King County
Department of Natural Resources
Solid Waste Division

Vashon Transfer/Recycling Station

Sustainable Materials Specification Review

Final Report
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prepared by:

Paladino Consulting
for Miller|Hull Architects

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I. Overview

The project is the development of the Vashon Island Transfer/Recycling Station, located on Vashon Island in King County, Washington. The building is a recycling facility for the distribution and transfer of waste and recyclable materials.

King County Capital Facilities Management has identified a sustainable approach to materials selection as a project goal. The Miller|Hull Partnership contracted with Paladino Consulting to review the project specifications from a sustainable perspective, and develop recommendations and new specification language in selected material categories.

This report provides the materials analysis for each of the materials categories. The information is organized in a nine grid matrix, presenting environmental impacts of energy use, environmental quality, and resource use over the production, use, and recovery phase of each material. These matrixes were used as a decision making tool, to target specification changes that would improve environmental performance.

With the information presented in these tables, specific recommendations for , specification revisions were developed. Various alternatives were identified and researched. Product information was obtained, and analysis performed. Options were accepted or rejected based on budget and program needs. Specification language was then developed to incorporate accepted options.

II. The Process

Project Scope

The scope of this project was determined by identification of a list of eleven materials categories to be targeted for research and specification development. These materials areas are:

- Concrete
- Ferrous Metals
- Aluminum
- Insulation
- Gypsum Wall Board
- Ceramic Tile
- Paint
- Resilient Flooring
- Modified Countertops and Faced Casework

The scope was bounded by giving priority to options that would not require structural revisions to building design detailing. Budget and schedule constraints limited the investigation in some cases. For example, the complexity of issues and possible alternates in the area of special coatings limited the range of alternates offered.

Research

Alternative products and construction methods within each of the materials categories were identified and researched. Research sources varied, and include documents published by neutral third parties, public agency information, manufacturer's product information, and verbal interviews with factory representatives.

In some cases, supplier and manufacturing sources provided conflicting information on a material. In this case, sources were requeried for supporting details, and secondary sources were queried to develop a more complete picture of the situation. Trade associations were also consulted for clarification on industry wide information.

Evaluation

The evaluation phase of the project involved assessing the feasibility of the materials alternates that were researched. Some of the possible alternates had to be investigated to determine their suitability to the particular project application. For example, in the case of the use of flyash as a substitute for Portland cement, evaluation revealed a possible problem. The only concrete mixer on Vashon Island, where the project is located, is limited to one hopper for concrete mixing operations, preventing ease of mixing Portland cement and flyash in the required ratios. Therefore, the use of pre-bagged cement/flyash products was chosen to make the implementation of the alternate feasible. In other cases,

the alternates were evaluated to ensure that they would function properly in conjunction with other building materials and design details.

Recommendations

As a result of the evaluation, specification recommendations were prepared. These recommendations were kept broad pending discussion with the client and approval or rejection of the change. Recommendations were presented to the client for discussion and review. The materials analysis matrixes were included in this presentation to establish an underlying understanding of the rationale behind the suggested specification changes.

Approval

The architectural design team reviewed the materials specification recommendations. In some cases, clarification of the recommendations was required. In other cases, if an alternative was rejected, another option was presented.

Specifications

Once final approval was received from the design team and the owner, alternate specification language was developed. Alternates are suggested not only regarding specific products, but also in their handling, storage, installation, and disposal. Alternates for associated materials are also suggested in some cases. In the case of resilient flooring, the material already specified was considered to be an environmental choice, so no alternate is suggested. The specification language was developed for ease of use by the architectural team, patterned after the original organization of the specifications.

III. The Findings

Format

Evaluating the environmental impact of industrial processes is complex and multi-layered, and can quickly become overwhelming and hard to comprehend. For this reason, Paladino Consulting offers a summary of environmental impact analysis organized into a matrix format. Three areas of environmental impact are reviewed. These are:

- Environmental Quality
- Energy Conservation
- Resource Efficiency.

Within each one of these areas, three specific phases of product use are considered.

These three phases comprise the entire life cycle of a material. The phases are:

- Product Use
- Product Production
- Product Recovery

Each impact area is assessed separately to ascertain significance and potential for improvement from a sustainable perspective. The resulting nine grid presentation of information can be used to target improvements in architectural decisions from an environmental standpoint. For example, the production phase of one material may have larger environmental impacts than in another area such as material use. Once a key area within the matrix is identified, a target can be set to improve environmental performance in this area of the grid, such as "Environmental Quality related to Product Use." This information can be used to aid in qualitative, as opposed to strictly quantitative decision making in selecting and using architectural materials.

Reading the Report

The material category findings are presented in a three part format. The analysis is presented in a nine grid matrix. Environmental impacts are shown in regular text, and recommendations are shown in ***bold italic*** text. Focus areas of opportunity are highlighted with a shaded box. The page following the matrix discusses the significance of the analysis and proposes a response. The final pages in each section show the proposed specification changes.

The Recommendations

The target areas for environmental improvement have been developed into the new specification language which follows, depending on the availability of alternatives and the requirements of the project such as budget and program needs. Following is the final specification language recommended by Paladino Consulting. The general numbering format of the original specification document has been conformed to, although in some cases the numbering system has been adjusted within this document to include information not in the original document. The spec language provided is either a revision of the existing spec or an addition to be added to the existing spec.

These products and their uses are suggested for their environmental benefits. Suitability for use on the project for specific detail and use conditions is ultimately the responsibility of the architectural design team.

