Phthalates in Exterior Use Products – Existing Data Summary

November, 2017

Prepared by Eva Dale and Heather Trim

Zero Waste Washington

This report summarizes existing information of phthalates as components of products that are used, or are potentially used in the exteriors of commercial or industrial sites. These data were compiled as a first step in the *Phthalates Research for Source Control* project because the project will build on previous work. Awareness of the types of products, the types of phthalates, and the range of concentrations allows for preliminary identification of products at sites in the Duwamish Waterway and Commencement Bay source areas which may contribute to loading in stormwater runoff.

Previous work has focused primarily on these phthalates: Bis (2-ethylhexyl) phthalate (DEHP), Butylbenzyl phthalate (BBzP), Diethyl phthalate (DEP), Dimethyl phthalate (DMP), Di-n-butyl phthalate/Dibutyl phthalate (DBP) and Di-n-octyl phthalate (DnOP).

Preliminary observations include:

- Some caulks and sealants are composed of up to 30% or more of phthalates
- Paint and other coatings may be important sources phthalates.
- Motor vehicle components and products may be important sources of phthalates.
- Hoses, including garden hoses, made of plasticized PVC contain phthalates.
- Products made of plasticized PVC may or may not leach phthalates (example: roofing).
- Many of the samples tested register as unknown quantities due to high laboratory detection limits which are associated with testing challenges.

In this Report

Phthalate Source Study

The City of Tacoma, Seattle Public Utilities and King County joined together to carry out a *Phthalate Source Study* in 2003-2004[1,2], comprised of two phases. Phase 1 of the study focused on collecting phthalate data associated with sediment in catch basins throughout the Thea Foss Watershed with the goal of identifying whether bis(2-ethylhexyl) phthalate DEHP[1] concentrations in sediments could be associated with nearby land

[1] Referred to as BEP in report

use. Highest concentration of phthalates in catch basins were observed at newly paved parking lots, areas with high automobile use and fast food locations.

Phase 2 of the study focused on sampling specific products and waste known or suspected to be a source of DEHP contamination in stormwater. The Tacoma portion of the study focused on solid materials that had outdoor exposures (

Table 1). High DEHP concentrations were found in serpentine belts, used cigarette butts, packing peanuts, brake pads, brake pad dust, and tires. In addition, di-n-butylphthalate (DBP) was found in used cigarette butts (200,000 µg/kg) but not new butts, some brake pads (17,000-22,000 µg/kg), and certain automobile serpentine belts (950-1,900 µg/kg). BBzP was found in packing peanuts and used car brake pad dust. DEP was found in some brake pads and some serpentine belts.

Table 1: Outdoor Solid Products, Phthalate Source Study 2003-2004, published in SPU and King County Progress Report (June 2003)

Phthalates (ug/kg DW)	Bis (2-ethylhexyl) phthalate (DEHP)	Butylbenzyl phthalate (BBzP)	Diethyl phthalate (DEP)	Dimethyl phthalate (DMP)	Di-n-butyl phthalate (DBP)	Di-n-octyl phthalate (DnOP)
Ford-Motorcraft Serp Belt-new	3,900	970 U	970 U	970 U	970 U	970 U
New Cigarette butt Marlbro light 100	5,400 U	5,400 U	5,400 U	5,400 U	5,400 U	5,400 UJ
Used Cigarette butt-Muni	67,000*	49,000 U*	49,000 U*	49,000 U*	200,000*	49,000 U*
Used Cigarette butt-TDome	49,000 U*	49,000 U*	49,000 U*	49,000 U*	210,000*	49,000 U*
Plastic Bottles -Tacoma Recycling	810 U	810 U	810 U	810 U	810 U	810 U
Packing Peanuts-Tacoma Recycling	18,000	670,000	9,500 U	9,500 U	9,500 U	9,500 U
Crafco AsphSealer	16,000 U	16,000 U	16,000 U	16,000 U	16,000 U	16,000 U
US Oil Liquid Asphalt- NC800	19,000 UJ	19,000 UJ	19,000 U	19,000 U	19,000 U	19,000 UJ
US Oil Asphalt Cement	20,000 UJ	20,000 UJ	20,000 U	20,000 U	20,000 U	20,000 UJ
Car Brake Pad Dust			NEED DATA			
Vehicle Undercoating			NEED DATA			
Atmospheric Dust Tires			NEED DATA			

U The analyte was not detected at or above the reported value
UJ The analyte was not detected at or above the reported estimated result
* Value is based on a 1:10 dilution

Seattle and King County focused on liquid products (

Table 2) and found DEHP in only four products including used oils, boat grey water and carwash rinsate. DEP was found in tire dressings and carwash rinsates. BBzP was found in boat gray water and used oils. While not tested in this study, researchers noted that diesel exhaust may be a source based on California studies.

