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Hazardous Waste Management Program
GOVERNMENTS WORKING TOGETHER FOR A HEALTHIER AND CLEANER KING COUNTY

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Final Report

Hazard Evaluation of Products used in Fabric Cleaning

Stephen G. Whittaker, PhD
Hazardous Waste Management Program in King County
Research Services Team

Rachel M. Shaffer, MPH
Hazardous Waste Management Program in King County
Research Services Team and
University of Washington, Department of Environmental and Occupational Health Sciences

This report was prepared by the Hazardous Waste Management Program in King County, Washington, a coalition of local governments. Our customers are residents, businesses and institutions with small quantities of hazardous wastes. Our mission is: to protect and enhance public health and environmental quality in King County by reducing the threat posed by the **production**, **use, storage** and **disposal** of hazardous materials.

For more information, contact:

Hazardous Waste Management Program
GOVERNMENTS WORKING TOGETHER FOR A HEALTHIER AND CLEANER KING COUNTY

Public Health-Seattle & King County
401 Fifth Ave., Suite 1100
Seattle, WA 98104
Voice 206-263-8899 TTY Relay: 711
Fax 206-296-0189
www.hazwastehelp.org

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Acronyms and Abbreviations

CAS	Chemical Abstract Service
OSHA	Occupational Safety and Health Administration
PERC	Perchloroethylene / Tetrachloroethylene
PWC	Professional wet cleaning
SDS	Safety Data Sheet

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Executive Summary

Starting in 2018, the Hazardous Waste Management Program (Haz Waste Program) in King County, Washington established a pilot financial incentive program to help perchloroethylene (PERC) dry cleaners transition to professional wet cleaning (PWC). Dry cleaners were provided grants of $20,000 towards the purchase of new equipment and process chemicals.

In order to document the potential improvements in human and environmental health, we compared the hazards associated with the products used for PERC dry cleaning (before transition) and PWC (after transition).

We learned that once shops had switched to PWC, they used fewer hazardous chemicals and products. Most notably, the shops no longer used PERC (a hazardous chlorinated hydrocarbon) to clean fabrics; they were now using water. In addition, most shops disposed of their legacy spot cleaners (many of which are hazardous) and were using safer products provided by their PWC vendor.

However, some shops continued to use hazardous legacy spot cleaning products in their PWC operations. One shop also purchased a new hazardous spray spotter and detergent. Consequently, in future assistance programs, it is important to ensure that all legacy spot cleaners are disposed of before PWC equipment is installed and that shop owners only purchase safer products to support their new PWC systems.

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Introduction

Recognizing the adverse effects of perchloroethylene (PERC) on human health and the environment, the Hazardous Waste Management Program (Haz Waste Program) in King County, Washington established a pilot financial incentive program to help PERC dry cleaners switch to professional wet cleaning (PWC) in 2018. Dry cleaners were provided grants of $20,000 towards the purchase of new equipment and process chemicals, including spotting agents, detergents, fabric softeners, and additives.

In addition to using PERC as their primary cleaning solvent, PERC dry cleaners typically use several other hazardous chemicals and products in their fabric cleaning operations. In contrast, the primary cleaning agents used to clean fabrics in PWC are water and detergents. However, the safety of the process chemicals used in PWC have not been critically evaluated.

Therefore, the goal of this study is to compare the hazards associated with the process chemicals used for PERC dry cleaning (before transition) and PWC (after transition).

Products used in fabric cleaning

Spotting agents

Regardless of the cleaning technology used, stained fabrics may be pre-cleaned or "pre-spotted" with spot treatment products before being placed in the cleaning machine. These products are formulated according to the type of stains to be removed.

In traditional organic solvent-based dry cleaning (e.g., PERC), these products are classified as either "wet-side" or "dry-side" agents. Wet-side spotting agents are generally aqueous products that are used to remove water-soluble stains from clothing. Dry-side agents are typically comprised of non-aqueous solvents and alcohols and are used to remove stains comprised of oils, fats, waxes, grease, cosmetics, paints, and plastics.[(1)] Fabrics may also be "post-spotted" if stains remain after machine cleaning. A typical PERC dry cleaning machine and a "spotting table" used with PERC dry cleaning are shown in Figures 1 and 2, respectively.

Figure 1. PERC dry cleaning machine

Figure 2. Spotting table at a PERC dry cleaner

The spotting agents designed for use with PWC are also formulated to remove various types of stains and they are typically water soluble. A typical PWC machine and spotting table are shown in Figures 3 and 4, respectively.

Figure 3. Professional wet cleaning machine

Figure 4. Spotting table at a professional wet cleaner

Detergents and additives

In PERC dry cleaning, fabrics are spot cleaned and then placed in the dry cleaning machine where they are agitated with PERC. Some shops also use a detergent designed to work with organic solvents. Additives may also be introduced to the machine during cleaning. The most frequently used additives are "sizing" agents, which may be injected into the machine during the cleaning process. Sizing agents are typically comprised of hydrocarbon resins in a petroleum solvent carrier, and are used to restore shape, body, and texture to fabrics.[(1)]

In PWC, spot-treated fabrics are washed in water and detergent. Additional products may be added to the detergent-water mixture, depending on the type of fabric being cleaned. These products protect fibers during drying, prevent dye bleeding, provide suppleness to leather, etc. The metering system that dispenses the detergent and other additives into the washer's drum is shown in Figure 5.

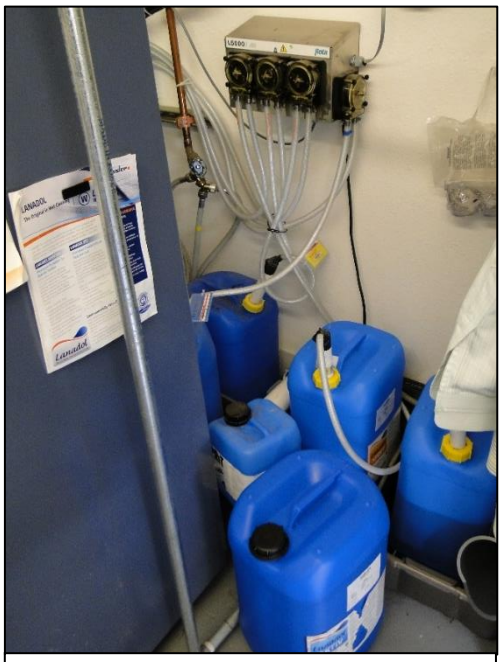

Figure 5. Products used for professional wet cleaning

Methods

Product inventories

PERC dry cleaning

We visited 15 PERC dry cleaners across King County, Washington to recruit shops for the pilot phase of the financial incentive program. Field visits were conducted between April 2018 and January 2019. Because many of these shops were owned and operated by Korean-Americans, we were typically accompanied by the native Korean-speaking vendor representative who had brought the shops to our attention. We administered an English language "Pre-Switch Survey" to gather information about business operations, work practices, attitudes and knowledge about PERC and PWC, as well as other information to inform our financial incentive program (presented in Appendix A). When necessary, interpretation was provided by the vendor representative. As part of this survey, we conducted inventories of the products used at the shops (see Question 15 on the Pre-Switch Survey). Products included spotting agents, detergents, and sizing agents. In order to protect confidentiality, shops were assigned a unique identification number for presentation of results.

Professional wet cleaning (PWC)

We re-visited dry cleaners approximately 6 months after they transitioned to PWC. At this visit, we conducted another product inventory as part of our "Post-Switch Survey" (presented in Appendix B; see Question 12). This survey was also developed in English and a Korean language interpreter helped with administration, when necessary. Products evaluated included spotting agents, detergents, and a variety of additives designed for use with specific fabrics.

Hazard evaluation of ingredients and products

Evaluating ingredients

We reviewed the Safety Data Sheets (SDSs) for every fabric cleaning-related product identified at the shops, and ingredient information was entered into a subscription-based online hazard evaluation system (SciveraLENS Rapid Screen©).[(2)] In this system, each product is classified as a "Collection," which is comprised of one or more chemical ingredients. PDF versions of SDSs may be scanned, which allows for automatic entry of ingredient and concentration information into the system. When SciveraLENS Rapid Screen occasionally failed to scan and enter SDS data, we entered the information manually using the ingredients' Chemical Abstract Service (CAS) numbers. It should be noted that when no ingredients were disclosed on SDSs (i.e., listed as "Proprietary" or "Trade Secrets"), we assumed that the products were hazardous. The only exception to this rule was if Section 2 of the SDS stated that the unlisted ingredients were non-hazardous according to United States or European regulations. However, no products were classified in this way.

SciveraLENS Rapid Screen provides two types of output: *List Screening* and *Human and Environmental Health Screening*.[(3)]

List Screening involves evaluating the ingredient and its concentration against a series of "authoritative lists" published by various agencies and organizations, including:

- Restricted Substance Lists (e.g., the State of California's Proposition 65 list),
- Lists published by academic or scientific organizations (e.g., the International Agency for Research on Cancer list), and
- Preferred chemical lists (e.g., the United States Environmental Protection Agency's Safer Chemical Ingredient List).