CIP Concrete

A. Analysis Matrix

	Environmental Quality	Energy Conservation	Resource Efficiency
USE	Concrete has been found to have some low emmissions of aromatic and halogenated hydrocarbon .	Concrete provides thermal mass that can reduce energy use by shifting peak energy loads.	Low maintenance material. The use of concrete in building construction can offset some of the need for other materials such as structural steel and wood, and insulation.
	Seal slabs to prevent moisture wickage. Use waxes or synthetic non-stick treatments for forms, eliminate petroleum solvents such as creosote or diesel oil.	***Insulating formwork conserves energy.***	***Eliminate secondary floor finishes wherever possible.***
PRODUCTION	Production causes greenhouse gases, CO2, particulates. Mining of feedstock causes soil erosion, pollutant runoff, land and habitat loss, air and water quality degradation. Installation exposure caustic to skin.	Portland cement production requires large energy inputs in the firing process. Concrete has an embodied energy from 2401 to 4060 Btus per lb. (0.15 KwH/Lb). Steel production for the rebar has an embodied energy of 3.8 KwH/lb.	Component reserves of sand, gravel, and cement are plentiful. The use of disposable wood forms creates waste.
	Substitute flyash to displace portland cement, reducing embodied energy associated environmental effects.	***Substitute flyash to displace portland cement, reducing embodied energy.***	***Use glass cullet for sub-base. Avail. from Fibers (206/762-8520).*** ***Build forms from sustainably certified material, specify re-useable formwork, or require salvage or recycling of wood formwork.***
RECOVERY	Typically landfilled.	CIP concrete is durabile, requires energy to crush.	Concrete can be crushed for aggregate, used as structural fill, or road base.
	Crush and re-use on site can create dust and noise problems.	***Detail for rennovation and adaptation, as opposed to demolition.***	***No change.***

B. Discussion of Findings

The target areas selected for focus and specification revision are shown below.

Product Use - *Environmental Quality*

The **use** of concrete on site has impact in terms of the type of formwork and accompanying products used. Disposable forms use valuable resources, and form releasers which contain environmental toxins can negatively impact water quality. Reusable forms with low toxic form releasers are recommended.

Product Production - *Environmental Quality*

The **production** of Portland cement requires large inputs of energy and virgin materials. Therefore, reducing the amount of Portland cement used is a desirable goal. The use of waste flyash as a substitute for a portion of the Portland cement used in the concrete mix is recommended.

Research revealed that the only concrete supplier on Vashon Island has limited capability of using a custom flyash/Portland mix due to their manufacturing setup. Therefore, a pre-bagged flyash/Portland mix is recommended, thus making it possible for the concrete supplier to fulfill the spec requirements.

Product Production - *Resource Efficiency*

Use of recycled aggregate was investigated, but the engineering design required appeared to be extensive. It was also not possible to locate a clean quantity of source of material for the project. Information on recycled plastic aggregate concrete was found, but no local examples exist, and the idea was dropped.

Part 2 - Products

2.01 FORM MATERIALS

E. Reusable forms: Use reusable wood or metal forms to the maximum extent economically feasible. Clean all forms immediately after removal.

C. Form Coatings

2. Use waxes or water-based emulsion treatments for forms, shall contain no petroleum solvents such as creosote or diesel oil. The use as a form release agent of any substance which has not been specifically manufactured for that purpose is prohibited.

D. Manufacturers:

1. Duoguard II, WR Meadows, Elgin, IL 707/ 745-6666;

2. Bio-form, Leahy-Wolf Company, Franklin Park, IL 847/455-5710.

2.03 CONCRETE MATERIALS

A. Portland Cement

2. Portland cement manufactured in a kiln fueled by hazardous waste shall be restricted. Maintain a record of source for each batch.

B. Fly Ash: ASTM C 618, Type F. Fly Ash shall be form an approved source, tested and certified as required by the Engineer.

1. At no time in the course of the project will a change in the fly ash source be permitted with permission of the Engineer.

C. Pre-mixed / pre-bagged type I pozzolanic modified cement, from: a) Tilbury Cement Co., or b) Holnan Co.; 10-15% fly-ash or equivalent.

2.04 RELATED MATERIALS

I. Supplier shall certify that no hazardous waste is used in the fuel mix of cement kiln or raw materials.

J. Incorporate crushed concrete or masonry materials in sub-base to the maximum extent economically feasible in accordance with sub-base specifications.

2.05 CONCRETE PROPORTIONING

A. Supply a concrete mix with flyash as a minimum of *10%* and a maximum of *15%* of the cementitious content (by weight) of the concrete, with water / cement ratio as approved by the engineer.

Part 3 - Execution

3.19 WASTE MANAGEMENT

A. Separate and recycle waste materials in accordance with the Waste Management Plan and to the maximum extent economically feasible.

B. Give preference to suppliers who take back waste for reuse or recycling.

C. Place materials defined as hazardous or toxic waste in designated containers.

D. Use trigger operated spray nozzles for water hoses.

E. Use the least toxic sealants, adhesives, sealers, and finishes necessary to comply with the requirements of this section.

