing for maximum reuse of concrete forms. The forms currently in use at CTC are on their third construction cycle.

Crews are using steel and rebar with large recycled content make-up, reducing the environmental impact of raw materials

Project-wide target: Continuous improvement

- Cumulative recycled content make-up to date (all job sites): 99 percent of rebar, 84 percent of structual steel, four percent of concrete.
- Determining the recycled content of products can be challenging and at times must be estimated (e.g., structural steel).
- The project has limited influence in setting the recycled content for materials, except in purchasing decisions. The product manufacturer or supplier typically sets the recycled content of its products.
- Options for structural concrete are especially limited. Some types of concrete include a high amount of recycled content; however, they are not typically used for critical structural applications, such as bridges.

Levels of regional sourcing are high, reducing the environmental impact of transporting materials and contributing to the local economy.

Project-wide target: Continuous improvement

- Cumulative regional sourcing rate (all job sites): 85 percent of concrete, 59 percent of structural steel, and 38 percent of rebar from within 500 miles. The materials travel on average less than a quarter of a mile (per cubic yard of concrete poured).
- The project has limited influence over the location of its material suppliers, except in purchasing decisions. Specific requirements—for example, the rebar needed at CTC—may require sourcing materials from farther than 500 miles away.

Background on the Sustainable Practices Plan

Development process and Sustainability Task Force

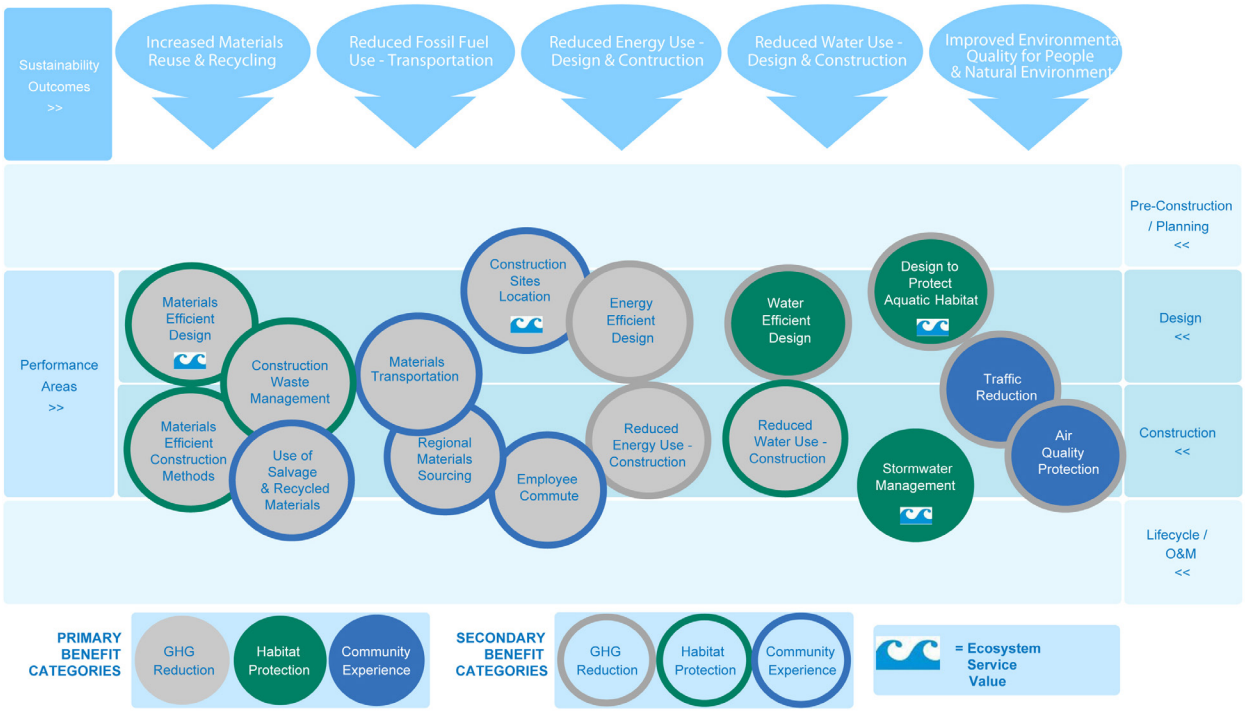
To develop the Sustainable Practices Plan for the SR 520 Floating Bridge and Landings project, KGM and WSDOT staff formed a joint Sustainability Task Force in November 2011. This group collectively determined the content of the plan, including what aspects of the project would be measured and how. The group first identified several joint goals in creating this plan:

- Recognize and quantify the sustainable design features, including those within KGM's proposal.
- Develop mechanisms for tracking progress of sustainable construction practices.
- Pilot a planning and tracking system that can be used on other major state construction projects.
- Base metrics on reasonably available data and straightforward methodologies.