Table 2: Outdoor Liquid Products, Phthalate Source Study, published in SPU and King County Source Control Program Progress Report (June 2004)

Phthalates (ug/L)	Bis(2-ethylhexyl) phthalate (DEHP)	Butylbenzyl phthalate (BBzP)	Diethyl phthalate (DEP)	Dimethyl phthalate (DMP)	Di-n-butyl phthalate (DBP)	Di-n-octyl phthalate (DnOP)
Drinking Water Through Barista Maker	0.45 U	0.29 U	1.05	0.19 U	1.88	0.29 U

Dishwasher Soap, McDonalds	4,800 U	6,000 U	10,000 U	4,000 U	10,000 U	6,000 U
Dish soap, Ultra Joy with aromatic release	3,600 U	6,000 U	10,000 U	40,000 U	10,000 U	6,000 U
Dish soap, Ultra Palmolive (antibacterial)	5,900 U	6,000 U	19,000 <RDL	4,000 U	10,000 U	6,000 U
All purpose, Cleaner, Simple Green (concentrated)	6,000 U	6,000 U	10,000 U	4,000 U	10,000 U	6,000 U
Boat tap water	1.90 U	0.31 U	0.52 U	0.21 U	0.52 U	0.31 U
Boat gray water	52	20	6.0 U	2.4 U	116	3.6 U
Tire Dresser Black Magic Tire Wet	10,000 U	30,000 U	176,000	20,000 U	50,000 U	30,000 U
Tire Dresser 1	10,000 U	30,000 U	700,000	20,000 U	50,000 U	30,000 U
Tire Dressing 2	10,000 U	30,000 U	701,000	20,000 U	50,000 U	30,000 U
Automated Car Wash Rinseate from Elephant Car Wash	7.98	0.32 U	1.53	0.21 U	0.53 U	0.32 U
Car wax/soap, Turtle Wax 2 in 1 Wash Plus Wax	5,100 U	6,000 U	10,000 U	4,000 U	10,000 U	6,000 U
Car care product Armorall Protectant	3,900 U	6,000 U	10,000 U	4,000 U	10,000 U	6,000 U
Car Wash Soap, Mother's California Gold Car Wash	9,600 U	6,000 U	10,000 U	4,000 U	10,000 U	6,000 U
Automated Car Wash product, Harmony Presoak 180 (Elephant Car Wash)	2,000 U	6,000 U	10,000 U	4,000 U	10,000 U	6,000 U
Automated car wash product, Harmony Triple Coat	302,000 U	6,000 U	1,320,000	4,000 U	10,000 U	6,000 U
Rain X	10,000 U	30,000 U	50,000 U	20,000 U	50,000 U	30,000 U
Clear Shield Windshield Fluid	5,100 U	6,000 U	10,000 U	4,000 U	10,000 U	6,000 U
Asphalt sealer	10,000 U	6,000 U	10,000 U	4,000 U	10, 000 U	6,000 U
Rainwater exposed to asphalt sealer	1,200 U	300 U	500 U	200 U	500 U	300 U
Driveway sealer, Henry 132 Driveway coating	10,000 U	6,000 U	10,000 U	4,000 U	10, 000 U	6,000 U
New Penzoil Oil, Synthetic	10,000 U	30,000 U	50,000 U	20,000 U	50, 000 U	30,000 U
Used Penzoil Oil, Synthetic*	75,000 <RDL	581,000	50,000 U	20,000 U	50, 000 U	30,000 U
Car Engine Oil Mobile 1 5W-30	10,000 U	3,390,000	50,000 U	20,000 U	50,000 U	30,000 U
Car Engine Oil Valvoline SAE 20W-50	10,000 U	30,000 U	50,000 U	20,000 U	50,000 U	30,000 U
Spent automotive oils	10,000 U	30,000 U	50,000 U	20,000 U	50, 000 U	30,000 U
Spent automotive oils	77,000 <RDL	30,000 U	50,000 U	20,000 U	50,000 U	30,000 U
Tristar Extender (ink product)	6,300 U	6,000 U	10,000 U	4,000 U	10,000 U	6,000 U
Polycon Blue Crude M31 (ink product)	15,000 U	6,000 U	10,000 U	4,000 U	10,000 U	6,000 U
Inxvelope Extender (ink product)	11,000 U	6,000 U	10,000 U	4,000 U	10,000 U	6,000 U
Inxvelope dense black (ink product)	8,500 U	6,000 U	10,000 U	4,000 U	10,000 U	6,000 U

