



RESPIRABLE CRYSTALLINE SILICA IN CONSTRUCTION

A Web-based Quantitative Risk Assessment Tool

HUGH DAVIES, ASSOC PROFESSOR, SCHOOL OF POPULATION AND PUBIC
HEALTH, UBC

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OUTLINE OF TALK

- Respirable crystalline silica (RCS) and health
- Construction exposure to RCS, challenges
- Occupational exposure data
- RCS risk assessment tool



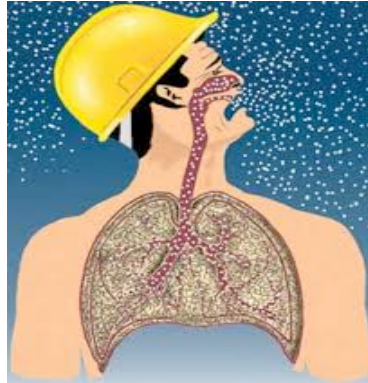
RCS AND HEALTH



THE RESPIRABLE CRYSTALLINE SILICA HAZARD



Respirable dust



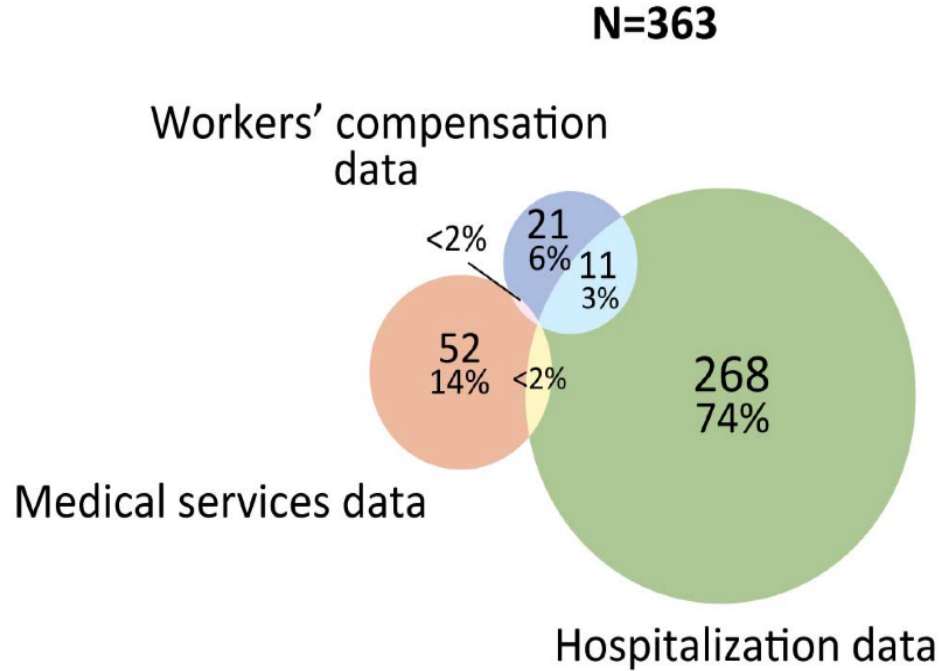
Silicosis
Lung Cancer



Silicosis

1992-2007

Time trends for asbestosis, silicosis, and coal workers' pneumoconiosis in British Columbia
Demers P, *et al.* CARWH Conference. Toronto, ON2010.