Plan development began with creating a comprehensive structure to approach the sustainability planning, monitoring, and reporting required in the plan. For this purpose, the task force developed an overall Sustainable Design and Construction Framework, shown below.

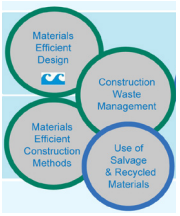
The framework defines the relationship between high-level project goals and the specific strategies that will be employed to achieve those goals. There are many "levels" of evaluation between those high-level goals and specific strategies; the framework graphic below does not contain all of the information that the plan measures.

Sustainability Framework

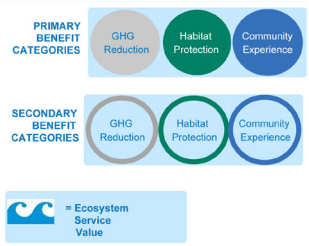


Here is how the framework is structured:

At the top are the high-level project sustainability goals, termed “sustainability outcomes.” These five areas set the direction for determining what areas of project performance will be measured.



At the next level are the various “performance areas.” This category includes discrete areas of work on the project that collectively roll up into one of the sustainability outcomes.



Finally, the framework identifies one primary and one secondary “benefit category” to each performance area. These categories define the main ways in which the level of anticipated benefits will be measured.

Plan development

The task force developed the Sustainable Practices Plan in stages because work did not begin at the same time at each of the three main KGM construction sites. Those sites are Concrete Technology Corporation (CTC) in Tacoma, the Kenmore Industrial Park construction site in Kenmore, and the eastern Floating Bridge & Landings site in Medina.

Volume 1: Off-Site Locations Plan (CTC and Kenmore job sites)
The first volume of the plan applied the sustainability framework to work at CTC and Kenmore, as crews began building pontoons, anchors, and other bridge components.

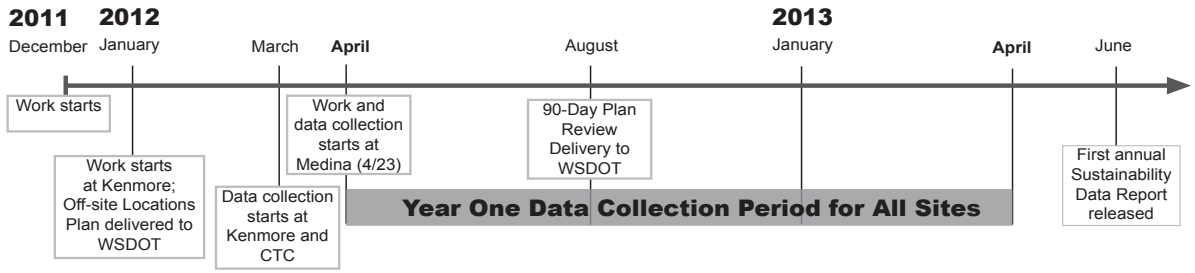
Volume 2: Floating Bridge and Landings Plan (Medina construction site)
The second volume of the plan expanded the analysis from the Off-Site Locations Plan to the Floating Bridge & Landings construction site in Medina, and included establishment of formal communications protocols, sustainability strategies, and monitoring for the full project. After adopting this version of the Plan, the team aggregated and reported jointly on data from the Kenmore and Medina sites as if they were a single location.

Volume 3: 90-Day Plan Review (“Lessons Learned” – all sites)
This third and final volume of the plan provided an initial progress report on the various sustainability strategies from three months of data collection on all sites, as well as lessons learned from the plan development process.

The plan is a living document, and may change slightly as the team learns more about what is and is not effective in achieving sustainability goals. However, because the plans have been reviewed, submitted and accepted, and they are considered final. Annual reporting will continue

through the completion of the SR 520 Floating Bridge and Landings project. The team will provide a Final Sustainability Report to WSDOT upon project completion.

The timeline below illustrates the evolution of the report volumes, leading up to the release of this first annual data report.



Data collection and reporting process

After finalizing the plan, the task force shifted to its current focus: assessing the overall performance of the plan's sustainability strategies. This section describes how KGM gathers, analyzes, and reports the project data, and how the task force uses that information to assess sustainability performance.