This approach is primarily used by industry groups and companies to set governance policies on chemicals used in products or processes and is similar to the GreenScreen List Translator™ system developed by Clean Production Action.[4]

In contrast, *Human and Environmental Health Screening* generates ingredient-specific color codes to depict the human and environmental health attributes for specific endpoints and for a chemical overall (see Table 1). A solid green, yellow, red, or black circle indicates sufficient authoritative or experimental evidence for an unequivocal hazard assessment. A half-gray circle indicates limited evidence is currently available for the endpoint and that Scivera has used systems such as modeling software, quantitative structural activity relationship methods, or expert judgment to complete the assessment. The methodology used in this system is similar to that used by the full GreenScreen® for Safer Chemicals developed by Clean Production Action.[5]

Table 1. Human and Environmental Health Screening endpoint scores for ingredients

Color code	Explanation
	Green: Low Hazard (Preferred chemical)
	Green/Yellow: Low-Moderate Hazard (Acceptable chemical)
	Yellow: Moderate Hazard (Conditional chemical)
	Red: High Hazard (Chemical of high concern)
	Black: Very High Hazard (Chemical of high concern)
	Gray: Insufficient Data (data gaps for health endpoints)
	Light blue/Gray: Insufficient Data (data gaps/chemical not fully assessed)
	Light blue: Hazard Assessment Not Completed (in process)

Key: A half-gray circle indicates limited evidence for the endpoint of concern.

Human and Environmental Health Screening generates two ingredient-specific summary assessments based on the endpoint scoring described above:

- The Maximum Hazard is based on the highest hazard assessment for the chemical across all Human Endpoints and a combination of Environmental Health Endpoints.[a]
- The Hazard Category score is based on an algorithm that uses several Human Health and Environmental endpoints.

Evaluating products

SciveraLENS Rapid Screen also generates a summary Hazard Category score for a Collection (i.e., a product) based on the Hazard Category scores of the ingredients.

Upon reviewing the *List Screening* and *Human and Environmental Health Screening* systems, we selected the summary Hazard Category score to depict the overall hazard associated with each product because it considers a balance of human health and environmental endpoints.

In descending order, the levels of concern for products were:

1. High Concern (red)
2. No SDS data/High Concern – Haz Waste Program-assigned category (red cross-hatch)
3. Insufficient toxicity data (gray)
4. Conditional (yellow)
5. Acceptable (yellow/green)
6. Preferred (green)

[a] Core endpoints for Human Health are carcinogenicity, mutagenicity, developmental toxicity, and reproductive toxicity. Core endpoints for Environmental Health are persistence, bioaccumulation, acute aquatic toxicity, and chronic aquatic toxicity. Several Supplemental Endpoints are also considered when assigning the Hazard Category.

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Results

PERC dry cleaning products

PERC, the primary solvent used in PERC dry cleaning, was rated as High Concern.

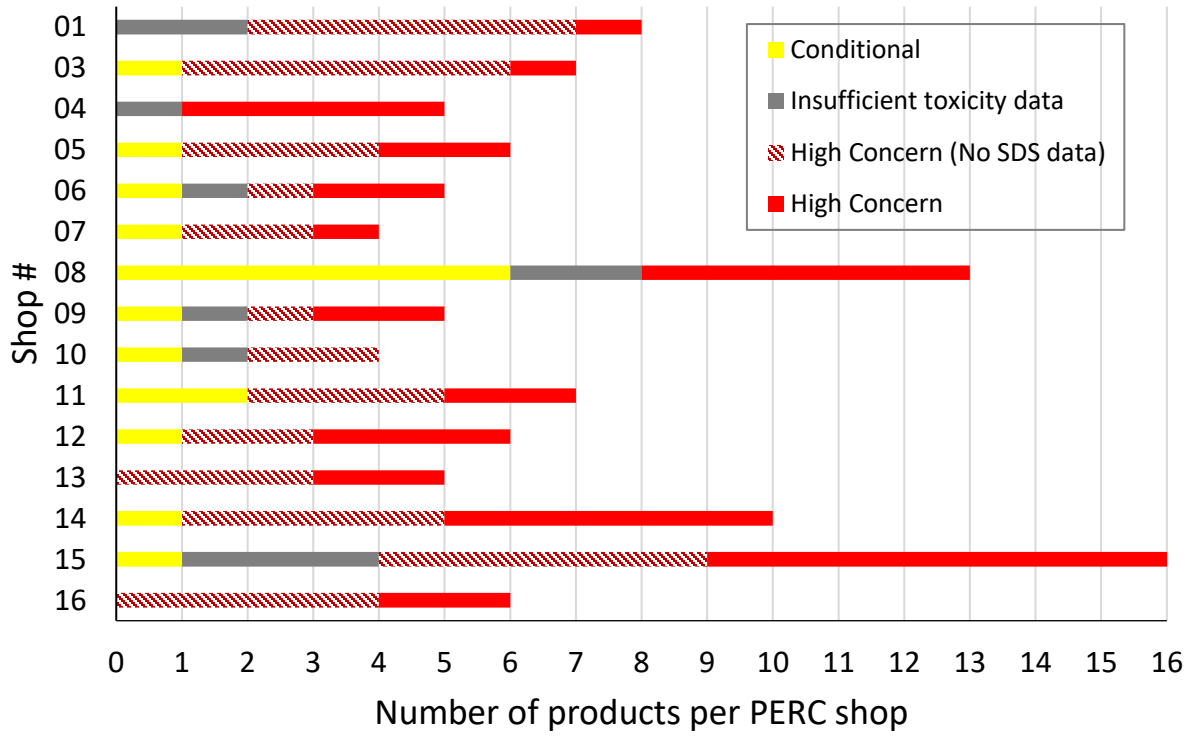
A matrix showing the other products identified, the shops in which they were found, and the SciveraLENS Rapid Screen Human and Environmental Health Screening results are presented in Appendix C. Hazard Category scores were assigned in May 2019.

Among the 15 PERC shops inventoried, we identified 48 unique spotting products, six unique detergents, two unique sizing agents, and one stabilizer.

The number of products identified in each shop ranged from four (two shops) to 16 (one shop) – see Figure 6. The median number of products per shop was six and the average was 6.7.

Also shown in Figure 6 is the distribution of products by Hazard Category in each shop. (Shop # is the unique ID number assigned to the shop. Note that no data were available for Shop #02).

Figure 6. Number of products per PERC shop by Hazard Category



Products designated as High Concern because their SDSs listed at least one High Hazard ingredient are shown in Table 2. Although the SDS for Kreussler Clip Combi lists Distillates (petroleum), Hydrotreated Light Paraffinic (CAS# 64742-55-8) as an ingredient (rated as High Hazard), documentation provided by the manufacturer provided assurance that this base oil contains <1% aromatic compounds and is free of carcinogens;[a] therefore, this product was not rated as High Hazard in our assessment.

Table 2. High Hazard ingredients present in PERC dry cleaning products

Product[a]	High Hazard ingredient (CAS number)
Adco Fashion Finish Synthetic	tetrachloroethylene (127-18-4)
Adco Knock Out Ink Remover	Solvent naphtha (petroleum), light arom. (64742-95-6)
Adco Soft Kleen Xtra	2,2'-iminodiethanol (111-42-2)
Adco Wetspo	Solvent naphtha (petroleum), light arom. (64742-95-6)
AL Wilson RustGo	ammonium hydrogendifluoride (1341-49-7)
AL Wilson TarGo	Nonylphenol, ethoxylated (9016-45-9) trichloroethylene (79-01-6)
AL Wilson YellowGo	ammonium hydrogendifluoride (1341-49-7)
AlbaChem PSR	Petroleum gases, liquefied, sweetened (68476-86-8)
Amway Legacy of Clean Prewash Spray	isobutane (75-28-5)
ANC Pull-Out 2	dichloromethane (75-09-2) methyloxirane (75-56-9) Petroleum gases, liquefied, sweetened (68476-86-8) tetrachloroethylene (127-18-4)
Caled Ink Out	Solvent naphtha (petroleum), light arom. (64742-95-6) 1,5-dichloropentane (628-76-2)
Diamond CP Injection Detergent	4-Nonylphenol, branched, ethoxylated (127087-87-0) Poly(oxy-1,2-ethanediyl),a-(nonylphenyl)-w-hydroxy-, branched, phosphates (68412-53-3)
K2r Spotlifter	Petroleum gases, liquefied, sweetened (68476-86-8)
Laidlaw Pull Out Premium V	dichloromethane (75-09-2)
Logos Fabricare POG	Nonylphenol, ethoxylated (9016-45-9) stoddard solvent (8052-41-3)
Stamford Proteen	Amides, coco, N,N-bis(hydroxyethyl) (68603-42-9)
Stamford Spol	Amides, coco, N,N-bis(hydroxyethyl) (68603-42-9)
Stamford Spot Buster	Amides, coco, N,N-bis(hydroxyethyl) (68603-42-9)
Stamford Trik	Amides, coco, N-[3-(dimethylamino)propyl], N-oxides (68155-09-9)
Stamford Vol	Naphtha (petroleum), light alkylate (64741-66-8)
Streets 2-1 Formula	trichloroethylene (79-01-6)
Streets Picrin	trichloroethylene (79-01-6)

[a] Products in which at least one ingredient listed on the SDS was a High Hazard chemical. Does not include products with no ingredient information on SDSs.