3.08 CONCRETE PLACEMENT

H. Preparation: Before concrete pours, designate locations or uses for excess concrete.

I. Before concrete pours, designate a location for cleaning out concrete trucks. Options include:

1. Company owned site for that purpose (meeting environmental standards).

2. Remote on-site area to be paved later in project.

End of Section

Steel fabrications

A. Analysis Matrix

	Environmental Quality	Energy Conservation	Resource Efficiency
USE	Steel does not outgas, so its use for interior environments has little effect on indoor air quality.	Steel penetrations at the envelope cause thermal bridging, increasing energy use.	Steel framing is displaces the need for wood resources used in lumber framing.
	Eliminate cold bridging and cold spots that may cause condensation inside the envelope.	***Consider snap caps and thermal break details, offset stud construction;***	***Use most efficient section of the lightest weight; Consider A572 substitution on selected members.***
PRODUCTION	Steel production can result in loss of land, water and air quality, and habitat. Dust and combustion emissions from refinement and furnaces are problematic. Sulfur dioxide emissions from coal combustion contribute to global	Embodied energy for steel is 3.8 KwH/Lb. Steel production is highly consumptive of energy in refinement and combustion.	Production is energy intensive. Iron is abundant, but iron ore is of varying quality and distribution. Coal is used for smelting, lime from limestone for smelting.
	Consider ISO 14000 requirements for any manufacturer; require letter of certification. Require shop finishing whereever possible.	***Resource efficient choices lower embodied energy.***	***Require heavy section melt mix to contain 90% or greater scrap content, production in electric minimill. Require thin section materials 25 % scrap content.***
RECOVERY	Emission control technology for refinement has improved emissions. Pollution has been reduced by 90%.	Mechanical recovery requires minimal energy.	Most steel is made from partially or totally recycled steel. Difficult to ascertain exact recycled content of materials being purchased.
	Consider ISO 14000 requirements for any scrap dealers; require letter of certification.	***Resource efficient choices lower embodied energy.***	***Spec details for cleaner recovery of metal; eliminate secondary finishes.***

B. Discussion of Findings

The target areas selected for focus and specification revision are shown below.

Product Production - *Resource Efficiency*

The **production** of steel is very energy intensive. Use of heavy gauge metal materials is recommended to have a minimum of 90% recycled scrap content, obtained from a regional mini mill. This results in a significant savings in embodied energy.

Smaller section steel is not necessarily smelted in the high recycling mini mills, so a lower minimum recycled content should be specified. The Steel Recycling Institute (800/876-7274) advises that light gauge ferrous metals have a minimum of 25% recycled scrap content.

Some compositions of steel are more efficient due to their superior strength. A 572 steel has a higher yield strength, in theory thinner sections can support the same load of a thicker A36 section. This requires engineering calculations and needs to be incorporated very early in the design. The idea was dropped due to the advanced stage of the project.

Product Recovery - *Resource Efficiency*

The **recovery** of steel is a well-accepted practice which can be specifically addressed in specification language. In order to close the loop on steel recycling, details are specified for clean recovery of metal. Use of the least toxic primers and finishes is recommended. Recycling separation is included.

Product Production - *Environmental Quality*

Several steel producers said they were considering the ISO 14000[1] protocol for environmental manufacturing, but none were currently following it. In the future this may be a way to distinguish manufacturers, as they all use very similar recycling practices based on material costs.

[1] ISO 14000, developed by the International Organization for Standardization (ISO), is the first set of generic business management standards which includes management of environmental impacts.

C. Specification Sections 05100, 05500, 05510, 05521,

Part 2 Products

A. Recycled Content: All heavy section steel components shall contain a minimum of 90 % recycled scrap content. Production shall be from a regional mini mill, electric arc furnace that utilizes locally generated scrap material as feedstock. Furnish letter of verification from steel producer.

Part 3 - Execution

3.08 WASTE MANAGEMENT

A. Coordinate with suppliers on reducing packing material, and backhauling of reuse or recycling.

B. Fold up metal banding, flatten, and place in designated area.

C. Separate for recycling and place in designated containers the following metal waste in accordance with the Waste Management Plan and local recycler standards: steel, iron, galvanized steel, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.

D. Use the least toxic primers and sealers necessary to comply with the requirements of this section.

End of Section

D. Specification Sections 07411 Manufactured Roof Panels, 07460 Manufactured Metal Wall Panels, Light Gauge Ferrous Metals

Part 2 Products

A. Recycled Content: All sheet and rolled steel components shall contain a minimum of 25 % recycled scrap content. Production shall be from a regionally located BOF mill that utilizes locally generated scrap material as feedstock. Furnish letter of verification from steel producer.

Part 3 Execution

3.08 WASTE MANAGEMENT

A. Coordinate with suppliers on reducing packing material, and backhauling or reuse or recycling.

B. Fold up metal banding, flatten, and place in designated area.

C. Separate for recycling and place in designated containers the following metal waste in accordance with the Waste Management Plan and local recycler standards: steel, iron, galvanized steel, galvanized sheet steel, stainless steel.

D. Use the least toxic primers and sealers necessary to comply with the requirements of this section.

End of Section

Aluminum fabrications

A. Analysis Matrix

	Environmental Quality	Energy Conservation	Resource Efficiency
USE	No known effects on IAQ.	High thermal transmittance	Low maintenance material.
	Anodizing and powdered coatings considered the most environmentally friendly finishes.	*Spec thermal breaks.*	
PRODUCTION	Feedstock is bauxite, strip mining can cause destruction of tropical forests, soil structure, and water quality. Hazardous waste generated from mining, fabrication, and finishing. Installation hazard exists from welding.	Embodied energy very high (103,500 Btu/lb.), OR 2.9 KwH.Lb./but it is a very lightweight material. Uses 1.4 % of worldwide energy consumption.	Raw materials: aluminum ore fluorides, petroleum pitch. Bauxite is a finite resource, about 8 percent of the earth's crust. Associated materials: coatings.
	Consider ISO 14000 Comliance for extruder, producer	*If aluminum is produced from recovered scrap and recycled aluminum, 80% of total energy consumption is saved.*	*Possible to spec secondary billet w/minimum 50 % recycled content material from extruder. Problems with finishes, some extruders won't warranty.*
RECOVERY	Metal recovery is a mechanical process, air and surface pollution is generated.	Minimal, recovery of material does not require appreciable energy, simple separation by mechanical means.	Aluminum must be recycled by alloy type. Material formulations require most scrap to be used in a lower grade alloy. Approximately 20% recycled content. Many alloys cannot be spec'd as 100% recycled.
	Clear finish requires less processing.	*Not Applicable*	***Recovery plant operation difficult to control as an end user, No action possible.***

Aluminum fabrications

B. Discussion of Findings

The target area selected for focus and specification revision are shown below.