Data gathering

KGM gathers and provides all data analyzed and presented in the monthly reports. The company uses a variety of source materials, including utility bills, materials shipment or delivery invoices, and custom information-gathering tools, such as an Employee Commute Survey. KGM staff enters the data into a Data Collection Form (at right) developed specifically for this project.

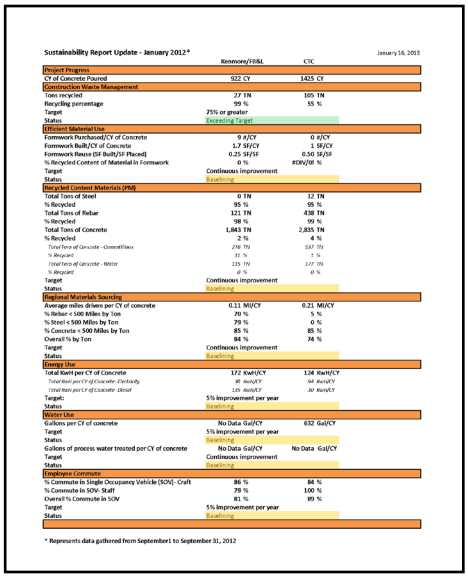
Month :

	QUANTITY	UNIT	NOTES
Craft Hours Worked		MH	
Sub Hours Worked		MH	
Location:			
Concrete Poured		CY	
Rebar			
Amount		tons	
% Recycled Content		%	
Material Source/Supplier			
Certifications			
Cost		$	
Permenant Steel Delivered			
Amount		TN	
% Recycled Content		%	
Description of Items			
Source/Supplier			
Temp Engr Steel			
Amount from Existing Stock		TN	
Amount Purchased		TN	
% Recycled Content of Purchased		%	
Source/Supplier			
Amount Returned to Stock		TN	
Amount Recycled		TN	
Amount of Steel Used in Formwork		TN	
% Recycled Content		%	
Concrete			
Amount		tons	
% Recycled Material		%	
Tons of Cementitious Material		TN	
% Recycled Cementitious Material by Wt		%	
Material Source/Supplier			
Water used in mix		gal	
% Water from recycled source		%	
Certifications			
Cost		$	
Wood			
Amount			
% Recycled Content		%	
Material Source/Supplier			

Data analysis and presentation

Once the data is entered, KGM transmits the completed form to the sustainability consultant team. The consultant team analyzes the raw data and drafts the standard monthly report to WSDOT.

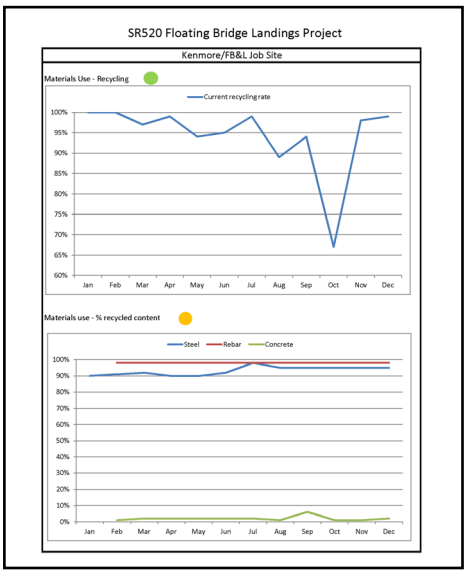
The team presents data in two ways, as illustrated in the sample reports below: a table showing results for the month, and a series of charts showing trends over time.