RCS AND LUNG CANCER

Exposure Assessment

*Proportion of
workers exposed
(1961 – 2001)*

3.3% of the 2011 population, or
779,000 current or former workers

Attributable Cancers

573

lung cancers
AF = 2.4%



549

AF = 4.4%

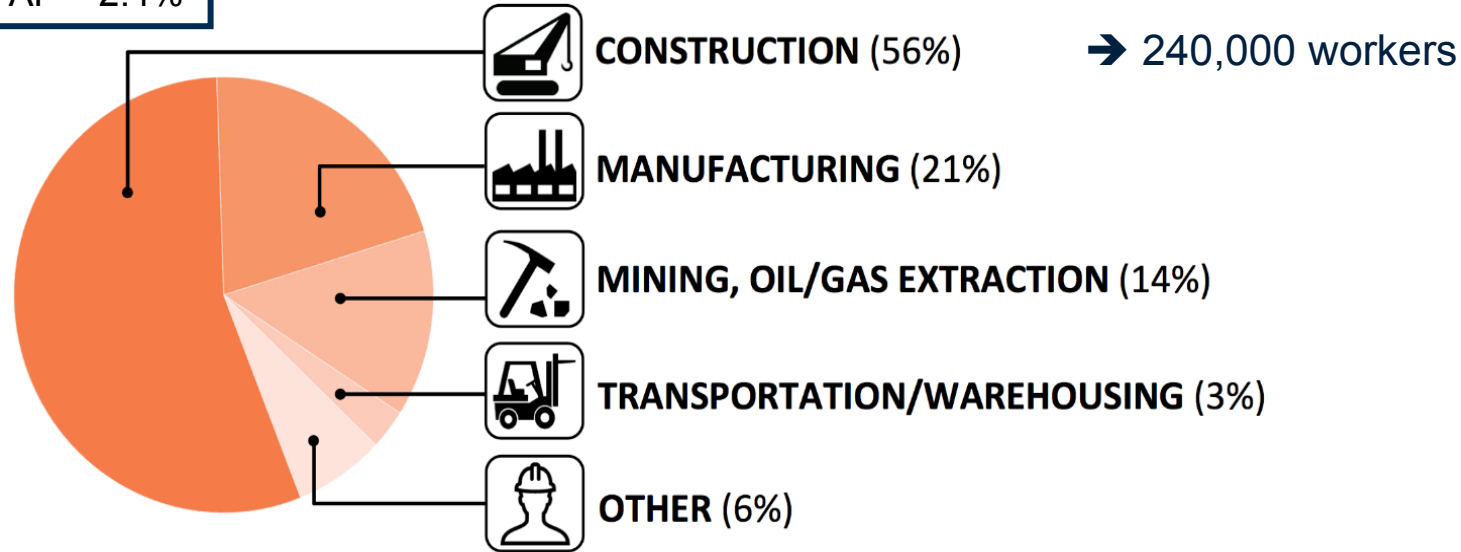


24

AF = 0.2%

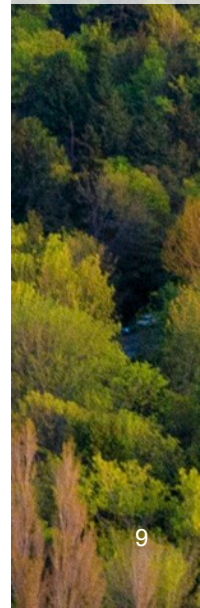
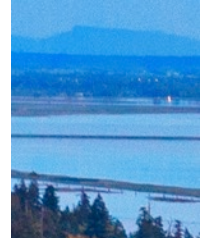
RCS CANCER BURDEN: BY INDUSTRY