Product Production - *Resource Efficiency*

The **production** of recycled content aluminum requires substantially less energy than virgin aluminum, making recycled content an attractive approach. In practice, the production of aluminum fabrications requires the material to be handled by a large number of processors. Each processor changes their practice and material formulation depending on who they are buying from and who they are selling to, making it difficult for King County, the end user, to influence the market.

Primary billet is used for the vast majority of aluminum fabrications, and never contains recycled content. Secondary billet contains post-industrial content, but does not extrude as well as primary billet. It is often used for truck bodies and other formed shapes. As the cost is comparable, most extruders use primary billet to lower production defects. Window fabricators also prefer primary material as it takes finishes better. As the risk of defects and finish failures seemed high in regards to this project, requiring recycled content for aluminum fabrications was dropped.

Product Recovery - *Resource Efficiency*

The **recovery** of aluminum is a well-accepted practice which can be addressed in specification language. In order to close the loop on aluminum recycling, details are specified for clean recovery of metal. Recycling separation and metal banding (packaging) recycling are included.

Part 3 Execution

WASTE MANAGEMENT

A. Separate corrugated cardboard in accordance with the Waste Management Plan and place in designated areas for recycling.

B. Provide covered storage area to protect materials and products from sunlight, moisture, staining, and impact or other damage.

C. Place materials defined as hazardous or toxic waste in designated containers.

F. Place used sealant tubes and other containers in areas designated for hazardous materials.

End of Section

Cavity insulation

A. Analysis Matrix

	Environmental Quality	Energy Conservation	Resource Efficiency
USE	Chemical release of release of fibers, binders, backing adhesives, and installation adhesives contain toxins problematic. EPA classifies fiberglass insulation as a probable carcinogen.	Thermal insulation has signifigant energy conservation and environmental benefits.	Most insulation materials will perform well over time, and fiberglass batts have good durability and long-term performance.
	Spec material with twisted glass fibers; Low or no-formaldehyde; Wrap batts in polywrap; Spec dye free white or yellow batts; Avoid fiber contact with airstream.	***Use BIB system for full cavity fill; Specify installation details carefully. Eliminate cold spots; use thermal stud caps to eliminate thermal bridging.***	***Verify detailing to prevent cold spots and resulting IAQ problems;***
PRODUCTION	Mining feedstock impacts air quality, damage to ecology and habitat, and water pollution. Ozone damage is caused by the use of (CFC's).	Energy required to produce different types of insulation varies. No reliable data is available at this time for comparison purposes.	Feedstock (sand, dolomitic limeston, and borax), all are abundant. Post-consumer glass is used for some (5-90%) of most fiberglass batt insulation.
	Select low or no formaldehyde products.	***Minimum 25% recycled content reduces embodied energy; high slag content further reduces embodied energy.***	***Glass can be 25% recycled content; Slag wool, an industrial by-product from iron ore blast furnaces can have 75% recycled content.***
RECOVERY	Because of dust and dirt, it is unlikely that any fiber insulation materials will be reprocessed into anything other than insulation.	Not Applicable	Capture of material difficult without deconstruction.
	Non-toxic approach minimizes problems during rehab or demo phase.	*Not Applicable*	*Non-tox improves capture potential. Some insulation contractors use a machine to chop up batt insulation from installation waste or demolition.*

Cavity insulation

B. Discussion of Findings

The target area selected for focus and specification revision are shown below. Several alternatives for insulation are available, ranging from cellulose to non-toxic formulations of fiberglass, to recycled content. Given the function of the project, the focus was on maximizing the recycled content.

Product Production - *Resource Efficiency* and *Energy Conservation*

The **production** of standard fiberglass insulation requires inputs of energy and virgin materials, and causes environmental damage in the form of ozone depletion. After determining that it could be used in the same configuration as fiberglass batts, rock wool was recommended. Rock wool insulation is recommended for its recycled content, which saves embodied energy and virgin materials. Rock wool is an industrial by-product from iron ore blast furnaces and can have up to 75% recycled content.

Rigid insulation is fairly uniform in it's thermal properties, so there was little to improve. Recycled content is where some products perform better than others, this is where the investigation was focused.

Part 2 - Products

2.01 GENERAL

Where choices exist in the provision of fiber insulation, preference is to be given to the following characteristics: natural mineral based rock wool, or post-industrial recycled content slag wool.

2.02 MINERAL WOOL

A. Rock wool insulation: ASTM C655 Mineral Fiber Batt composition. Made from natural basalt and diabase rock material, or from iron ore blast-furnace slag. R-values from 2.8 to 3.7 per inch, per thermal conductivity ASTM C518, post industrial recycled content of 75%. Insulation with foil reinforce kraft facing (FRK). Insulation and facing flame spread rating of 25 or less when tested in accordance with ASTM E84. Widths to suit condition of insulation.

B. Manufacturers:

1. Thermafiber LLC, Tacoma, WA 702/868-7711;
2. OCHT, Toledo, OH, subsidiary of Owings Corning, 419/248-6097;
3. Fibrex, Include, Westmont, IL; 630/887.1200;
4. Roxul, Inc., Milton. Ontario 905/878-8474, or approved equal.