Sustainability Report Update - January 2012* January 16, 2013

	Kenmore/FB&L	CTC
Project Progress		
CY of Concrete Poured	922 CY	1425 CY
Construction Waste Management		
Tons recycled	27 TN	105 TN
Recycling percentage	99 %	55 %
Target	75% or greater	
Status	Exceeding Target	
Efficient Material Use		
Formwork Purchased/CY of Concrete	9 sf/CY	0 sf/CY
Formwork Built/CY of Concrete	1.7 SF/CY	1 SF/CY
Formwork Reuse (SF Built/SF Placed)	0.25 SF/SF	0.50 SF/SF
% Recycled Content of Material in Formwork	0 %	#DIV/0! %
Target	Continuous improvement	
Status	Baselining	
Recycled Content Materials (PM)		
Total Tons of Steel	0 TN	12 TN
% Recycled	95 %	95 %
Total Tons of Rebar	121 TN	438 TN
% Recycled	98 %	99 %
Total Tons of Concrete	1,843 TN	2,835 TN
% Recycled	2 %	4 %
Total Tons of Concrete - Cement/Flyash	*276 TN*	*537 TN*
% Recycled	*11 %*	*1 %*
Total Tons of Concrete - Water	*115 TN*	*177 TN*
% Recycled	*0 %*	*0 %*
Target	Continuous improvement	
Status	Baselining	
Regional Materials Sourcing		
Average miles driven per CY of concrete	0.11 MI/CY	0.21 MI/CY
% Rebar < 500 Miles by Ton	70 %	5 %
% Steel < 500 Miles by Ton	79 %	0 %
% Concrete < 500 Miles by Ton	85 %	85 %
Overall % by Ton	84 %	74 %
Target	Continuous improvement	
Status	Baselining	
Energy Use		
Total Kwh per CY of Concrete	172 Kwh/CY	124 Kwh/CY
Total Kwh per CY of Concrete- Electricity	*38 Kwh/CY*	*94 Kwh/CY*
Total Kwh per CY of Concrete- Diesel	*135 Kwh/CY*	*30 Kwh/CY*
Target:	5% improvement per year	
Status	Baselining	
Water Use		
Gallons per CY of concrete	No Data Gal/CY	632 Gal/CY
Target	5% improvement per year	
Status	Baselining	
Gallons of process water treated per CY of concrete	No Data Gal/CY	No Data Gal/CY
Target	Continuous improvement	
Status	Baselining	
Employee Commute		
% Commute in Single Occupancy Vehicle (SOV) - Craft	86 %	84 %
% Commute in SOV- Staff	79 %	100 %
Overall % Commute in SOV	81 %	89 %
Target	5% improvement per year	
Status	Baselining	

* Represents data gathered from September1 to September 31, 2012

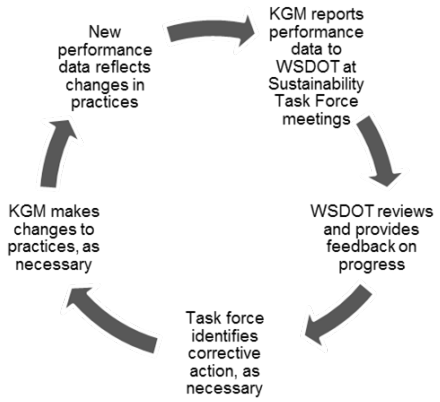


Data delivery and project feedback

KGM communicates performance results in two ways. Internally, KGM displays a custom "dashboard," showing each month's results, in one or more highly visible locations on the job site. KGM also regularly presents results, and communicates any highlights or actions required at regularly held internal "toolbox" meetings, where staff and crews briefly discuss work topics. Externally, KGM communicates these results to WSDOT through the standard monthly report.

The task force reviews the monthly reports to identify overall trends, potential issues, data gaps, and new design or construction innovations. If the task force identifies issues with performance, KGM communicates these issues back to the appropriate party. Once addressed, any resulting changes in performance show up in future monthly reports.

For example, on noting that recycling rates had dropped at one of the job sites, KGM staff contacted the site supervisor to identify the issue. In this example, it turned out to be a reporting issue, and not a performance issue. After correction, the recycling rate was back at expected levels in the next monthly report. The figure above shows this reporting and communications feedback cycle.



Based on performance data, KGM and the task force make adjustments in practices as necessary.

The task force team also created a short training video for project staff and crews, which introduces the on-site sustainability strategies and helps connect individual job site practices to high-level sustainability goals. KGM includes this training as part of the required new employee orientation.

Important data considerations

When reviewing the cumulative results from the first year of project data, it is useful to keep in mind the following important details of how the team analyzes and reviews this data:

Collection locations: As described above, monthly reporting is organized by job site; however, annual reporting and cumulative results combine data from all job sites.

Performance targets: Performance targets apply to the project as a whole; not for any individual job site. For example, if one job site only reached 90 percent of the target, but the other site hit 110 percent of the target, then the project would receive an aggregate 100 percent.

Limitations of annual report: The monthly and annual reports measure and present only design and construction strategies introduced after the adoption of the Sustainable Practices Plan. The monthly and annual reports do not measure strategies introduced early in the design process (before the adoption of the Sustainable Practices Plan). Their estimated impact on the overall project will be included in the final, project-end sustainability report.

Units of measurement: Much of the data is provided in units (tons, gallons, etc) per cubic yard of concrete poured. Information is reported in this activity-based way because, of the many kinds of work that happen on each job site, pouring concrete is the most significant common feature.

For example, it is not possible to make a useful comparison of overall energy used in April versus March, because the type of work taking place varies from job site to job site, and from month to month. But if both months involved using energy and pouring concrete, then it is possible to compare the amount of energy used per cubic yard of concrete poured, and extract useful information.