* Collected from a single vehicle after 3 months of use. One quart of fresh non-synthetic oil added during the 3-month period.
U - The analyte was not detected at or above the reported value

Pharos Building Product Library

The Healthy Building Network, through their Pharos Building Product Library project, have assessed potential chemicals in 139 common building products, many of which might be applicable to this study. The project identified common ingredients based on manufacturer information and independent research. The project focuses primarily on interior use products but can be extrapolated to similar exterior-use products. PVC roofing membranes, specialized items such as wall protection products, flooring, paint, caulk, adhesive, sealants, and wire cable coatings are all identified as potential sources of phthalates. Automobile components and other items such as traffic cones are also potential sources.

Table 3: Product Information from Pharos Building Products Project Database[3]

Product	Description from Pharos Project
PVC roofing membranes Other two roof membranes analyzed include Ethylene Propylene Diene Monomer (EPDM), Thermoplastic Polyolefin (TPO), which do not have phthalates listed.	Phthalates can comprise up to 50 percent of the total weight of a membrane. (Athena) The European Union estimated in 2003 that roofing material consumed 1,000 tons per year of DEHP phthalate, and another 230 tons per year of DINP phthalate. Another phthalate, DnOP, may be used as a component of linear phthalates in vinyl sheet roofing, according to the American Chemistry Council.
Wall protection products (examples: corner guards, bumper guards, and handrails)	They are typically composed of a cover, which is made with metal, plastic, rubber, and/or wood, and a vinyl or metal retainer to offset the cover from the wall. Historically, polyvinyl chloride (PVC), polycarbonate, and metals have been the most commonly used cover materials. While most PVC wall protection products are rigid (thereby reducing the presence of plasticizers), flexible PVC wall protection is available which may use phthalate plasticizers
Resilient Flooring - non-textile flooring often made from synthetic materials, including vinyl, synthetic rubbers, polyolefin, or linoleum.	*Vinyl sheet flooring* is primarily composed of polyvinyl chloride (PVC) (often 50% or more of the content). It is made by mixing PVC resins, plasticizers (commonly phthalates), and stabilizers to make a vinyl foam mixture that is then spread onto a backing of felt, wood pulp or other plastic before a pattern is printed onto the vinyl and a coating of PVC and plasticizer is applied. *Vinyl composition tile* (VCT) is made from as much as 80% limestone filler, and plastic, much of which is PVC. Similar to vinyl sheet flooring, VCT also contains a mix of plasticizers, stabilizer, pigments, and coatings, but it is cut into tiles once pressed. The three phthalates most commonly used are butyl benzyl phthalate (BBP or BzBP), di(2-ethylhexyl) phthalate (DEHP), and di-n-hexyl phthalate (DnHP). Phthalate plasticizers typically comprise four percent in VCT and 20% or more in vinyl sheet flooring.
Paint – (Interior paint and standard paint)	*Several phthalates are listed in the Pharos database as likely ingredients of paint.* Incomplete data: Manufacturers for the most part have not reported 100% of the material content for their products to the Pharos Project
Adhesives and sealants	Plasticizers, fillers, thickeners, surfactants, hardeners, and many other ingredients comprising the balance of adhesive formulations vary widely.

	2-Ethylhexyl methyl terephthalate is used as plasticizer in adhesives and sealants. 2-Ethylhexyl methyl terephthalate is listed as common impurity in 2-Ethylhexyl terephthalate (6422-86-2).
Finishes	Phthalates – particularly dibutyl phthalate and butyl benzyl phthalate – may also be used as plasticizers in waterborne finishing systems. The Carboset CR-785 data sheet states: "Plasticizers such as butyl benzyl phthalate or dibutyl phthalate can be used as needed to improve coalescence and flexibility." Some floor finish MSDSes, such as those for M-Chem's Foundation and Rudd Company's GlitsaSC finishes, list dibutyl phthalate plasticizers
Fluid-applied flooring (FAF) - high performance coating	Many methyl methacrylate (MMA) flooring systems also use dicyclohexyl phthalate.
Wire and cable	Diisodecyl Phthalate (DIDP) is preferred plasticizer for PVC in wire and cable.
Automotive components	The automotive sector accounts for 25 % of the total consumption of Polybutylene Terephthalate, e.g. bumpers, water pumps, breaking systems, components in doors, car windows, and rear view mirrors…Other applications are found in household and consumer articles, e.g. handles for irons and frying pans, structural components in vacuum cleaners, coffee machines, propellers for outboard motors
Other products described as containing phthalates: Tarps, traffic cones, vinyl gloves, weather stripping and conveyor belts, automobile parts, siding, lubricants, fuel stabilizer, concrete additive, auto vinyl upholstery, garden hoses thermal insulation and insulation sprays, thermoplastic polyester resin, and solid surfacing materials (polymeric materials with pigments and fillers, like Corian).	