573
lung
cancers
AF = 2.4%



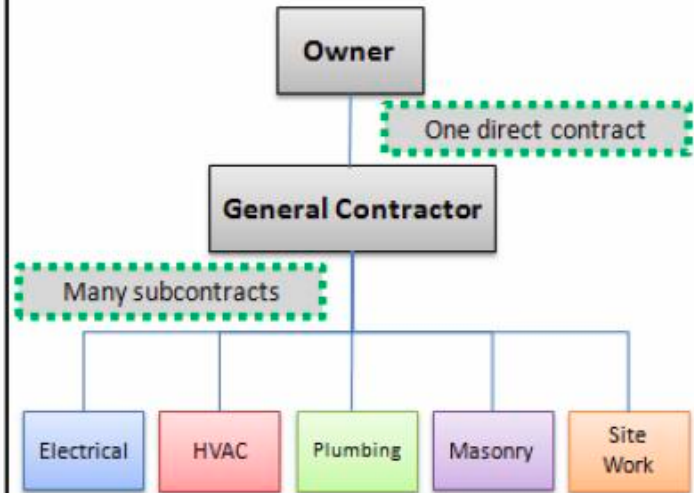
CONSTRUCTION RCS EXPOSURE, CHALLENGES







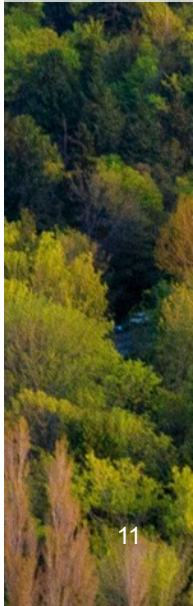
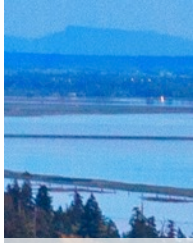
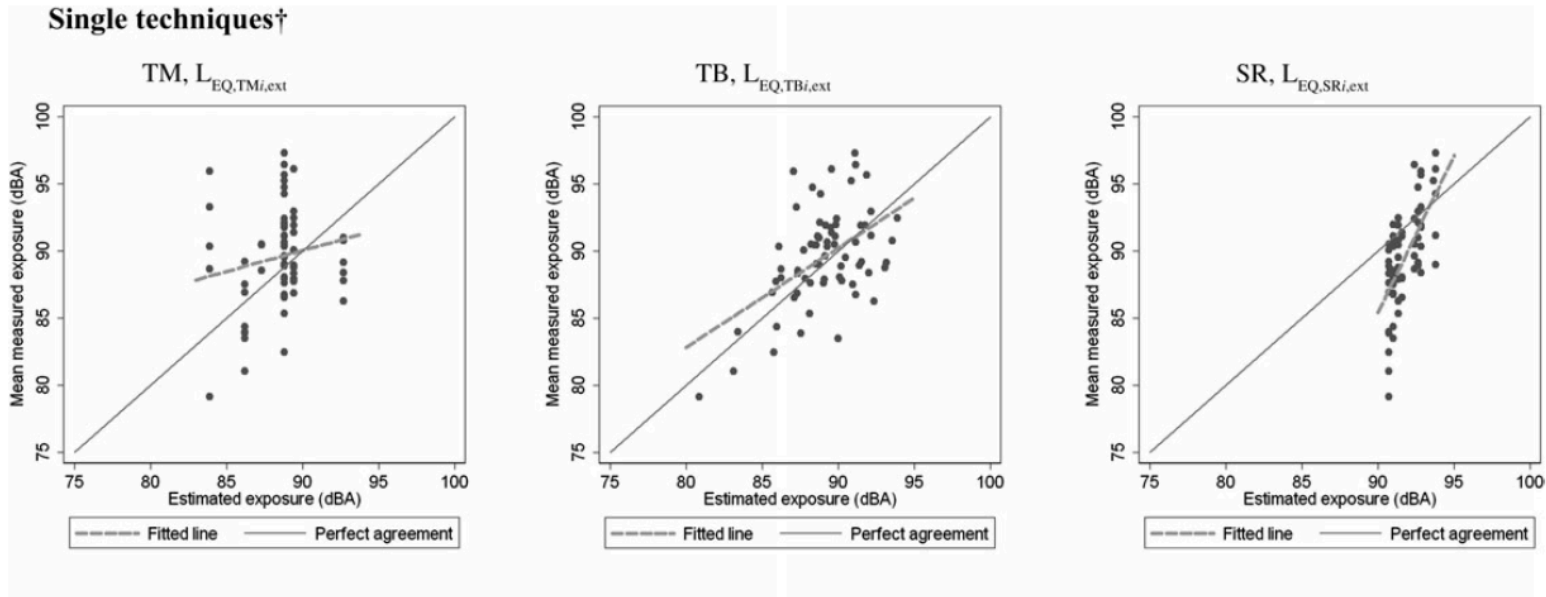
General Construction Contract