Job site naming: Data collected from January 2012 through March 2012 is for Kenmore only. However, Medina data collection started in April 2012, and the job site name changed to Kenmore-Medina. All data collected and reported for Kenmore-Medina (April 2012 and after) is combined data from both sites.

Annual report timeframe: Medina was the final job site to begin data collection. The task force agreed that April 2012 should mark the beginning of the official data collection and reporting cycle because all three sites were operational at that time. Therefore, this 2013 annual report (year one) runs from April 2012 to April 2013.

Next steps

During May and June of 2013, the task force began to review the detailed annual data described in this report in order to establish the baselines for evaluating the next project year performance and to brainstorm and prioritize strategies for improving the performance over the year.

Establishing baselines

Before measuring progress on any strategy, it is necessary to understand where the project stands now. The first year of data collection established numbers—called baselines—for various metrics, such as how much water and energy crews use at a specific site during a specific construction cycle. In future project years, the team can measure against those baselines to determine whether it is meeting its targets.

Setting accurate baselines is crucial so that sustainability commitments are achievable, but also represent true innovations, and not simply a continuation of existing construction practices. The baseline-setting process includes a quality-control measure to ensure that the baselines are accurate. During the first year of project work, KGM developed and used a suite of existing best practices for construction. This approach ensures a high level of performance from the outset of work, and that new practices and innovations are contributing to the sustainability results.

Most of the sustainability strategies being measured have targets, which represent a commitment to improve environmental performance over time. This project has three types of targets:

1. ***Quantitative reduction target:*** A simple example of a quantitative target is five percent reduction per year. The task force agreed on specific quantitative reduction targets for three areas: Job Site Energy Use, Job Site Water Use, and Employee Commute. The task force chose to treat these areas differently because of their high level of overall impact and ease of measurement. Based on the energy, water, and commute baselines established in the first year, the team is currently developing a suite of strategies that should enable KGM to hit the agreed upon targets. The team will continue to track and report progress on a monthly basis to ensure sufficient time for course correction if performance is not on track.

2. ***Continuous improvement target:*** This type of target simply measures whether the project team is exceeding expectations in a particular area year after year. The majority of the targets on this project fall into the continuous improvement category. Target setting for the kind of construction practices employed in building a floating bridge has not been done before, and no industry standards exist to provide quantitative reduction targets. Continuous improvement is a widely used measurement in sustainable business practices and rating systems, and ensures that KGM will continue to develop new innovations going forward.

3. ***High initial targets based on industry benchmarks:*** On this project, this approach is unique to the Construction Waste Recycling performance area. Instead of committing to target of continuous improvement, the plan established a high target from the beginning: recycling at least 75 percent of all project waste. The target is based on an industry benchmark from the Leadership in Energy and Environmental Design (LEED) rating system.

Commitments and future improvements

After establishing the baselines, the next step is to develop options for improving performance. In particular, where there is a quantitative target, the team must work to understand how much of an improvement a given strategy might achieve.

The task force is aiming to develop the baselines by the date of this report's release, and a suite of strategies that will improve performance over the next year soon afterward. The task force will present WSDOT with the results of second year activities and progress toward target performance in 2014.

Conclusion

The 2013 Annual Sustainability Report provides a summary of data collection from the SR 520 Floating Bridge and Landings project during the first full year of operation. Some early stories of success have already emerged, such as high rates of recycling and reusing materials and measures to curb water and fossil fuel usage. As a whole, it is too early to determine the project's progress toward the majority of the sustainability strategies, as the task force must first set baselines against which they can measure performance. However, much important groundwork was laid this past year. Going forward, the task force will tackle the challenge of on-going improvements. Future annual reports will present comparative information showing results over time.

The task force believes that tracking sustainability practices on the SR 520 Floating Bridge and Landings project will yield numerous benefits for the project team and future large-scale construction projects at WSDOT, nationally, and beyond. At a basic level, by gaining a greater awareness of sustainability strategies and progress, the project can reduce many negative environmental impacts while producing economic and community benefits.

In addition, no project of this scale has ever collected such a large and diverse volume of data related to on-site construction practices and the impacts of various sustainability strategies. Information from this pilot program will likely prove useful to WSDOT in analyzing and reducing impacts of future transportation investments. KGM will achieve a more fine-grained understanding of the impacts of various construction practices and strategies to reduce them.

Other construction projects both domestically and internationally may also benefit from this new guidance on understanding and quantifying the impacts of large infrastructure projects. Over the lifetime of this project, these reports will serve not only as a report of sustainable performance, but also as a source of information on various strategies and their results unlike anything that exists today.