Roofing Material

In 2013, the Washington State Department of Ecology (Ecology) conducted a roofing materials pilot study[4]. The pilot study was the first step in an attempt to assess toxic chemical releases, including phthalates, from new roofing systems. The study was comprised of two initial parts: roofing materials and post-manufactured treatment. This study was followed up by a third phase done by the Washington Stormwater Center of the Washington State University in 2016 and 2017[5], examining water runoff from the same roofing material set up that was then aged by over 4 years.

Roofing Materials. One part of the study examined the runoff from commonly used roofing materials and roofing materials recommended by Ecology's Roofing Task Force. The roofing materials did not include components to roofing systems other than the main roofing materials. Materials not included in the study were gutter components, flashings, exposed fasteners, or post-manufactured treatments.

Synthetic Precipitation Leaching Procedure (SPLP). The SPLP focused on assessing the effectiveness of the coatings applied post-manufacture in reducing metals leaching. In addition, Ecology also assessed phthalate leachate.

Runoff After xx Years. The third phase of the study collected runoff from precipitation events from the xx year old set up.

Findings: The Pharos Project has identified PVC membrane roofing materials as a likely source of phthalates (Table 3). In phase of this study examining new roofing materials, Ecology only found detectable phthalates, including DEHP, in one material: wood shake treated with chromated copper arsenate. In the treated wood shake roofing material, the estimated values of the sum of the detected phthalates were 1.82, 4.20, and 4.60 ug/L. For roof treatments from the SPLP analysis, one phthalate (diethyl phthalate) was detected at 0.27 ug/L in association with one sample of three from the coating from Elastuff 101. There was not a conclusion that Elastuff 101 was the source of the phthalate. In phase three of this roofing study, the PVC membrane roof was

the only material associated with a phthalate (DEHP) detected at a level above 1 ug/L for one precipitation event tested. The sum of phthalates for this runoff event was measured in collected runoff at 8.00 ug/L.

Concrete

Many concrete products are now advertised as being "phthalate-free," which implies that there may be or may have historically have been products with phthalates. Concrete generally contains various additives in addition to the basic components of cement, water, and aggregate. The additives are where phthalates would exist in the concrete mixture. Based on 2015 information from *Design and Control of Concrete Mixes*, a handbook published by the Portland Cement Association[6], phthalates are not often used in concrete. This publication only lists concrete air detrainers as an additive potentially containing a phthalate (dibutyl phthalate). Air detrainers are added to decrease air content of the concrete. The handbook states that air detrainers are rarely used additives.

US Department of Health and Human Services Household Products

The US Department of Health and Human Services maintains a database of over 16,000 household products and their chemical constituents[7], based on information from Safety Data Sheets (formerly Material Safety Data Sheets) and brand-specific labels.

Table 4 displays the products from the database that are most likely to be used in exterior uses. The products from the database that are listed as containing phthalates include sealants, paints, caulks, fillers, and adhesives. Some of the products listed in this database contain phthalates with ranges at levels approaching 30% and 40% phthalate, including caulks, sealants, and a chemical hardener.

Table 4: US Department of Health and Human Services Database

Brand	Form	%	Phthalate
Aqua Mix Floor Shine and Hardener-Old Product	liquid	1	Dibutyl phthalate (DBP)
Bars Leaks Transmission Stop Leak Concentrate	liquid		Diiso octyl phthalate
Behr Low-VOC Basement & Masonry Waterproofing Paint with NanoGuard No. 2-875	liquid	1.0-5.0	Butyl benzyl phthalate (BBzP)
Brilliance Floor Finish	liquid	1.0-5.0	Dibutyl phthalate (DBP)
Canberra Husky 1000 Semi-Permanent Resilient Floor and Concrete Sealer, Professional Use	liquid	1.0-5.0	Dibutyl phthalate (DBP)
Champion SprayON Premium Interior-Exterior Enamel, Copper Metallic-4190923, Aerosol	aerosol	0.1-1.0	Butyl benzyl phthalate (BBzP)
Champion SprayON Premium Interior-Exterior Enamel, Gloss Clear Coat -4190932, Aerosol	aerosol	<1	Butyl benzyl phthalate (BBzP)
Cove Base Adhesive, 16964-discontinued - test	semi-solid	<2	Butyl benzyl phthalate (BBzP)
Custom 2000 Ceramic Tile Mastic	paste		Butyl benzyl phthalate (BBzP)
Custom Exterior Spackling Paste-Old Product	paste	1.8	Dibutyl phthalate (DBP)
Custom Grout Colorant-Old Product	liquid	1.6	Dibutyl phthalate (DBP)
Custom Polyblend Ceramic Tile Caulk	caulk tube	7.0-8.0	Butyl benzyl phthalate (BBzP)