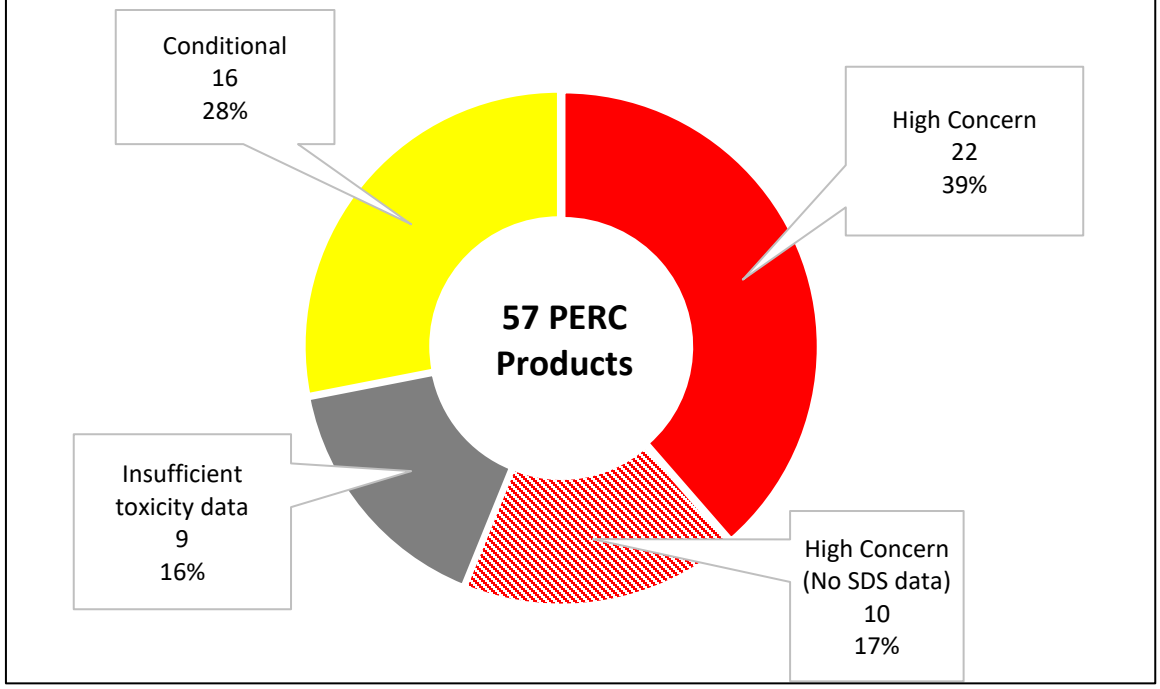
[a] Personal communication with Dr. Manfred Seiter, Kreussler GmbH. May 28, 2019.

Ten products did not disclose ingredient information; formulations were proprietary or trade secrets. By default, as noted above, these products were also scored as High Concern and included Caled Tan e-cal Plus as well as the following Streets products: Devour, Fabricol, Multispot, Pyratex, Sofspot, Streepro, Streetan, Streetex, and Staticol.

With the single exception of Shop #10, all shops used at least one High Concern product based on ingredient disclosure on SDSs. The number of these High Concern products per shop ranged from zero (one shop) to seven (one shop). The median number of High Concern products per shop was two and the average was 2.8. Most shops also used products with undisclosed (i.e., proprietary or trade secret) ingredient information. No Acceptable or Preferred products were identified.

The overall distribution of products used in PERC dry cleaning by Hazard Category is shown in Figure 7, presented as frequency and percentage of the total. Of the 57 products identified, 22 (39 percent) were rated as High Concern based on ingredient information. As described above, the SDSs for ten products did not disclose ingredient information (listed as trade secrets or proprietary) and therefore were also scored as High Concern by default. Overall, we rated a total of 32 products (56 percent) as High Concern.

Figure 7. Hazard Categories of PERC dry cleaning products



The products found in five or more shops are presented in Table 3. As stated previously, ingredient information was typically not available for Streets products. Consequently, these products with undisclosed ingredients were rated as High Concern by default. One exception to

this lack of disclosure was Streets Picrin, which is comprised of 100% trichloroethylene (High Hazard). AL Wilson RustGo is comprised of 16% ammonium hydrogendifluoride (High Hazard) and 12% hydrogen fluoride (Conditional). Therefore, we rated all six of these most frequently-used products as High Concern.

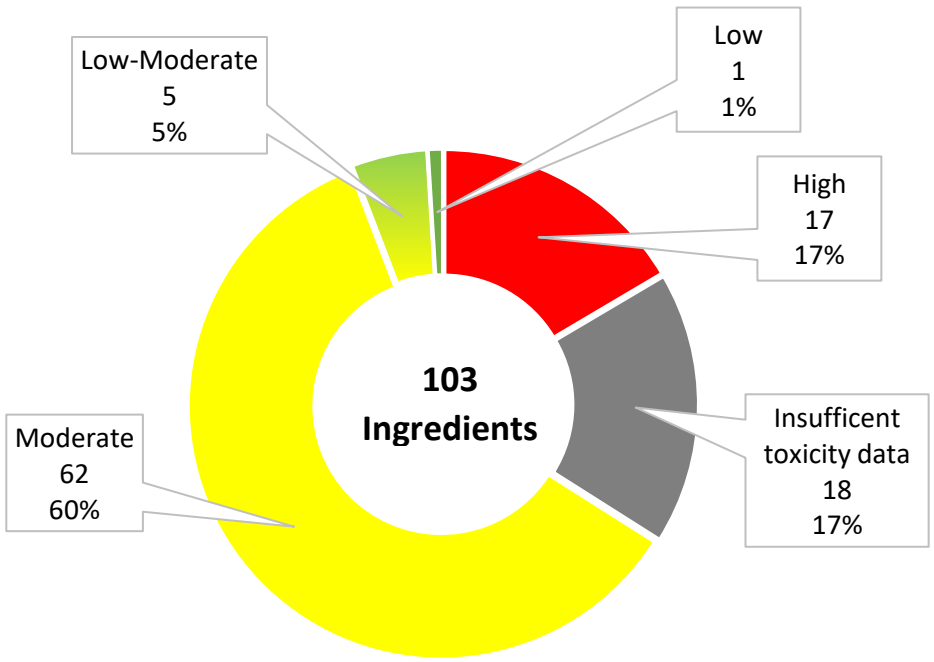
Table 3. Products found in five or more PERC shops and associated Hazard Category

Products	Number of shops	Product Hazard Category
Streets Streepro	9	High Concern (No SDS data)
Streets Pyratex	9	High Concern (No SDS data)
Streets Picrin	6	High Concern
AL Wilson RustGo	6	High Concern
Streets Streetan	6	High Concern (No SDS data)
Streets Streetex	5	High Concern (No SDS data)

The products that disclosed ingredients on their SDSs were comprised of a total of 103 chemicals. The distribution of ingredients by Hazard Category is presented by frequency and percentage in Figure 8. Of these 17 (17 percent) were High Hazard and 18 (17 percent) had insufficient toxicity data to assign a hazard score. Only five ingredients (five percent) were Low-Moderate Hazard and one was Low Hazard.

The only Low Hazard chemical identified on any SDS was water, which was listed as an ingredient in AL Wilson RustGo.

Figure 8. Hazard Categories of ingredients in PERC dry cleaning products



Professional wet cleaning products

We conducted follow-up visits to 11 of the 15 shops that switched to PWC.[a] The complete list of products identified, the shops in which they were found, and the SciveraLENS Rapid Screen Hazard Categories for products used in PWC are presented in Appendix D. Hazard Category scores were assigned in August 2019.

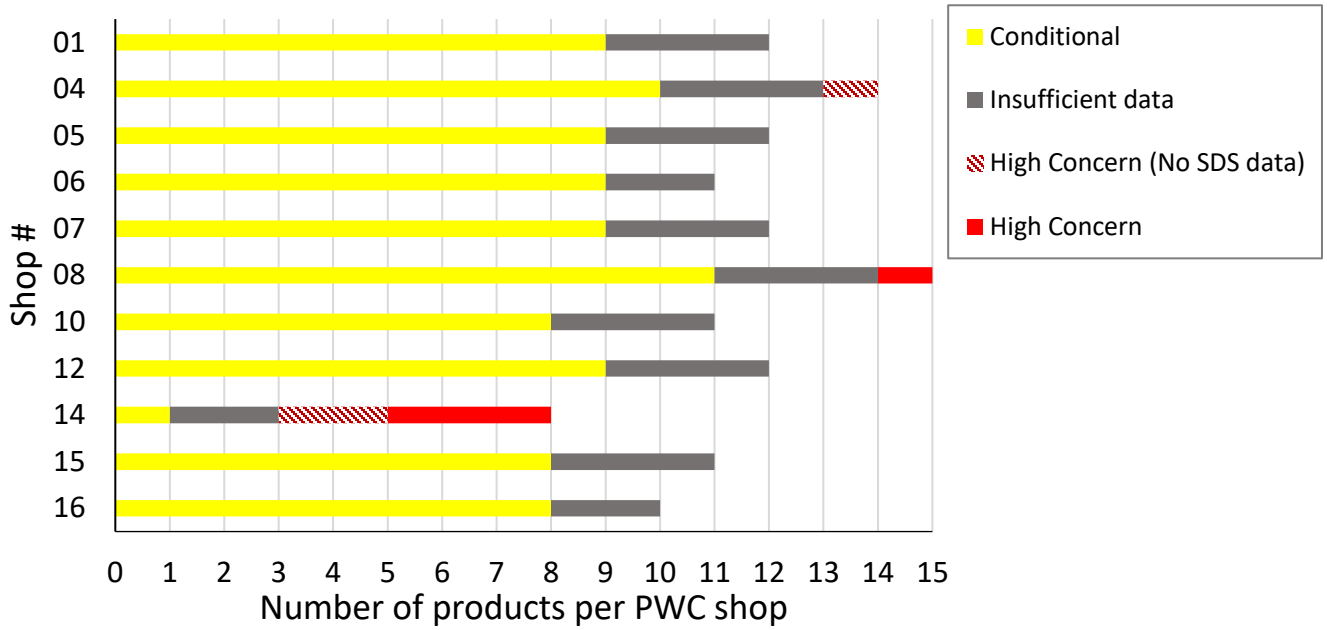
Among the 11 PWC shops inventoried, we identified 16 unique spotting products and 8 unique detergents/fabric conditioners.