Improving Exposure Estimates by Combining Exposure Information

RICHARD L. NEITZEL¹*, WILLIAM E. DANIELL¹, LIANNE SHEPPARD^{1,2,3},
HUGH W. DAVIES⁴ and NOAH S. SEIXAS¹

¹Department of Occupational and Environmental Health Sciences, University of Washington, Box 354695, Seattle, WA 98195, USA; ²Department of Occupational and Environmental Health Sciences, University of Washington, Seattle, WA 98195, USA; ³Department of Biostatistics, University of

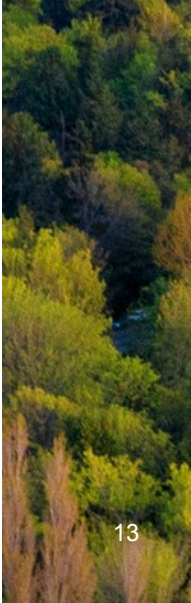
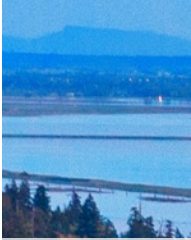
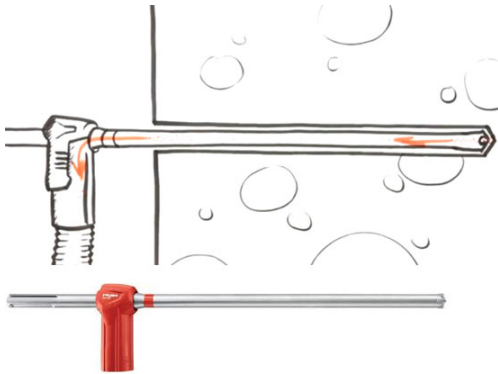




Substance	% Silica content
Brick	Up to 30
Concrete, cement, mortar	25 to 70
Tile	30-45
Sandstone, gritstone, quartzite	More than 70
Granite	Up to 30
Sand, gravel, flint	More than 70
Slate	Up to 40
Flint	More than 80



EXPOSURE/CONTROLS IN CONSTRUCTION



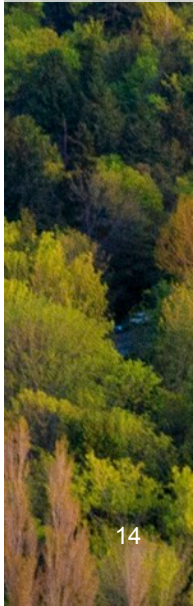
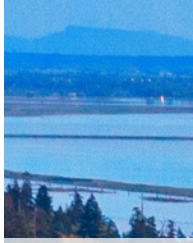
POPULATION & SITE

- Precarious employment
- Language
- Education levels
- Stability

- Dynamic
 - Temporal
 - Spatial
 - Mobile
- “Proximal work”



- BC Construction Workforce:
 - 196,000 Workers
 - ~ 40,000 Employers
 - 200 Large Employers (Over 100 employees)
 - 1200 Medium Employers (20 to 99 employees)
 - ~38,000 Small Employers (1 to 19 employees)



OCCUPATIONAL EXPOSURE DATA



THE PROBLEM WITH (LACK OF) NUMBERS

COMMENTARY

Exposed! Or not? The diminishing record of workplace exposure in Canada

Amy L. Hall, MSc,¹ Cheryl E. Peters, MSc,¹ F

ABSTRACT

The Canadian Workplace Exposure Database (CWED) is the Exposure project (CAREX Canada) to assist in estimating v
Following the CWED's establishment, all Canadian federal

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BOHS
The Chartered Society for
Worker Health Protection