2.03 ACOUSTICAL INSULATION

A. Rock wool insulation: ASTM E84. Unfaced sound control batts made from natural basalt and diabase rock material, or from iron ore blast-furnace slag, R-values from 2.8 to 3.7 per inch, post industrial recycled content of 75%. Widths to suit condition of insulation.

B. Manufacturers:

1. Thermafiber LLC, Tacoma, WA 702/868-7711;
2. OCHT, Toledo, OH, subsidiary of Owings Corning, 419/248-6097;
3. Fibrex, Include, Westmont, IL; 630/887.1200;

4. Roxul, Inc., Milton. Ontario 905/878-8474, or approved equal.

2.05 ACCESSORIES

A. INSULATION ADHESIVE

A. Use water-borne low odor, low VOC, Low VOC Franklin Construction Adhesive or equivalent.

Part 3 Execution

3.01 PRODUCT STORAGE

A. Store insulation in dry area to prevent growth of fungi an bacteria.

3.02 INSTALLATION

A. Install insulation snugly between framing members with all ends snugly fitted between other adjacent construction.

B. Carefully cut and fit around pipes, conduit, and other penetrations.

C. Do not use batts with ripped edges and backs.

D. Hand-pack around door and window framing with additional material.

E. Installers should wear protective clothing and respirators.

F. Use adequate ventilation during storage and curing.

G. Avoid insulation contact with HVAC airstream, especially with loose fill materials.

H. Seal insulation products within wall, floor and ceiling cavities with suitable vapor barrier. Carefully seal around all penetrations, including but not limited to: window and door openings, vent openings, duct joints, electrical outlets.

3.03 WASTE MANAGEMENT

A. Require waste management. plan from contractor for waste minimization and pollution prevention.

B. Separate and recycle waste materials in accordance with the Waste Management Plan.

End of Section

Rigid Insulation

A. Analysis Matrix

	Environmental Quality	Energy Conservation	Resource Efficiency
USE	Location of this product in typical installation applications makes it benign in regards to indoor air quality considerations.	Rigid board insulation provides a high R factor per square footage. In tight spaces, it is an energy efficient choice. Use good installation practices to increase the insulative quality of this material.	Most insulation material will perform well over time. Glass board insulation has the best long term performance. There is a tradeoff between cost and aging characteristics of the type chosen.
	Not applicable.	***Specify installation details carefully.***	***Use standard sizes in design to avoid waste; reuse scraps for infill. Require contractor to have recycling plan in place for offcuts.***
PRODUCTION	In the past most foam boards have been produced using ozone depleting CFC's. Less polluting HCFC's are now being used.	Embodied energy of polystyrene products: 50,400 Btu/pound of product. Embodied energy of polyurethane products: 31,040 Btu/pound of product.	The production of rigid board insulation requires input of finite fossil fuel resources.
	Pentane, the blowing agent in polystyrene, should be specified as the blowing agent for EPS insulation with a requirement for it to be recovered in order to avoid air pollution.	***Minimum recycled content levels minimize embodied energy.***	***Recycled content polystyrene insulation is available. The % recycled content varies, but up to 50% is possible depending on the individual manufacturing operation. Specify higher recyled content material.***
RECOVERY	Not applicable.	Not applicable.	Capture of material difficult without deconstruction. Lack of infrastructure for collection of waste can be an issue.
	Client can assist in closing the loop, divert from the landfill.	*Not applicable.*	***Polystyrene can be heated and remolded into new product. Polyurethane and phenol products cannot be remolded, but can be recycled as filler. Recycled content board should not be used if finish appearance is an issue.***

B. Discussion of Findings

The target area selected for focus and specification revision are shown below. The same insulation type as previously specified was recommended, with revisions in the recycled content and blowing agent spec.

Product Production - *Resource Efficiency* and *Environmental Quality*

The rigid insulation specified, EPS, is a good environmental solution for underslab insulation. The limit on recycled content is typically 15%, in order to keep defects and variations minimal. This is because of the use of the product in EIFS applications. The manufacturer reports that in theory 100% recycled content is possible. It is up to the local plant to determine what is acceptable. Requesting 50% recycled content may challenge some factory locations.

Pentane capture during manufacturing is also location specific. Requiring pentane collection will potentially eliminate some factories and could increase cost. The small amount of material in the project will not affect the total budget significantly.

C. Specification Section 07212

Part 2 - Products

2.01 MANUFACTURES/MATERIALS

A. Manufactures/Materials

1. Underslab - on-Grade: Expanded Polystyrene (EPS) with recycled content of 50% (25 % post consumer, 25% post industrial), pentane expanded. Manufacturer shall certify pentane collection capability at plant.

2. Manufacturers: AFM "Perform 1" unfaced EPS , or approved. AFM is specified for type, quality, construction and recycled content.

2.02 INSULATION ADHESIVE

A. Use water-borne low odor, low VOC adhesives for sealing.

B. Manufacturers: Low VOC Franklin Construction Adhesive, or equivalent.

Part 3 - Execution

3.02 INSTALLATION

B. Store insulation in dry area to prevent growth of fungi an bacteria.

C. Install insulation snugly between other adjacent construction.

D. Installers should wear protective clothing and respirators.

E. With rigid insulation, score and snap rather than saw material.

G. Seal insulation products within wall, floor and ceiling cavities with suitable vapor barrier. Carefully seal around all penetrations, including but not limited to: window and door openings, vent openings, duct joints, electrical outlets.