The number of products per PWC shop ranged from eight (one shop) to 15 (one shop) (Figure 9). The average number of products was 11.6 and the median was 12.

Figure 9 also shows the hazard category of products found in PWC shops, where Shop# is the unique ID assigned to the shops. All shops used at least one product with a Conditional hazard rating, with a mean of 8.3 Conditional products per shop and a median of 9. All shops also used at least one product with insufficient toxicity data. Only three shops used products with a rating of High Concern.

[a] As of the writing of this report, 11 of the 15 shops originally evaluated had switched from PERC to PWC.

Figure 9. Number of products per PWC shop by Hazard Category



The four products designated as High Concern because their SDSs contained at least one High Hazard ingredient are listed in Table 4. In addition to these products, three received a High Concern rating because their ingredients were not disclosed on their SDSs.

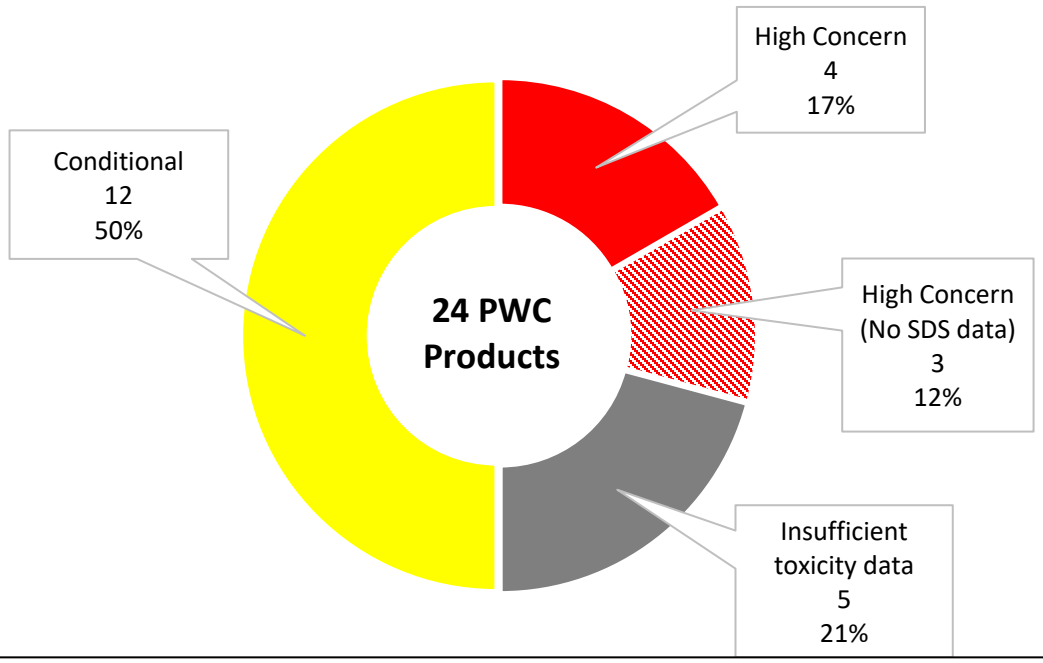
Table 4. High Hazard ingredients present in products used with PWC

Product[a]	**High Hazard ingredient (CAS number)**
AL Wilson RustGo	ammonium hydrogendifluoride (1341-49-7)
Amway Home Prewash Spray	isobutane (75-28-5)
Amway Home SA8 Laundry Detergent	borax ($B_4Na_2O_7.10H_2O$) (1303-96-4)
ANC Pull-Out 2	dichloromethane (75-09-2) methyloxirane (75-56-9) Petroleum gases, liquefied, sweetened (68476-86-8) tetrachloroethylene (127-18-4)

[a] Products in which at least one ingredient listed on the SDS was a High Hazard chemical. Does not include products with no ingredient information on SDSs.

The overall distribution of products used in PWC shops by Hazard Category is shown in Figure 10, presented as frequency and percentage of the total. Of the 24 products identified, four (17 percent) were rated as High Concern based on ingredient information. An additional three products were rated as High Concern due to missing ingredient information on SDSs, for a total of seven High Concern products (29 percent) across PWC shops.

Figure 10. Hazard Categories of products used with PWC



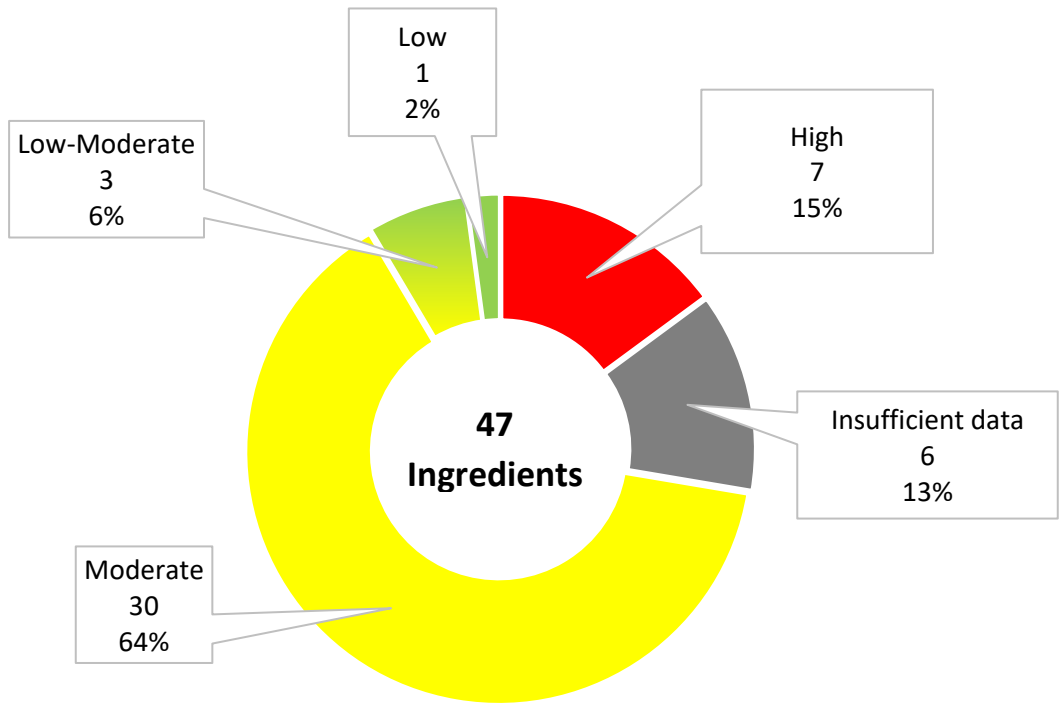
The products found in five or more PWC shops are presented in Table 5. All these products were manufactured by Kreussler and were assigned to the Conditional or Insufficient toxicity data Hazard Categories. None of the products found in five or more PWC shops were rated as High Hazard.

Table 5. Products found in five or more PWC shops and associated Hazard Category		
Products	**Number of shops**	**Product Hazard Category**
Kreussler Deprit Professional 1	10	Conditional
Kreussler Deprit Professional 2	10	Conditional
Kreussler Deprit Professional 3	10	Conditional
Kreussler Deprit Professional 4	10	Conditional
Kreussler Deprit Professional 5	10	Insufficient data
Kreussler Deprit Professional 6	10	Insufficient data
Kreussler Lanadol Aktiv	10	Insufficient data
Kreussler Lanadol Apret	10	Conditional
Kreussler Lanadol Avant	10	Conditional
Kreussler Lanadol X-press	10	Conditional
Kreussler Ottalin Soft	10	Conditional
Kreussler Trebon Plus	8	Insufficient data

Forty-seven ingredients were identified in products with sufficient disclosure on their SDSs. The distribution of ingredients by Hazard Category is presented by frequency and percentage in Figure 11. Overall, 7 (15 percent) were High Hazard, 30 (64 percent) were Moderate Hazard, three (6 percent) were Low-Moderate Hazard, and one (2 percent) was Low Hazard. Six (13 percent) had insufficient toxicity data to assign a hazard score.

As with PERC cleaning products, the only Low Hazard chemical identified on any SDS was water.