COMMENTARY

Hygiene Without Numbers

HANS KROMHOUT*

Department of Environmental Epidemiology, Institute for Risk Assessment Sciences, Utrecht University, Yalelaan 2, 3584 CM Utrecht, The Netherlands

*Author to whom correspondence should be addressed. Tel: +31 30 253 9440; e-mail: h.kromhout@uu.nl
Submitted 1 December 2015

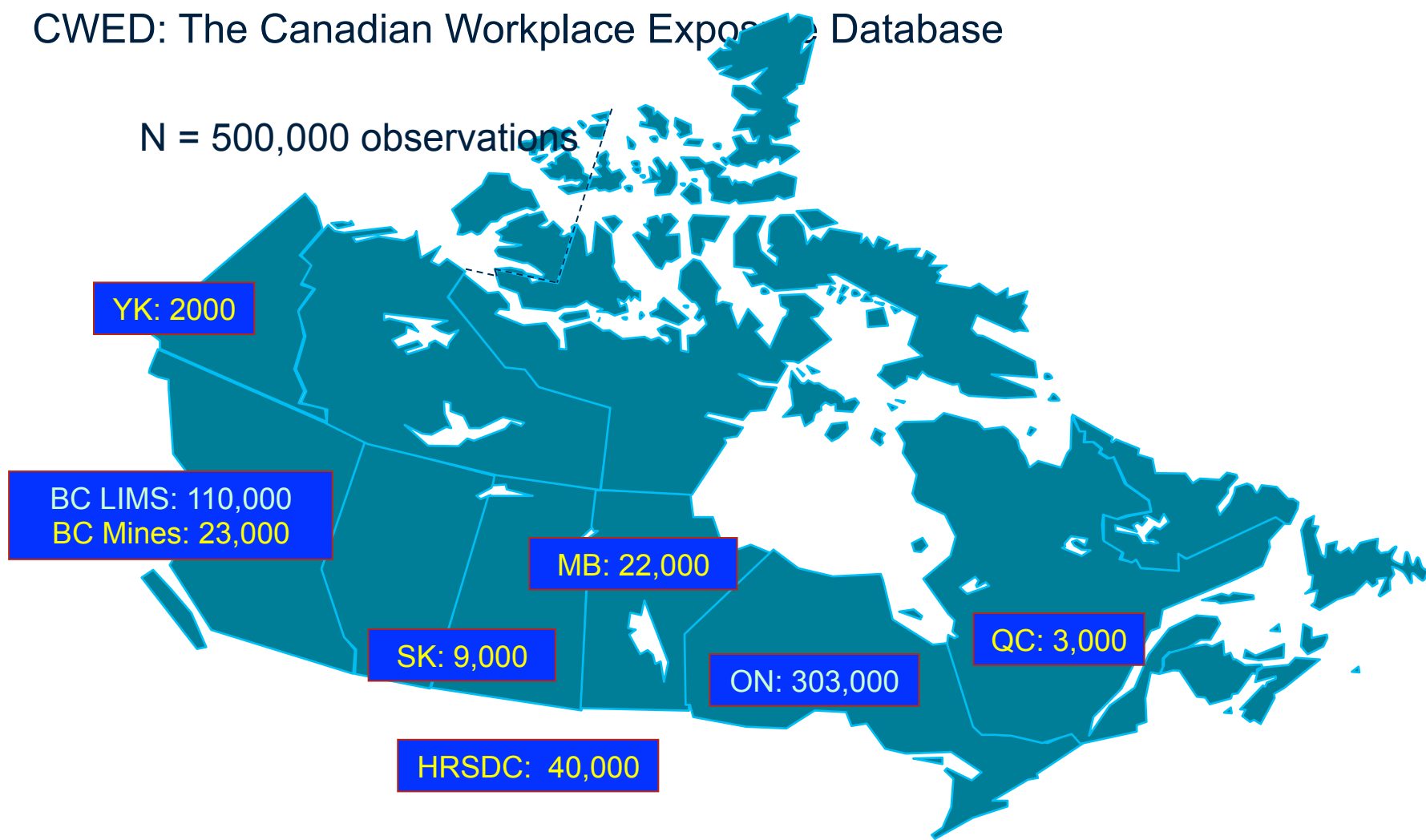
I have been a member of both British and Dutch Occupational Hygiene Societies and a 'hygienist' (AKA: 'exposure scientist') for >30 years. During my attendance at a recent meeting in Manchester between Occupational Health and Safety specialists from companies contributing to the IMA-Europe Dust Monitoring Programme and representatives of the UK's Health and Safety Executive (HSE), I was intrigued and amazed to note that the following title