Brand	Form	%	Phthalate
Custom Squeeze N Fill Concrete Crack Filler	liquid	10	Dibutyl phthalate (DBP)
DAP FRP Adhesive	paste	0.5-1.5	Diallyl phthalate (DAP)
DAP Premium Polyurethane Concrete & Masonry Sealant	paste	10.0-30.0	Butyl benzyl phthalate (BBzP)
DAP Premium Polyurethane Concrete & Masonry Sealant	paste	7.0-13.0	Diisodecyl phthalate (DIDP)
DAP Premium Polyurethane Roof & Flashing Sealant	paste	10.0-30.0	Butyl benzyl phthalate (BBzP)
DAP Premium Polyurethane Roof & Flashing Sealant	paste	7.0-13.0	Diisodecyl phthalate (DIDP)
DAP Weldwood Multi-Purpose Ceramic Tile Adhesive	paste	1.0-5.0	Diallyl phthalate (DAP)
DAP Wood Dough, All Colors	paste	1.0-5.0	Dibutyl phthalate (DBP)
Devcon Multi-Purpose Weldit All Purpose Adhesive and Vinyl Mender Tube	liquid	<3	Dibutyl phthalate (DBP)
Duco Cement Bottle	liquid	<3	Dicyclo hexyl phthalate (DCHP)
Duco Cement Tube	liquid	<3	Dicyclo hexyl phthalate (DCHP)
Elmers Probond Clear Household Cement-Old Product	liquid	3.62	Butyl benzyl phthalate (BBzP)
Evercoat Professional Liquid Hardener-Old Product	liquid	50	Dimethyl phthalate (DMP)
Formica Brand Kitchen & Bath Caulk	paste	1.0-10.0	Butyl benzyl phthalate (BBzP)
Franklin Side Out Gym Floor Finish-10/03/2011	liquid	<2	Dibutyl phthalate (DBP)
GE Groov Exterior-Interior Caulk, M90026, White	paste	10.0-30.	Diisodecyl phthalate (DIDP)
GE MAX 5000 Caulk, GE22764, White	paste	10.0-30.0	Butyl benzyl phthalate (BBzP)
GE MAX 5000 Caulk, GE22764, White	paste	10.0-30.0	Diiso heptyl phthalate
GE MAX 5000 Caulk, GE25356, Black	paste	10.0-30.0	Butyl benzyl phthalate (BBzP)
GE MAX 5000 Caulk, GE25645, Cedarwood	paste	10.0-30.0	Butyl benzyl phthalate (BBzP)
GE MAX 5000 Caulk, GE25665, Gray	paste	10.0-30.0	Butyl benzyl phthalate (BBzP)
GE MAX 5000 Caulk, GE25681, Almond	paste	10.0-30.0	Butyl benzyl phthalate (BBzP)
GE MAX 5000 Caulk, GE25692, Antique White	paste	10.0-30.0	Butyl benzyl phthalate (BBzP)
GE Silicones Paintable Sealant-Old Product	paste	5.0-10.0	Butyl benzyl phthalate (BBzP)
Groov Kitchen-Bath-Plumbing Caulk, M90025, White	paste	10.0-30.0	Diisodecyl phthalate (DIDP)
Gunk Tite-Seal Paintable Auto Body Undercoating T1616	aerosol	1.0-5.0	Dibutyl phthalate (DBP)
Henry 224 Window and Door Sealant-06/24/2014	liquid	5.0-15.0	Butyl benzyl phthalate (BBzP)
Henry 289 White Roof Sealant-06/24/2014	liquid	5.0-10.0	Butyl benzyl phthalate (BBzP)
Henry HE900 Construction and Flashing Sealant-Old Product	paste		Butyl benzyl phthalate (BBzP)
Kilz Casual Colors Spray Paint Gloss Clear Coat M492047	aerosol	0.1-1	Butyl benzyl phthalate (BBzP)
Kilz Casual Colors Spray Paint Satin Clear Coat M482047	aerosol		Butyl benzyl phthalate (BBzP)
Kilz Masonry Waterproofing Paint, Gray 239141	liquid	1.0-5.0	Butyl benzyl phthalate (BBzP)
Kilz Masonry Waterproofing Paint 390	liquid	0.1-1	Butyl benzyl phthalate (BBzP)
Lacquer Spraying, Clear, TT-L-58E	spray		Diethylhexyl phthalate (DEHP)
Liquid Nails Latex Adhesive Projects and Foamboard, Interior-Old Product	caulk tube	1.0-5.0	Butyl benzyl phthalate (BBzP)
Loctite H.V.A.C. Blue Pipe Joint Compound-discontinued	paste	1.0-3.0	Dibutyl phthalate (DBP)