Figure 11. Hazard Categories of ingredients in products used with PWC



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Conclusions and Recommendations

Overall conclusions

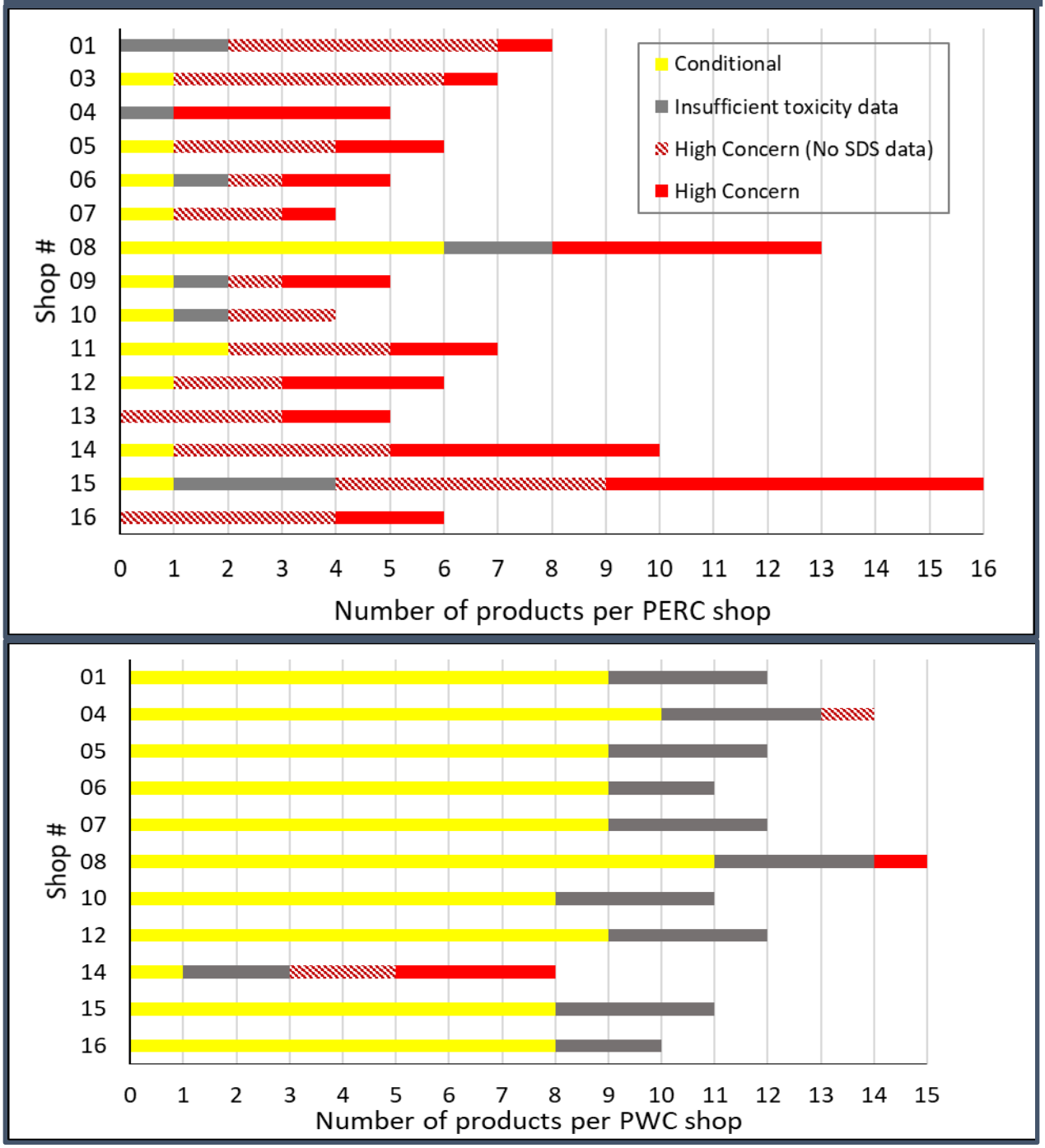
A significant advantage of PWC is that the main cleaning solvent is water, a Preferred substance according to SciveraLENS Rapid Screen. In contrast, PERC, as used in traditional organic solvent dry cleaning, is a High Hazard solvent – see Table 6. When performing dry cleaning with PERC, 56 percent of all products used by the shops were rated as High Concern. In contrast, only 29 percent of all products used in shops that adopted PWC were High Concern.

Table 6. Summary of process chemicals used in PERC dry cleaning vs. PWC

Metric	Cleaning System	
	PERC Dry Cleaning	**PWC**
Hazard rating of cleaning solvent	PERC – High Hazard	Water – Preferred
No. shops evaluated	15	11
Total no. of unique products	57	24
Median no. products per shop	6	12
Total no. High Concern products	32 (56%)	7 (29%)
No. High Concern products with hazardous ingredients disclosed	22 (39%)	4 (17%)
No. High Concern products with no ingredient disclosure	10 (17%)	3 (12%)
No. High Hazard ingredients (disclosed in all products)	17 (17%)	7 (15%)

The number of products used per shop by Hazard Category before and after they switched to PWC is shown in Figure 11.

Figure 12. Number of products per shop by Hazard Category before and after switching to PWC



Overall, the shops used a much greater diversity of process chemicals when they were dry cleaning with PERC compared to using PWC. This situation reflects the fact that of the 11 shops that transitioned to PWC, 10 installed Miele brand washing equipment, which includes a standard package of process chemicals provided by Kreussler GmbH. The Miele-Kreussler package includes the Deprit line of spot cleaning chemicals in addition to Lanadol detergents and softeners (none of which are High Concern products).

As requested by the Haz Waste Program, most shops disposed of their hazardous process chemicals when they switched to PWC. However, some shops either purchased new hazardous products or retained hazardous legacy products, as shown in Table 4 and Appendix D. It is noteworthy that the one shop, which did not install the Miele-Kreussler package (Shop #14), purchased a pre-wash spray and detergent that were rated as High Concern. This shop also continued to use several High Concern products from their PERC dry cleaning operation. Two additional shops (Shop #04 and #08) also continued to use High Concern products, even though they were provided the Miele-Kreussler package.

Strengths and limitations of the study

To our knowledge, this study is the first to critically evaluate the process chemicals used by dry cleaners as they transitioned from PERC to PWC. The success of this pilot program largely reflected our excellent working relationships with vendors and others in the dry cleaning community. The Haz Waste Program is a trusted partner of the dry cleaning industry because of an almost 25 year history of providing technical assistance, education, and financial help to this sector. This study was informed by extensive observations made during field investigations conducted in King County and interviews with local shop owners, vendors, and suppliers. The comprehensive review of SDSs for products used in PERC dry cleaning vs. PWC offers valuable insights into the relative chemical hazards associated with these two technologies, which can inform future related efforts by federal, state, and local health agencies and programs.

However, our findings may not be representative of the entire fabric cleaning industry or reflect long-term work practices for the following reasons:

1. As of December 2019, there were approximately 50 PERC dry cleaners remaining in King County. Yet data for this study were collected from only 15 PERC dry cleaning shops. Consequently, the process chemicals and work practices observed at these 15 PERC shops may not be representative of all shops in the area.

2. PWC systems are available from several manufacturers, including Miele-Kreussler, Wascomat, and Poseidon. However, of the 11 shops that switched to PWC in our pilot program, 10 purchased the Miele-Kreussler package because the vendor who participated in this pilot sold this package exclusively. The one shop that opted for alternative technology purchased a used washer and dryer and a High Concern spray spotter and detergent. As additional vendors that sell products from alternative manufacturers

participate in the program in the future, they will likely introduce different process chemicals that were not observed in our pilot program.[a]

3. Although shops were provided Kreussler spot cleaners and detergents/softeners for use in their Miele PWC machines, some shop owners have complained that these products are relatively expensive. Some had used hazardous spot cleaners for many years and found it difficult to transition to new products. Therefore, some shop owners may choose to purchase legacy spot cleaners and less expensive detergents, softeners, and other process chemicals as they use up their supply of Kreussler products.[b]

Other limitations of this study include relying on SDSs to determine a product's hazard rating:

1. The quality and completeness of SDSs varied considerably. Whereas those prepared for the European market provided relatively complete information, many of those generated by United States manufactures (especially R.R. Streets, Inc.) failed to disclose ingredient information (i.e., trade secrets or proprietary), as allowed under Occupational Safety and Health Administration (OSHA) law. Consequently, it was not possible to fully evaluate the hazards associated with many products used locally.

2. Hazardous ingredients present at relatively low concentrations in products may not be listed on SDSs and therefore would be excluded from this evaluation. OSHA only requires that manufacturers list the hazardous chemicals that are found in a product in quantities of 1 percent or greater, or 0.1 percent or greater if the chemical is a carcinogen. Without full disclosure of product composition, it is not possible to determine whether the SDSs accurately represented the chemical composition of the products.

3. Because products are periodically reformulated, some formulations presented on SDSs may not reflect the current composition of products seen in the shops.

Additional limitations related to the hazard screening include:

1. The hazard screening approach used in this study considers only the intrinsic hazard of a substance. However, the ultimate risk posed by these products to human health or the environment depends on concentration, route of exposure, individual susceptibility, and additional scenario-specific factors.

2. The Hazard Categories assigned to ingredients do not account for all possible hazard considerations, such as the potential additive or synergistic health effects of multiple chemicals in complex products.

3. Many of the substances not regarded as High Hazard can still potentially have severe human and environmental effects. Certain vulnerable populations, including pregnant

[a] In November 2019, the Haz Waste Program became aware of PWC process chemicals manufactured by Seitz Gmbh (Kriftel, Germany) that were provided to a King County cleaner. Of the 15 new products, two were rated as High Concern (red), eight had insufficient toxicity data (gray), and five were Conditional (yellow).
[b] In December 2019, we learned that one shop that had originally purchased the Miele-Kreussler package was considering purchasing Seitz products because of their lower cost.

and nursing women, children, and older adults, may also be particularly susceptible to the toxic effects of even relatively low hazard substances.