3.04 WASTE MANAGEMENT

A. Reuse scraps for gap filling where possible.

B. Separate and recycle waste materials in accordance with the Waste Management Plan.

C. Sub contractor shall work with supplier to take back waste for reuse or recycling.

Gypsum wall board

A. Analysis Matrix

	Environmental Quality	Energy Conservation	Resource Efficiency
USE	VOC's (hexanol) may be emitted from board or joint compound during curing. GWB can adsorb VOC's, acting a sink for pollutants. Installation hazard from dust.	Depending on the type of insulation used, GWP can dually function as a thermal barrier in walls where fire retardance is needed.	Maintenance is moderate, painting every 5 years. This is a fairly durable product.
	Low-toxic formula (increases dry time); bake-out to remove VOC's; wet sand joints/screws; store in well-ventilated area and apply surface finishes as soon as possible once installed to reduce adsorption of VOC's,	***Increase thermal mass with a double layer of rock.***	***Use standard sizes in design to avoid waste; require contractor to have recycling plan in place for offcuts.***
PRODUCTION	Mining raw materials causes particulate emissions, soil ersosion, habitat alteration, pollutant runoff, pollution from energy use in mining and processing. Paper production causes forest depletion and paper mill pollution.	Embodied energy 0.9/KwH/Lb Paper manufacturing is energy intensive.	Raw materials: gypsum, limestone, clay, talc, mica, perlite, Kraft paper, starch binders, mineral fibers. Material reserves are large.
	The greater the recycled content, the lower the off-site impacts.	***Savings of 30% of energy required for production of board paper can be saved if made from recycled stock.***	***Specify higher recycled content material; use wood waste reinforced GWG***
RECOVERY	If landfilled, can cause production of toxic gas (hydrogen sulfide.)	Not applicable.	Gypsum is 90% recyclable, although large scale recycling of this product is not currently done.
	Client can assist closing the loop, divert from landfill.	***Not applicable.***	***No issues.***

Gypsum wall board

B. Discussion of Findings

The target areas selected for focus and specification revision are shown below.

Product Production - *Resource Efficiency*

The **production** of standard gypsum wall board requires inputs of energy and virgin materials. Recycled content gypsum wall board is recommended. One product in particular has recycled cellulose fiber in a matrix of perlite and gypsum, and is especially durable.

Product Use - *Environmental Quality*

The **use** of gypsum wall board can negatively impact environmental quality during the curing process from board or joint compound VOC's. In addition, wall board can become a sink for VOC's from other building products. Priming or sealing of wall board as soon as possible after installation is recommended to prevent absorption of VOC's.

Gypsum Wall Board

C. Specification Section 09250

General

1.01 GENERAL ENVIRONMENTAL CRITERIA

A. Environmental considerations of gypsum wall board shall not supersede design and performance criteria in regards to health, safety and durability. The contractor shall immediately inform the owner of conflicts between recycled content and engineering performance.

PART 1- GENERAL

1.05 DELIVERY STORAGE AND HANDLING

A. Store GWB in well-ventilated area, remove any shrink wrap or packaging 24 hours prior to installation.

Part 2 - Products

2.02 ACCEPTABLE MANUFACTURERS

A. Add Louisiana Pacific FiberBond, which has recycled cellulose fiber in a matrix of perlite and gypsum, or equivalent.

Part 3 Execution

3.01A CONSTRUCTION SEQUENCING

A. Coordinate construction sequencing of installation, to prevent contamination of dry wall with offgassing from other wet materials being installed into the space.

3.03 INSTALLATION

A. Install drywall in continuous operation, apply joint tape and finish compound material immediately after GWB installation.

B. Apply sealant/primer as soon as possible once GWB is installed to reduce adsorption of VOC's.

C. Finish taped seams with wet sponge, avoid sanding to reduce dust/particulates.

3.06 WASTE MANAGEMENT

A. Reuse scraps for gap filling where possible.

B. Separate and recycle waste materials in accordance with the Waste Management Plan.

C. Sub contractor shall work with supplier to take back waste for reuse or recycling.

End of Section

Ceramic Tile

A. Analysis Matrix

	Environmental Quality	Energy Conservation	Resource Efficiency
USE	Not a contributor to poor IAQ. Adhesives, latex mortar, non-cementious grout and sealants can be source of air emissions. Installation hazard from cutting (dust), and inhaling fumes from adhesives.	Ceramic tile is a good source of thermal mass for passive solar gain.	Durable material. Maintenance is low for glazed types. In wet areas, mold may cause maintenance problems.
	Thick-bed set method is best. Allow cure time for adhesives, solvents, and sealers prior to building occupation.	*Not applicable*	***Consider thin sections to reduce material content. Require contractor to have recycling plan for waste material.***
PRODUCTION	Material becomes inert once fired, as component materials become fixed in vitreous matrix. Energy use and fuel combustion in mining and firing causes atmospheric pollution.	Embodied energy 0.9 KwH/Lb. Energy consumed for production has decreased due to mfg. efficiency improvements. Use of lower vitrification temperature materials such as glass reduce energy needed for firing.	Open pit mining cause habitat alteration, water pollution, and erosion, tailing and overburden waste. Adhesives from petrochemicals cauase resource depletion and water pollution.
		Some producers use waste materials for firing energy. Avoid toxic waste disposal as firing fuel.	***Raw materials: clay and sand, in abundant supply. Associated materials: mortar or adhesive, grout, sealers. Some manufacturers use recycled glass as feedstock. Min. 50% recycled content material.***
RECOVERY	Mechanical separation is not typical, waste usually landfilled.	Minimal energy use associated with recovery.	Recovery not typical.
	Material can be crushed for aggregate.	*Not applicable*	***Up to 70% recycled content ceramic tile available. Many tile manufacturers recyle fired scrap and reclaim waste dust.***

B. Discussion of Findings

The target area selected for focus and specification revision are shown below.