Brand	Form	%	Phthalate
Loctite PL S10 Polyurethane Concrete Crack Masonry Sealant-10/28/2014	paste	5.0-10.0	bis(2-propylheptyl) phthalate (DPHP)
Loctite PL S20 Polyurethane Self-Leveling Concrete Crack Sealant-10/28/2014	paste	5.0-10.0	bis(2-propylheptyl) phthalate (DPHP)
Loctite PL S30 Polyurethane Roof & Flashing Sealant-10/28/2014	paste	5.0-10.0	bis(2-propylheptyl) phthalate (DPHP)
Loctite PL S40 Polyurethane Window, Door and Siding Sealant-10/28/2014	paste	5.0-10.0	bis(2-propylheptyl) phthalate (DPHP)
Mapei Keracaulk S	paste	5.0-10.0	Butyl benzyl phthalate (BBzP)
Mapei Keracaulk U	paste	5.0-10.0	Butyl benzyl phthalate (BBzP)
Mobil 1 Synthetic Gear Lube LS 75W-140	liquid	10.0-20.0	Diiso octyl phthalate
Oatey Tub and Tile Caulk-06/10/2005	paste	1.0-5.0	Butyl benzyl phthalate (BBzP)
P&G Pro Line Floor Sealer Ready-to-Use, Professional Use	liquid	1.0-5.0	Dibutyl phthalate (DBP)
Polyblend Ceramic Tile Caulk, 2060-72	paste	5.0-10.0	Butyl benzyl phthalate (BBzP)
Polyblend Grout Renew, 3089	liquid	1.0-5.0	Dibutyl phthalate (DBP)
Prefer Floor Finish	liquid	1.0-5.0	Dibutyl phthalate (DBP)
Quikrete Concrete Repair	paste		Butyl benzyl phthalate (BBzP)
Quikrete Polyurethane Non-Sag Sealant No. 8660-11	paste	15.0-40.0	Butyl benzyl phthalate (BBzP)
Quikrete Polyurethane Sealant, Self-Leveling No. 8660-10, 8660-30	paste	10.0-30.0	Butyl benzyl phthalate (BBzP)
Red Devil Polyurethane Blacktop & Roof Cartridge, Black	paste	<5	Diisodecyl phthalate (DIDP)
Red Devil Polyurethane Masonry & Concrete Sealant, All Colors	paste	<5	Diisodecyl phthalate (DIDP)
Rust Oleum Premium Stops Rust Protective Enamel Spray 7701 Crystal Clear	aerosol	5	Butyl benzyl phthalate (BBzP)
Rust Oleum Stops Rust, Crystal Clear Spray	aerosol	5	Butyl benzyl phthalate (BBzP)
Sherwin-Williams Zinc Clad 5 Organic Zinc Rich Primer	liquid	1	Dibutyl phthalate (DBP)
Shur Stik 66 Border and Seam Adhesive	liquid	3.0-5.0	Butyl benzyl phthalate (BBzP)
SprayPAK Enamel-Clear	aerosol		Butyl benzyl phthalate (BBzP)
STP Power Steering Fluid & Stop Leak-06/01/2011	liquid	1.0-5.0	Butyl benzyl phthalate (BBzP)
Thosa Concrete Crack Filler and Concrete Leveler	paste	5.0-10.0	bis(2-propylheptyl) phthalate (DPHP)
TileLab Matte Sealer and Finish	liquid	0.5-1-5	Dibutyl phthalate (DBP)
Titebond Painters Plus Caulk, Gray	paste	>3	Butyl benzyl phthalate (BBzP)
Titebond Painters Plus White	paste	>3	Butyl benzyl phthalate (BBzP)
Titebond Tub and Tile Caulk, White	paste	>3	Butyl benzyl phthalate (BBzP)
Turtle Wax Scratch Repair Pen T-121	liquid	3.0-7.0	Butyl benzyl phthalate (BBzP)
UGL Driveway Crack Filler	paste	10	Butyl benzyl phthalate (BBzP)
UGL Tub and Tile Caulk	paste	10	Butyl benzyl phthalate (BBzP)
Water White Rubbed Effect Clear Lacquer (Professional)	aerosol		Di(C8-C10) branched alkyl phthalate