4. The hazard assessment relied on SciveraLENS Rapid Screen, which is a convenient and systematic method to screen chemicals and products. Although we performed our own toxicity review on some key substances and then worked with Scivera to confirm their Hazard Categories, resource constraints prevented us from verifying Scivera's toxicity information for most ingredients evaluated in this study. Additionally, our results are specific to the hazard screening algorithms used by Scivera. Other hazard screening systems (such as GreenScreen) that use different algorithms may provide different results.

Recommendations

We recommend that agencies and other programs seeking to promote the adoption of PWC consider the following courses of action:

1. All High Concern products should be removed from the shops before installing PWC equipment. This will minimize worker exposures and environmental release of hazardous chemicals. Funding for shops to make the transition to PWC should be contingent upon the use of products that do not contain harmful ingredients, especially chlorinated hydrocarbons such as PERC, trichloroethylene, and methylene chloride.
2. The process chemicals intended for use with PWC should be reviewed prior to funding the transition from PERC dry cleaning to ensure that none are rated as High Concern.
3. Periodic unannounced inspections should be conducted to ensure that no High Concern products are being used by PWC shops.
4. The vendors of PWC equipment and process chemicals should be notified immediately if any changes to the equipment or process chemicals are noted during inspections.

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Acknowledgments

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- Katie Fellows (Haz Waste Program)
- Jeffrey Gutschmidt (Ecology)
- Ashley Pedersen (Haz Waste Program)
- Myles Perkins (Ecology)

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Appendix A:
Pre-Switch Survey

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PERC Fabric Cleaning Questionnaire
[DO NOT RECORD SHOP NAME OR CONTACT DETAILS ON THIS FORM]

Interview Date:	
Interviewer	
Interpreter	
Shop ID#:	
Interviewee Position:	
Manufacturer of Machine:	
Model of Machine:	
Machine capacity (lbs.)	

Please tell me your race and ethnicity (optional)

☐ **I would prefer not to answer this question**.

☐ **American Indian and Alaska Native**
☐ **American Indian / Native American**
☐ **Alaska Native**
☐ **Other (please list): _____**

☐ **Asian**
☐ **Asian American**
☐ **Asian Indian**
☐ **Chinese**
☐ **Filipino**
☐ **Japanese**
☐ **Korean**
☐ **Vietnamese**
☐ **Other (please list): _____**

☐ **Black or African American**
☐ **African American**
☐ **Ethiopian**
☐ **Somali**
☐ **Other (please list): _____**

☐ **Hispanic or Latino**
☐ **Mexican or Mexican American**
☐ **Puerto Rican**
☐ **Other (please list): _____**

☐ **Native Hawaiian and Other Pacific Islander**
☐ **Guamanian**
☐ **Native Hawaiian**
☐ **Samoan**
☐ **Other (please list): _____**

☐ **White**
☐ **European American**
☐ **Russian**
☐ **Ukrainian**
☐ **Other (please list): _____**

☐ **Some Other Race**
☐ **Iranian**
☐ **Iraqi**
☐ **Other (please list): _____**

☐ **Other (please list): _____**

Attempt to **at least** answer all questions in gray portion on first data gathering visit

1. **Who is your dry cleaning solvent distributor/supplier?**

   __ Don't know
   Contact name: _____ Business name: _____
   Mailing address: _____
   Telephone number: _____ Email: _____

2. **Have you considered switching to professional wet cleaning? Yes / No**

   a. **If yes**, why are you thinking about switching to professional wet cleaning: (circle all that apply)
      1. Marketing reasons
      2. Concerns about the health effects on dry cleaners
      3. Pressure from the landlord or property owner,
      4. Concerns about the environment
      5. Liability for contamination
      6. Concern that PERC might be banned
      7. other: _____

   b. **If no**, what is stopping you from switching to professional wet cleaning?

      _____

3. **Are you having any problems with your machine? Yes / No**

If yes, please describe the problems you are having _____

_____

_____

4. **How old is your machine? _____ years**
5. **How many loads of dry cleaning do you do in a week? _____ loads per week**
6. **What is the approximate size of each load? _____ lbs./load**
7. **What is the approximate cycle time per load? _____ minutes/load**
8. **How much time do you or your employees spend on the following tasks?**
   a. **Spotting (average hours/day): _____**
   b. **Finishing (average hours/day: _____**
9. **How many drop shops collect clothing and other fabrics to be cleaned at this facility? _____**
10. **Do you offer a laundry pick-up service? Yes / No**

11. **Do you have a PERC leak detector? Yes / No**

12. **How many employees do you have? _____**

13. **How much dry cleaning solvent do you buy per year to top off your machine (gallons)? _____**

14. **Do you think that PERC can cause health problems? Yes / No**

    If yes, what type of health problems? _____

15. **Which cleaning products do you use?**

    On the table, circle the products that you use the most.

Type of chemical	**Manufacturer**	**Product name**
Pre-spotting product	1 _____ 2 _____ 3 _____ 4 _____ 5 _____	1 _____ 2 _____ 3 _____ 4 _____ 5 _____
Post-spotting product	1 _____ 2 _____ 3 _____ 4 _____ 5 _____	1 _____ 2 _____ 3 _____ 4 _____ 5 _____
Detergent	1 _____ 2 _____	1 _____ 2 _____
Sizing	1 _____ 2 _____	1 _____ 2 _____
Other	1 _____ 2 _____	1 _____ 2 _____

16. **Which fabrics are most difficult to clean? _____**

    a. Why are they difficult to clean? _____

    b. How do you clean them? _____

17. **Do you have any of the following health problems after spending time in your shop? (circle all that apply)**
    - headaches
    - dizziness
    - nausea
    - eye irritation
    - skin irritation
    - breathing problems
    - other, please describe _____
    - none

18. **How much do you spend on the following operational costs per year?**
    a. **Machine maintenance: $_____ per year**
    b. **Filters $_____per year**
    c. **Hazardous Waste disposal: $_____per year**

    Regulatory/permitting $_____ per year

19. **Would you be willing to share with us your average monthly cost for utilities? Yes / No**

    If yes, would you prefer that we review your utility bills or contact the utilities?

    On-site review of utility bills:

Gas	$_____ per month
Water	$_____ per month
Electricity	$_____ per month
Wastewater	$_____ per month

    Contacting utilities:

    Water _____

    Gas _____

    Electricity _____

    Wastewater _____

20. **How often do you need to re-clean a clothing item or respond to a customer claim, due to unsatisfactory results, after one round in the machine? _____ times/year**

21. **Is there anything else you would like to tell us?**

    _____

    _____

22. **Interviewee notes to inform Evaluation. Consider Grant Flyer, Financial Resources Flyer, Grants, Professional wet cleaning technology, Hydrocarbon or other technology, Customers, Other Shops, Utilities, Labor, Vendors, Disposal of their PERC machine, How their business is doing, Other.**

_____

_____

_____

_____

_____

_____

PID Scan of PERC Dry Cleaning Machine

Is the machine running? Yes / No

Location on machine	Measured ppm

Overall conclusions on state of machine

_____

_____

_____

_____

_____

_____

Appendix B:
Post-Switch Survey

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Post-PERC Switch Questionnaire
[DO NOT RECORD SHOP NAME OR CONTACT DETAILS ON THIS FORM]

Interview Date:	
Interviewer	
Interpreter	
Shop ID#:	
Interviewee Position:	
Date switched to wet cleaning (Month/Year)	
Manufacturer of Washer:	
Model of Washer:	
Capacity of Washer (lbs.)	
Manufacturer of Dryer:	
Model of Dryer:	
Capacity of Dryer (lbs.)	

Please tell me your race and ethnicity (optional)

☐ **I would prefer not to answer this question**.

☐ **American Indian and Alaska Native**
☐ **American Indian / Native American**
☐ **Alaska Native**
☐ **Other (please list): _____**

☐ **Asian**
☐ **Asian American**
☐ **Asian Indian**
☐ **Chinese**
☐ **Filipino**
☐ **Japanese**
☐ **Korean**
☐ **Vietnamese**
☐ **Other (please list): _____**

☐ **Black or African American**
☐ **African American**
☐ **Ethiopian**
☐ **Somali**
☐ **Other (please list): _____**

☐ **Hispanic or Latino**
☐ **Mexican or Mexican American**
☐ **Puerto Rican**
☐ **Other (please list): _____**

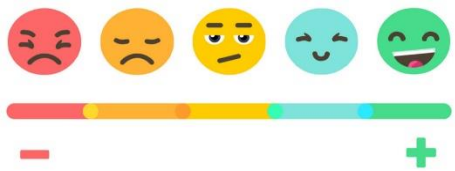
☐ **Native Hawaiian and Other Pacific Islander**
☐ **Guamanian**
☐ **Native Hawaiian**
☐ **Samoan**
☐ **Other (please list): _____**

☐ **White**
☐ **European American**
☐ **Russian**
☐ **Ukrainian**
☐ **Other (please list): _____**

☐ **Some Other Race**
☐ **Iranian**
☐ **Iraqi**
☐ **Other (please list): _____**

☐ **Other (please list): _____**

1. **On the scale below, please indicate how happy you are with your decision to switch from PERC to PWC?**



Please tell us why/why you are not happy.