Product Production - *Resource Efficiency*

The **production** of ceramic tile requires large inputs of energy and virgin materials. Use of waste materials for both firing and tile material content are recommended. Tile products were recommended which contain recycled glass in their material content.

The existing spec contained one of the recycled content tile products recommended in this report. Additional recycled content tile options were also offered.

Part 2 - Products

2.03 MATERIALS

B. Recycled content ceramic tile: Use tile with minimum 50 % recycled content from one of the following suppliers or approved equal:

1. Stoneware Tile Company, Traffic Tile 317/935-4760
2. Summitville, 216/223-1511
3. Terragreen, Inc. 765/935-4760

G. Low Toxic Tile Adhesive:
Use low toxic, low-VOC, solvent-free tile adhesive, approved by manufacturer of the selected tile, from one of the following suppliers:

1. AFM Safecoat, 3-in-1 Adhesive,
2. Advanced Adhesive Technology, Inc.,
3. Chicago Adhesives Products Co.,
4. Capitol Adhesives, or approved equal.

Execution

3.03 INSTALLATION

A. Use low toxic adhesive for installation.

B. Allow flush time period of 72 hours for adhesives, solvents, and sealers, with adequate ventilation, prior to building occupation. Cure time per manufacturer recommendation.

3.06 WASTE MANAGEMENT

A. Separate and recycle offcuts and waste materials in accordance with the Waste Management Plan and to the maximum extent economically feasible.

B. Place materials defined as hazardous or toxic waste in designated containers.

C. Return solvent and oil soaked rags for contaminant recovery and laundering or for proper disposal.

D. Use trigger operated spray nozzles for water hoses.

E. Sub contractor shall work with supplier to take back waste for reuse or recycling.

End of Section

Water-based Paints

A. Analysis Matrix

	Environmental Quality	Energy Conservation	Resource Efficiency
USE	Installation risk from inhalation of VOC's, heavy solvent exposure and intoxication with alkyds. Ventilation required when applying product: especially during spraying and misting.	N/A	Most conventional paints are derived from nonrenewable petroleum sources: acrylic and latex resins, alkyd oils, fillers, pigments, preservatives, petroleum solvents.
	Increase ventilation rates for field appl., use construction sequencing. Look for soap and water clean-up, as disruption during re-application is minimized.	*Light colored interior paint surfaces complement energy conservation by bouncing light. Low-e formula available.*	*Some plant based paints are derived from renewable sources.* *Specify recycled paints.*
PRODUCTION	Volatile emissions can result in poor indoor air quality and contribute to smog production.	Limited to low perm paint, retains heat of water vapor in a space.	**Most durable are semi-gloss or gloss.**
	Low VOC formulas available. Specify materials non-toxic and non-carcinogenic(OSHA) materials, (preferably water based). Application best done in shop,	*Embodied Energy estimated at 9 KwH/Lb.*	***Paints with 100% recycled content are available. Factor in durability over duty cycle when evaluating any alternative.***
RECOVERY	Considered hazardous waste, must be disposed of properly by contractor.	Not Applicable.	Leftover is typically given to owner, or disposed at landfill.
	Recycling may be possible: approved landfill recommendation	*Not applicable.*	*Most paints can be recycled.*

B. Discussion of Findings

The target areas selected for focus and specification revision are:

Product Production - *Resource Efficiency*

The **production** of paint requires large amounts of virgin materials. Recycled content paints are recommended to reduce virgin material use and close the loop of recycling. These paints use paint from the local hazardous material disposal facilities, turning pollution into a resource.

Product Use - *Environmental Quality*

The **use** of paint can have a large environmental impact on building indoor air quality via the release of volatile organic compounds and paint pigments. Low VOC paint formulas which do not contain toxic metal pigments are available, and these were investigated as an alternate. After investigating, several low-toxic exterior paints were found, but did not have an established track record for durability. Given the function of the project, durability was given priority for exterior paint selection.

For interior paint, the choice is limited to either low VOC, or recycled content, but not both. There is not a large enough volume of low VOC paint being recycled, nor clear performance data on the mixed product, to allow recycled, low VOC to be specified. Given the function of the project, recycled content was given a priority in the interior paint selection.

Part 2 - Products

2.01 Materials

Alternates

F. Paint for Gypsum Wallboard:

Alternate 1. All paints shall have a minimum of 50% recycled content, by Rasmussen or approved.

Alternate 2. All paints shall be low in Volatile Organic Compounds (VOC), and not contain toxic metal pigments, as manufactured by: Benjamin Moore "Pristine", ICI Paint Stores "Lifemaster 2000", Sherwin Williams "HealthSpec", or approved equal.

Part 3 - Execution

3.15 CONSTRUCTION SEQUENCING

A. Coordinate 72 hour curing and flush period, with plentiful ventilation, prior to building occupation.

3.16 WASTE MANAGEMENT

A. Separate and recycle waste materials in accordance with the Waste Management Plan.

1. All paints shall be water based, allowing for water clean up. Use of kerosene or any such organic solvents to thin or clean up water based paints is prohibited.

2. Collect all waste paint by type and provide for delivery to recycling or collection facility.

3. Place all waste cans in designated containers for proper disposal as promulgated by the WA Department of Ecology.

End of Section

Part 2 - Products

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: (add) AFM enamel topcoat; Sherwin Williams "Water Based Catalyzed Epoxy Coating", Sherwin Williams "DTM" Acrylic Coating", or approved equal.

B. As an alternative for highbuild acrylic polyurethane enamel in INTERIOR use, use AFM GS Superhard Enamel, or equivalent.