Ecology Children's Product Testing

Ecology has conducted testing of children's products in order to ensure state and federal rules are met. Eight phthalates have been restricted for certain uses, including children's products, by Washington and federal laws. In order to evaluate compliance with Washington's Children's Safe Product Act, Ecology carried out research in 2012 and in 2014 published the report, *Phthalates in Children's Products and Consumer and Children's Packaging*[8].

For this research, children's products were tested for eight phthalates. The products tested were primarily children's toys and clothing, and included packaging for those products. Table 5 displays data for products in which phthalates were detected that might be similar to products found in exterior use. Three of the products potentially used outdoors were found to be particularly high in phthalates: Coleman Clear plastic packaging pouch (166,000 ppm DEHP), Coleman opaque plastic waterproof pouch (264,000 ppm DIDP), and Perfect Touch paint roller (107,000 ppm DEHP).

Table 5: Phthalates in Children's Products, Ecology's Phthalates in Children's Products and Consumer and Children's Packaging (2014)

Phthalates (ppb)	Di(2-ethylhexyl) phthalate (DEHP)	Butyl benzyl phthalate (BBzP)	Diethyl phthalate (DEP)	Dibutyl phthalate (DBP)	Dihexyl phthalate	Diisodecyl phthalate (DIDP)	Diisononyl phthalate (DINP)	Di-n-octyl phthalate (DnOP)
Coleman Clear plastic packaging pouch	166,000,000	8300 U	8300 U	25800	10,000 U	1,570,000	24,900,000 U	8300 U
Coleman opaque plastic waterproof pouch	291,000	8380 U	8380 U	10400	10,000 U	264,000,000	385,000	8380 U
Dollar Tree Synthetic jump rope – red cord	24,000	5,000 U	5500	5,000 U	5,000 U	50,000 U	50,000 U	5,000 U
Perfect Touch paint roller	107,000,000	8770 U	8770 U	8770 U	10,000 U	1,630,000	42,700,000	8770 U

U - Analyte was not detected above the method reporting limit.

Garden Hoses

The Ecology Center in Ann Arbor, MI conducted a study of phthalates in commonly available garden hoses[8]. 39 hoses were tested for phthalates. Of the hoses tested, 24 were made of plasticized PVC. 75% of the plasticized PVC hoses were found to contain phthalates. None of the non-PVC hoses were found to contain phthalates. Seven of the 24 PVC hoses contained at least 100 PPM of phthalates.

Alternatives Assessments

Assessments Conducted To Date

Plasticizers for Wiring & Cable

The Green Chemistry and Commerce Council of the Lowell Center for Sustainable Production carried out chemical hazards assessments of alterative plasticizers for wire and cable applications. [10] This assessment was done in collaboration with businesses in an attempt to find an alternative to di(2-ethylhexyl) phthalate (DEHP).

For this study, nine plasticizers (Table 5) were assessed using Clean Production Action's GreenScreen™ for Safer Chemicals chemical hazard assessment method. Four of the nine products were independently verified by Clean Production Action. They found that, of the verified screenings, the best rated plasticizer (Di(2-ethylhexyl) terephthalate meets the standard of the classification "safer chemical" based on available data but there are data gaps for neurotoxicity and respiratory sensitization. The next best rated plasticizer, Diisononyl cyclohexanedi carboxylate, meets the classification of "use but sill opportunity for improvement" with moderate endocrine activity associated.