Numbers are indeed not required for approaches like control banding, which entail moving from hazard assessment to control without an exposure assessment step. Such numberless interventions may be appealing to policymakers, who face the hefty task of creating meaningful and economically feasible guidelines for workplace health. However, treating workers' exposure to chemical, biological, or physical agents as a static entity that can be satisfactory controlled

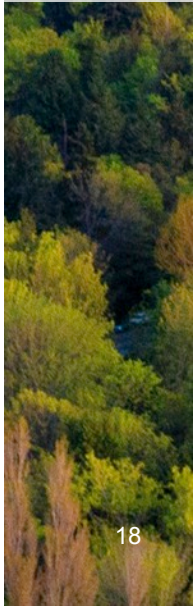
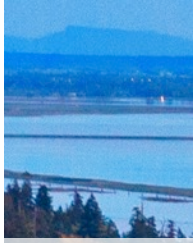
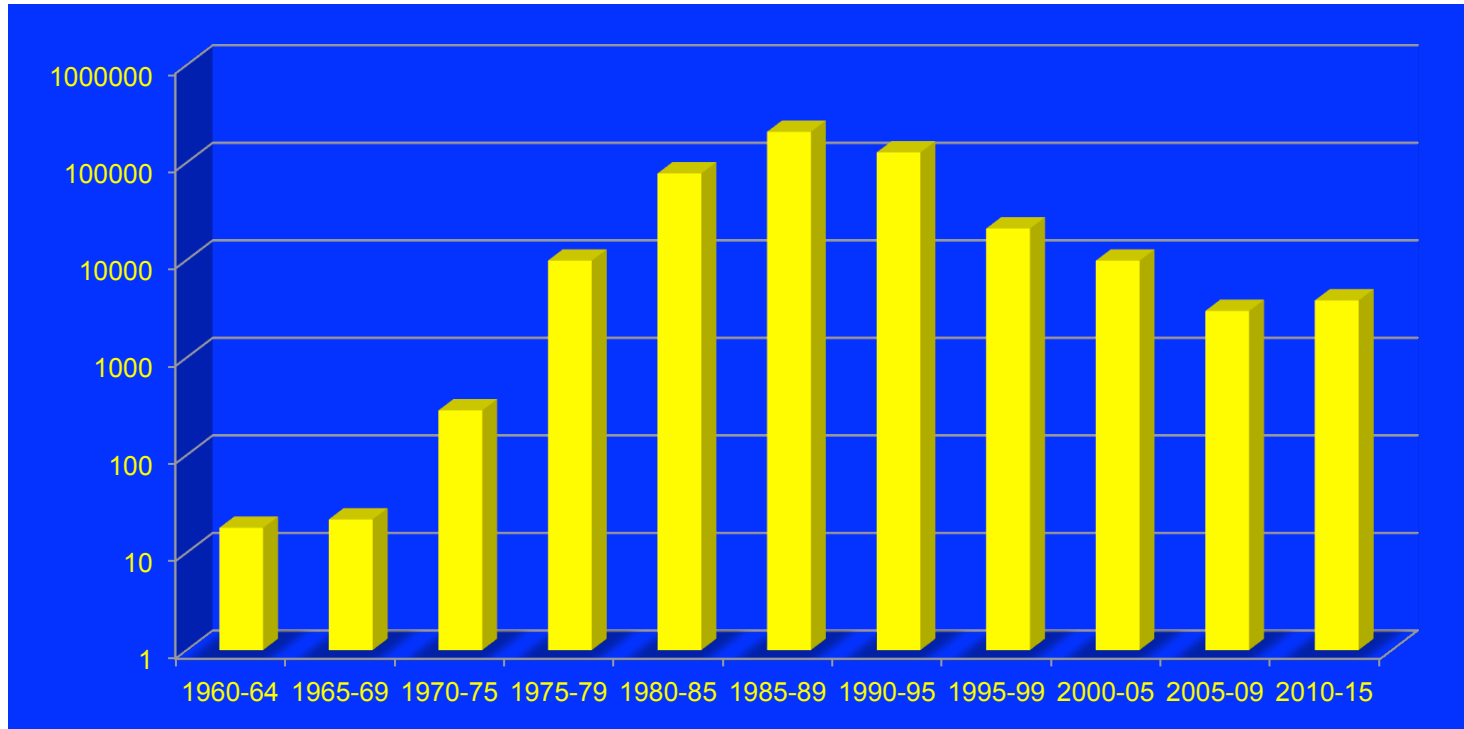