_____

_____

_____

_____

What would make you move one point up the happiness scale?

_____

_____

_____

_____

2. **Are you having any problems with PWC? Yes / No**

If yes, please describe the problems you are having _____

_____

_____

3. **Who is your Professional Wet Cleaning (PWC) vendor?**

Contact name: _____ Business name: _____
Mailing address: _____
Telephone number: _____ Email: _____

4. **Apart from the washer and dryer, what other equipment did you have to buy, and how much did it cost?**

   - Tensioning Pants Topper. Cost $_____
   - Tensioning Form Finisher. Cost $_____
   - Other: _____. Cost $_____

5. **What was the total cost for you to switch to PWC? $ _____**

6. **Did you get the training you needed when you switched to PWC? Yes / No**

   If no, how could the training be improved? _____

   _____

   _____

7. **How many loads of cleaning do you do in a week? _____ loads per week**

8. **What is the approximate size of each load? _____ lbs./load**

9. **What is the approximate cycle time per load?**

   a. Washer _____ minutes/load
   b. Dryer _____ minutes/load

10. **How much time do you or your employees spend on the following tasks?**

    c. Spotting (average hours/day): _____
    d. Finishing (average hours/day: _____

11. **Which fabrics are most difficult to clean with PWC?**
    _____

    c. Why are they difficult to clean? _____
    d. How do you clean them? _____

12. **Which cleaning products do you use with PWC?**

    On the table, circle the products that you use the most.

Type of chemical	Manufacturer	Product name
Pre-spotting product	1 _____ 2 _____ 3 _____ 4 _____ 5 _____	1 _____ 2 _____ 3 _____ 4 _____ 5 _____
Post-spotting product	1 _____ 2 _____ 3 _____ 4 _____ 5 _____	1 _____ 2 _____ 3 _____ 4 _____ 5 _____
Detergent	1 _____ 2 _____	1 _____ 2 _____
Sizing	1 _____ 2 _____	1 _____ 2 _____
Other	1 _____ 2 _____	1 _____ 2 _____

13. **Since switching to PWC, do you have any of the following health problems after spending time in your shop? (circle all that apply)**

    - headaches
    - dizziness
    - nausea
    - eye irritation
    - skin irritation
    - breathing problems
    - other, please describe _____
    - none

14. **Have you noticed any changes in your health since you switched to PWC? Yes / No**
    If yes, please describe _____

15. **Did you purchase a separate hydrocarbon machine to supplement your PWC system? Yes / No**

    If yes, which fabrics do you only clean in hydrocarbon, and why?

    _____

16. **Are you willing to share with us your average monthly cost for utilities? Yes / No**

If yes, do we have your permission to contact the utilities? Yes / No

On-site review of utility bills:

Gas	$_____ per month
Water	$_____ per month
Electricity	$_____ per month
Wastewater	$_____ per month

Contacting utilities:

Water

_____

Gas

_____

Electricity

_____

Wastewater

_____

17. **How often do you need to re-clean a clothing item when using PWC or respond to a customer claim, due to unsatisfactory results, after one round in the machine? _____ times/year**

18. **How much did you pay per year to dispose of hazardous wastes when you were using PERC? $_____**

19. **How much have you paid to dispose of hazardous wastes generated by the PWC machine? $_____**

20. **Have you told your customers that you have switched to PWC? Yes / No**

Why / Why not?

_____

21. **Do you send any fabrics to another dry cleaner to be cleaned? Yes / No**

If yes, why?

_____

_____

22. **Have your customers given you any feedback after you switched to PWC? Yes / No**

    If yes, what did they say?

    _____

    _____

23. **Is there anything else you would like to tell us about your experience working with King County, your vendors, or switching to PWC?**

    _____

    _____

    _____

    _____

24. **Interviewee notes to inform Evaluation. Consider Grant Flyer, Financial Resources Flyer, Grants, Professional wet cleaning technology, Hydrocarbon or other technology, Customers, Other Shops, Utilities, Labor, Vendors, Disposal of their PERC machine, How their business is doing, Other.**

    _____

    _____

Appendix C:
SciveraLENS Rapid Screen Hazard Categories for products used in PERC dry cleaning

Hazard Categories shown in Appendix C, in decreasing order of concern:

1. High: High Concern (red)
2. No data: No SDS data/High Concern – LHWMP-assigned category (red cross-hatch)
3. Insuff.: Insufficient toxicity data (gray)
4. Cond.: Conditional (yellow)

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SciveraLENS Rapid Screen Human and Environmental Health Screening Hazard Categories for Products used in PERC dry cleaning shops															
	Shop ID number														
Product Type / Product	**01**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Spotting agents															
Adco BPR					Cond.										
Adco Knock Out Ink Remover													High		
Adco Release										Cond.					
Adco Wetspo					High							High			
AL Wilson BonGo								Insuff.							
AL Wilson InkGo	Insuff.														
AL Wilson QwikGo								Cond.							
AL Wilson RustGo		High				High		High		High			High	High	
AL Wilson TarGo							High	High				High			
AL Wilson Yellow Go							High								
AlbaChem PSR											High				
Ammonia							Cond.								
Amway Legacy of Clean Prewash Spray													High		
ANC Pull-Out 2				High			High								
Caled Ink Out				High											
Caled Spray Spotter		Cond.													
Caled Tan e-cal plus				No data									No data		
K2r Spotlifter							High								
Kleen Warrior All Purpose Cleaner & Degreaser													Cond.		
Kreussler Deprit Professional 1							Cond.								
Kreussler Deprit Professional 2							Cond.								
Kreussler Deprit Professional 3							Cond.								
Kreussler Deprit Professional 4							Cond.								
Kreussler Deprit Professional 5							Cond.								
Kreussler Deprit Professional 6							Insuff.								
Laidlaw Pull Out Premium V										High					
Laidlaw Silk Sheen									Cond.						
Logos Fabricare POG			High												
Newhouse Eliminink			Insuff.												

SciveraLENS Rapid Screen Human and Environmental Health Screening Hazard Categories for Products used in PERC dry cleaning shops (cont.)															
	Shop ID number														
Product / Product Type	**01**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Stamford Aquadol														Insuff.	
Stamford Flik														Cond.	
Stamford POG									Insuff.					Insuff.	
Stamford Proteen														High	
Stamford Spol														High	
Stamford Spot Buster														High	
Stamford SSS														Insuff.	
Stamford Trik														High	
Stamford Vol														High	
Streets 2-1 Formula			High				High						High		High
Streets Devour														No data	
Streets Multispot	No data														
Streets Picrin	High		High								High		High	High	High
Streets Pyratex	No data	No data		No data		No data				No data	No data		No data	No data	No data
Streets Sofspot	No data	No data													
Streets Streepene											Cond.				
Streets Streepro	No data	No data		No data		No data			No data		No data	No data	No data		No data
Streets Streetan		No data							No data	No data		No data	No data	No data	
Streets Streetex	No data	No data			No data									No data	No data
Detergents															
Adco Soft Kleen Xtra					High										
Diamond CP Injection Detergent											High				
Kreussler Clip Combi	Insuff.						Insuff.								
Logos Fabricare Dry Soap				Cond.		Cond.									
Streets Staticol								No data		No data		No data			No data
Streets Fabricol														No data	
Sizing															
Adco Fashion Finish Synthetic			High												
Streets Revive										Cond.					
Other															
Kreussler Peramon					Insuff.										

Appendix D:
SciveraLENS Rapid Screen Hazard Categories for products used in professional wet cleaning

Hazard Categories shown in Appendix C, in decreasing order of concern:

1. High: High Concern (red)
2. No data: No SDS data/High Concern – LHWMP-assigned category (red cross-hatch)
3. Insuff.: Insufficient toxicity data (gray)
4. Cond.: Conditional (yellow)

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SciveraLENS Rapid Screen Human and Environmental Health Screening Hazard Categories for Products used in PWC shops											
	Shop ID number										
Product Type / Product	**01**	**04**	**05**	**06**	**07**	**08**	**10**	**12**	**14**	**15**	**16**
Spotting agents											
AL Wilson InkGo									Insuff.		
AL Wilson RustGo									High		
Ammonia						Cond.					
Amway Home Fabric Softener									Insuff.		
Amway Home Prewash Spray									High		
ANC Pull-Out 2						High					
Kleen Warrior All Purpose Cleaner & Degreaser									Cond.		
Kreussler Deprit Professional 1	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.		Cond.	Cond.
Kreussler Deprit Professional 2	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.		Cond.	Cond.
Kreussler Deprit Professional 3	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.		Cond.	Cond.
Kreussler Deprit Professional 4	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.		Cond.	Cond.
Kreussler Deprit Professional 5	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.		Cond.	Cond.
Kreussler Deprit Professional 6	Insuff.	Insuff.	Insuff.	Insuff.	Insuff.	Insuff.	Insuff.	Insuff.		Insuff.	Insuff.
Streets General Formula 209		No data									
Streets Pyratex									No data		
Streets Streepro									No data		
Other products											
Amway Home SA8 Laundry Detergent									High		
Kreussler Colofix		Cond.				Cond.					
Kreussler Lanadol Aktiv	Insuff.	Insuff.	Insuff.	Insuff.	Insuff.	Insuff.	Insuff.	Insuff.		Insuff.	Insuff.
Kreussler Lanadol Apret	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.		Cond.	Cond.
Kreussler Lanadol Avant	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.		Cond.	Cond.
Kreussler Lanadol X-press	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.		Cond.	Cond.
Kreussler Ottalin Soft	Cond.	Cond.	Cond.	Cond.	Cond.	Cond.		Cond.			
Kreussler Trebon Plus	Insuff.	Insuff.	Insuff.		Insuff.	Insuff.	Insuff.	Insuff.		Insuff.	