Table 6: Verified Wiring & Cable Alternatives Hazards Assessment, Green Chemistry Commerce Council Chemical Hazard Assessments of Alternative Plasticizers for Wire & Cable Applications (2013)

Short Name or Acronym	Chemical Name	GreenScreen Benchmark	Notes
DEHT (Eastman 168)	Di(2-ethylhexyl) terephthalate	3_{DG}	Data gaps for neurotoxicity and respiratory sensitization
Hexamoll® DINCH® (BASF)	Diisononyl cyclohexanedi carboxylate	2*	Moderate endocrine activity
DOZ	Bis(2-ethylhexyl) azelate	U	Data gaps for cancer and endocrine activity
TEHTM	Tris(2-ethylhexyl) trimellitate	U	Data gaps for cancer and endocrine activity

*BASF toxicologists disagrees with this assessment

Benchmarks Key:

1 – Avoid – Chemical of high concern
2 – Use but search for safer substitutes
3 – Use but still opportunity for improvement
4 – Safer chemical
U – Is not a BM1 chemical but does not meet the minimum data requirements to receive a BM2 designation
3_{DG} – Meets the hazard classification requirements of BM4, based on all available data, but does not achieve the minimum data requirements for BM4

The five unverified plasticizers have benchmark scores ranging between 1 and 3. For the plasticizers with BM2 or BM3, the GreenScreen assessment has been redacted and is considered a draft.

Phthalate-free Plasticizers in PVC

The Healthy Building Network published a report in 2014 titled *Phthalate-free Plasticizers in PVC* written by Sarah Lott[11]. This report compares the knowns and unknowns of the following six phthalate alternatives currently used in building materials:

- Di-(2-ethylhexyl) terephthalate (DEHT a.k.a DOTP)
- Diisononyl cyclohexane-1,2-dicarboxylate (DINCH)
- Dibenzoates [commonly Dipropylene glycol dibenzoate (DGD) or a blend of DGD, Diethylene glycol dibenzoate (DEGD), and Triethylene glycol dibenzoate (TGD)]
- Acetylated monoglycerides of fully hydrogenated castor oil (COMGHA)
- Isosorbide diesters
- Ecolibrium [a proprietary vegetable oil based blend]

This report uses available research and data to examine the potential toxicity of the six alternatives, and includes an upstream assessment of manufacturing impacts. The overall findings are that while many of the alternatives are clear improvements on phthalate plasticizers, COMGHA and Isosorbide Esters appear to be the best options. There are concerns of potential toxicity and data gaps with DINCH, Dibenzoates and DEHT. And Ecolibrium cannot be fully assessed for its toxicity due to lack of manufacturer data and potential manufacturing processes.

References

1. City of Tacoma. 2004. *Thea Foss and Wheeler-Osgood Waterways Stormwater Source Control Report*.
2. Seattle Public Utilities, King County. 2004. *June 2004 Progress Report - King County and SPU Source Control Program for the Lower Duwamish Waterway*. Available at www.seattle.gov/util/cs/groups/public/@spu/@drainsew/documents/webcontent/01_014243.pdf.
3. Healthy Building Network. Pharos Building Products Project Database. Available at www.pharosproject.net/material/product. Accessed May 17, 2017.
4. WA State Dept of Ecology. 2014. *Roofing Materials Assessment Investigation of Toxic Chemicals in Roof Runoff*. Written by Winters NL and Graunke K. Available at https://fortress.wa.gov/ecy/publications/SummaryPages/1403003.html.
5. Washington Stormwater Center of Washington State University. 2017. Roofing Materials Assessment: Investigation of Toxics in Roof Runoff at the Washington Stormwater Center. Written by Haskins T and Winters N.
6. Portland Cement Association. 2015. *Design and Control of Concrete Mixtures.* Written by Kosmatka S and Wilson M. Available by www2.cement.org/pdf_files/eb001.15.pdf.
7. U.S. Department of Health and Human Services. *Household Products Database.* https://householdproducts.nlm.nih.gov/. Accessed May 18, 2017.
8. Washington State Department of Ecology, Stone A. 2014. *Phthalates in Children ' S Products and Consumer and Children's Packaging*. Available at. https://fortress.wa.gov/ecy/publications/documents/1404017.pdf.
9. Ecology Center, Ann Arbor, MI. 2016. *Garden Hose Study.* Available at http://ecocenter.org/sites/default/files/healthy-stuff/images/Garden%20Hose%20Report%20June%2020%202016.pdf
10. Green Chemistry and Commerce Council. 2013. *Chemical Hazard Assessments of Alternative Plasticizers for Wire & Cable Applications*. Written by Mcfadden R, Robertson C, Cesaretti A, Harmon P, Tsang A. Available at http://www.cleanproduction.org/static/ee_images/uploads/resources/PilotProjectFullReportOct2-final_000.pdf.
11. Healthy Building Network. 2014. *Phthalate-free Plasticizers in PVC.* Written by Lott S. Available at https://healthybuilding.net/uploads/files/phthalate-free-plasticizers-in-pvc.pdf