2.02 MATERIALS

B. Primers

1. Use AFM Metalcoat Acrylic Metal Primer or equivalent, in conjunction with AFM topcoat system.

2. Use Sherwin Williams DTM Acrylic Primer/Finish with DTM topcoat, and Water Based Catalyzed Epoxy Primer with Water Based Catalyzed Epoxy Coating.

Part 3 - Execution

3.15 CONSTRUCTION SEQUENCING

A. Coordinate 72 hour curing and flush period, with plentiful ventilation, prior to building occupation.

3.16 WASTE MANAGEMENT

A. Separate and recycle waste materials in accordance with the Waste Management Plan.

1. All paints shall be water based, allowing for water clean up. Use of kerosene or any such organic solvents to thin or clean up water based paints is prohibited.

2. Collect all waste paint by type and provide for delivery to recycling or collection facility.

3. Place all waste cans in designated containers for proper disposal as promulgated by the WA Department of Ecology.

End of Section

Plastic Laminate Countertop

A. Analysis Matrix

	Environmental Quality	Energy Conservation	Resource Efficiency
USE	***Spec low-tox adhesive, Medex substitution, seal particleboard for offgassing, require installer to use respiratory protection; require construction sequencing.***	*Not applicable.*	*Maintain durability and duty cycle of substitutions.*
PRODUCTION	*Resource efficient substitutions will have cleaner production signature.*	*Not enough information to evaluate.*	***Require recycled paper feedstock; Substitute non-protroleum based mtl, soy composite or lightweight concrete; sustainably certified plywood or wood composite for substrate.***
RECOVERY	*Bio-composite is environmentally friendly; no hazardous or toxic substances.*	*Not applicable.*	*Spec material, and detail for future seperation and recovery.*

B. Discussion of Findings

The target areas selected for focus and specification revision are shown below.

Product Use - *Environmental Quality*

The **use** of laminated casework materials can contribute to indoor air quality problems due to the presence of resins and adhesives. Alternative substrate materials can be used to improve indoor air quality. Medex is suggested as an alternate substrate material with low VOC's. Sealing all exposed surfaces of substrates which are not low VOC and low toxic is recommended in order to seal these toxin sources from indoor air.

Product Production - *Resource Efficiency*

The **production** of substrate materials for countertops requires inputs of materials and resources. The use of recycled content substrates was recommended as an alternative to take advantage of recycled resources. Comply was recommended, and is a composite structural plywood panel system. Medex which was recommended is also made from This type of material uses small wood fibers and pieces as a substantial portion of its material component.

Part 2 Products

2.03 MATERIALS

G. Plywood

3. Cabinet Substrate alternate: Advanced Wood Resources "Comply" (800/533-3374) rated Exposure 1, or equivalent.

4. Cabinet Substrate alternate: Medite Medex (800/676-3339) rated Exterior grade and formaldehyde-free.

Part 3 - Execution

3.05 IAQ PROVISIONS

A. Seal substrates which are not low-toxic, low VOC by completely covering exposed edges with laminate

B. Installers should wear protective clothing and respirators.

C. Use adequate ventilation during storage and curing.

3.06 WASTE MANAGEMENT

A. Separate and recycle waste materials in accordance with the Waste Management Plan.

End of Section

Resilient Flooring

A. Analysis Matrix

	Environmental Quality	Energy Conservation	Resource Efficiency
USE	Offgassing continues for a long period, adhesive system contribute as well.	Not Applicable.	Baseline product is typically is very durable, contains recycled content.
	Non-toxic adhesives will provide a safer work environment; Recycled rubber mats provide cushioning for workers; Heavier linoleum sheets can be laid dry without adhesives; air out prior to installation.	*Not applicable*	***Linoleum is long lasting if properly cared for; synthetic rubber flooring has a long lifespan.***
PRODUCTION	Current product is non-renewable based material.	Data inconclusive, suspected to be higher than natural based materials.	Synthetic rubber is petroleum based.
		Data inconclusive, suspected to be lower than synthetic based materials.	***Natural products of linseed oil, cork, wood dust and dyes give this material great sustainability; Recycled content rubber uses waste as feedstock. Request manufacturer to use closed loop manufacturing including recycled content.***
RECOVERY	Non bio-degradeable.	Not Applicable	Closed loop available with synthetic rubber content.
	Natural alternatives bio-degradeable.	*Not applicable*	*Investigate closed loop recovery by manufacturer.*

B. Discussion of Findings

The target areas selected for focus are shown below.

Product Production - *Resource Efficiency*

The **production** of resilient flooring requires large amounts of virgin materials. The use of Nora Ecoplan supports the principle of using products based on closed loop manufacturing, in which the manufacturer uses its own waste and recyles it back into more product.

Product Use - *Resource Efficiency*

The **use** of non-durable resilient flooring that contains fillers decreases the durability and lifespan of the product's useful life. This causes the depletion of resources due to the need to replace the product. The resilient flooring specified, Nora Ecoplan, contains no fillers and is a very long lifespan product.

No change was suggested in the existing spec for resilient flooring, because it was found to be a good choice from an environmental perspective.

Product Appendices

Manufacturer information on the following products is provided for reference.

1. Duogard II form releaser
2. Bio-Form form releaser
3. ThermaFiber mineral fiber batt insulation
4. FiberBond gypsum wall board
5. TerraGreen ceramic tile
6. Sherwin Williams HealthSpec Paint
7. Sherwin Williams Catalyzed Epoxy
8. Sherwin Williams DTM Acrylic
9. AFM Safecoat Finishes and other products
10. Advanced Wood Resources/Oregon Strand Board Comply
11. Medex Medium Density Fiberboard