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Appendix E:
SciveraLENS Rapid Screen Hazard Categories for Ingredients in Products used in PERC dry cleaning and PWC

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Chemical name	CAS number	Scivera Hazard Category	Used in PERC dry cleaning	Used in PWC
2,2',2''-nitrilotriethanol	102-71-6	Moderate	X	
toluene-4-sulphonic acid	104-15-4	Low-Moderate	X	
2,2'-methyliminodiethanol	105-59-9	Moderate	X	
Alcohols, C12-15, branched and linear, ethoxylated	106232-83-1	Low-Moderate	X	X
butane	106-97-8	Moderate	X	
2-methylpentane-2,4-diol	107-41-5	Moderate	X	X
1-methoxypropan-2-ol	107-98-2	Moderate	X	
pentane	109-66-0	Moderate	X	
dimethoxymethane	109-87-5	Low-Moderate	X	X
5-methylhexan-2-one	110-12-3	Moderate	X	
N-(2-hydroxypropyl)oleamide	111-05-7	Insufficient data	X	
2,2'-iminodiethanol	111-42-2	High	X	
2-butoxyethanol	111-76-2	Moderate	X	X
dimethyl glutarate	1119-40-0	Moderate	X	
2-butoxyethyl acetate	112-07-2	Moderate	X	X
2-(2-ethoxyethoxy)ethyl acetate	112-15-2	Moderate	X	X
dodecyldimethylamine	112-18-5	Insufficient data	X	
2-(2-butoxyethoxy)ethanol	112-34-5	Moderate	X	X
hexadecyldimethylamine	112-69-6	Insufficient data	X	

Chemical name	CAS number	Scivera Hazard Category	Used in PERC dry cleaning	Used in PWC
dimethyl(tetradecyl)amine	112-75-4	Insufficient data	X	
Silica gel, pptd., cryst.-free	112926-00-8	Moderate	X	X
Silica, amorphous, fumed, cryst.-free	112945-52-5	Moderate	X	X
n-butyl acetate	123-86-4	Moderate	X	X
2-(2-butoxyethoxy)ethyl acetate	124-17-4	Moderate	X	X
carbon dioxide	124-38-9	Moderate	X	
4-Nonylphenol, branched, ethoxylated	127087-87-0	High	X	
tetrachloroethylene	127-18-4	High	X	X
Borax (B4Na2O7.10H2O)	1303-96-4	High		X
potassium hydroxide	1310-58-3	Moderate	X	
sodium hydroxide	1310-73-2	Moderate	X	X
sodium decylbenzenesulphonate	1322-98-1	Moderate	X	X
ammonia, aqueous solution	1336-21-6	Moderate	X	X
ammonium hydrogendifluoride	1341-49-7	High	X	X
titanium oxide sulphate	13825-74-6	Insufficient data	X	
disodium disilicate	13870-28-5	Insufficient data		X
oxalic acid	144-62-7	Moderate	X	X
sodium dodecyl sulphate	151-21-3	Moderate	X	
disodium carbonate, compound with hydrogen peroxide (2:3)	15630-89-4	Moderate		X

Chemical name	CAS number	Scivera Hazard Category	Used in PERC dry cleaning	Used in PWC
Alcohols, C13-15, branched and linear, ethoxylated	157627-86-6	Moderate	X	X
Ethanaminium, 2-hydroxy-N,N-bis(2-hydroxyethyl)-N-methyl-, esters with C16-18 and C18-unsatd. fatty acids, Me sulfates (salts)	157905-74-3	Insufficient data		X
xylenesulphonic acid	25321-41-9	Insufficient data	X	
Poly(oxy-1,2-ethanediyl), α-[(9Z)-2-[(1-oxo-9-octadecen-1-yl)amino]ethyl]-ω-hydroxy-	26027-37-2	Insufficient data		X
dodecylbenzenesulphonic acid	27176-87-0	Moderate	X	
1-(2-butoxy-1-methylethoxy)propan-2-ol	29911-28-2	Moderate	X	X
Undecan-1-ol, ethoxylated	34398-01-1	Moderate	X	
sodium carbonate	497-19-8	Moderate		X
D-gluconic acid	526-95-4	Low-Moderate	X	
glycerol	56-81-5	Low-Moderate	X	X
docusate sodium	577-11-7	Moderate	X	X
Fatty acids, coco, potassium salts	61789-30-8	Insufficient data		X
Fatty acids, coco	61788-47-4	Insufficient data	X	
1-Propanaminium, 3-amino-N-(carboxymethyl)-N,N-dimethyl-, N-coco acyl derivs., hydroxides, inner salts	61789-40-0	Moderate	X	
Quaternary ammonium compounds, dicoco alkyldimethyl, chlorides	61789-77-3	Insufficient data	X	
Fatty acids, coco, ethoxylated	61791-29-5	Insufficient data	X	
dimethyl adipate	627-93-0	Moderate	X	
pentyl acetate	628-63-7	Moderate	X	

Chemical name	CAS number	Scivera Hazard Category	Used in PERC dry cleaning	Used in PWC
1,5-dichloropentane	628-76-2	High	X	
Naphtha (petroleum), light alkylate	64741-66-8	High	X	
Distillates (petroleum), hydrotreated light	64742-47-8	Moderate	X	X
Distillates (petroleum), hydrotreated light paraffinic	64742-55-8	Insufficient data	X	
Solvent naphtha (petroleum), medium aliph.	64742-88-7	Moderate	X	
Solvent naphtha (petroleum), light arom.	64742-95-6	High	X	
propan-2-ol	67-63-0	Moderate	X	X
acetone	67-64-1	Moderate	X	
Benzene, C10-13-alkyl derivs.	67774-74-7	Moderate		X
1-(2-carboxylatoethyl)-2-(heptadec-8-enyl)-4,5-dihydro-1-(2-hydroxyethyl)-1H-imidazolium	67892-37-9	Insufficient data	X	
Alcohols, C10-16, ethoxylated	68002-97-1	Moderate	X	X
Alcohols, C12-15, ethoxylated	68131-39-5	Moderate	X	
Amides, coco, N-[3-(dimethylamino)propyl], N-oxides	68155-09-9	High	X	
disodium metasilicate	6834-92-0	Moderate	X	X
Poly(oxy-1,2-ethanediyl), Î±-(nonylphenyl)-Ï‰-hydroxy-, branched, phosphates	68412-53-3	High	X	
Quaternary ammonium compounds, benzyl-C12-16-alkyldimethyl, chlorides	68424-85-1	Moderate	X	
Amides, soya, N,N-bis(hydroxyethyl)	68425-47-8	Moderate	X	X
Alcohols, C9-11, ethoxylated	68439-46-3	Moderate	X	
Alcohols, C12-14, ethoxylated	68439-50-9	Moderate	X	

Chemical name	CAS number	Scivera Hazard Category	Used in PERC dry cleaning	Used in PWC
Alcohols, C12-14, ethoxylated propoxylated	68439-51-0	Moderate		X
Petroleum gases, liquefied, sweetened	68476-86-8	High	X	X
Alkanes, C10-13-iso-	68551-17-7	Moderate	X	X
Alcohols, C8-10, ethoxylated propoxylated	68603-25-8	Moderate	X	
Amides, coco, N,N-bis(hydroxyethyl)	68603-42-9	High	X	
2-(2-propoxyethoxy)ethanol	6881-94-3	Insufficient data	X	X
Isotridecanol, ethoxylated	69011-36-5	Moderate	X	X
Alcohols, C12-18, ethoxylated and propoxylated	69227-21-0	Insufficient data	X	
butan-1-ol	71-36-3	Moderate	X	
propane	74-98-6	Moderate	X	X
dichloromethane	75-09-2	High	X	X
isobutane	75-28-5	High	X	X
methyloxirane	75-56-9	High	X	X
hydrogen fluoride	7664-39-3	Moderate	X	X
sulphuric acid	7664-93-9	Moderate	X	
water	7732-18-5	Low	X	X
sodium dithionite	7775-14-6	Moderate	X	
citric acid	77-92-9	Moderate	X	X
Alcohols, C11-14-iso-, C13-rich, ethoxylated	78330-21-9	Moderate	X	

Chemical name	CAS number	Scivera Hazard Category	Used in PERC dry cleaning	Used in PWC
1-aminopropan-2-ol	78-96-6	Moderate	X	
trichloroethylene	79-01-6	High	X	
glycollic acid	79-14-1	Moderate	X	
methyl acetate	79-20-9	Moderate	X	
stoddard solvent	8052-41-3	High	X	
Amylase	9000-90-2	Moderate	X	
Poly(oxy-1,2-ethanediyl), α-sulfo-ω-(dodecyloxy)-, sodium salt (1:1)	9004-82-4	Moderate	X	
Subtilisin	9014-01-1	Insufficient data	X	
Nonylphenol, ethoxylated	9016-45-9	High	X	
sodium N-(2-carboxyethyl)-N-(2-ethylhexyl)-β-alaninate	94441-92-6	Insufficient data	X	X
1,2,4-trimethylbenzene	95-63-6	Moderate	X	