CWED: The Canadian Workplace Exposure Database

N = 500,000 observations



DATA HOLDING BY YEAR



THE PROBLEM OF HAVING NO NUMBERS.....

“If you can’t measure something, you can’t understand it. If you can’t understand it, you can’t control it. If you can’t control it, you can’t improve it.”

H. James Harrington

- Can’t accurately characterize exposure
- Challenges in control selection
- Challenges in PPE selection
- Can’t compare/test – to other measurements or regulatory levels
- Can’t track trends
- Can’t measure true impact of controls/interventions
- No data for health studies



THE ON-LINE TOOL



WorksafeBC Regulation Review – Silica

PROPOSED AMENDMENTS TO PART 6: SUBSTANCE SPECIFIC REQUIREMENTS
IN THE OCCUPATIONAL HEALTH AND SAFETY REGULATION

[Online Feedback](#)

PART 6: SUBSTANCE SPECIFIC REQUIREMENTS

Section 6.110, Respirable Crystalline Silica and Rock Dust

ROCK DUST

RESPIRABLE CRYSTALLINE SILICA AND ROCK DUST

Rock Dust	6.110	Section 6.111 to 6.115 apply to rock crushing, drilling, mucking, excavation, loading, transportation, road grading, road construction or conveying of rock or similar operations
Dust control	6.111	<p>(1) The employer must ensure that dust concentrations to which a worker may be exposed are maintained at or below the established exposure limits, by one or a combination of</p> <ul style="list-style-type: none">(a) mechanical ventilation,(b) the use of water spray,(c) other equally effective methods.





Air monitoring for RCS dust

6.112.3

personal protective equipment in addition to those control measures.

- (1) If there is a potential for hazardous exposure to RCS dust in a work activity or silica process, the employer must
 - (a) ensure that air monitoring is conducted using a sampling and analytical method referred to in subsection (2)
 - (i) during the first shift of the work activity or silica process, and
 - (ii) as necessary throughout the work activity or silica process to ensure that control measures are effective to prevent or minimize worker exposure to RCS dust, and

Exceptions to monitoring requirements

6.112.4

(b) another method acceptable to the board.

(1) In this section, “**equivalent work operations**” means work operations closely matching the silica processes, types of materials, work practices, control measures and environmental conditions prevailing in the employer’s current work operations.

(2) Despite section 6.112.3, an employer is not required to monitor the exposure of workers to RCS dust if a qualified person determines that

(a) existing control measures are effective in keeping worker exposure as low as reasonably achievable below the exposure limit, and

(b) the employer

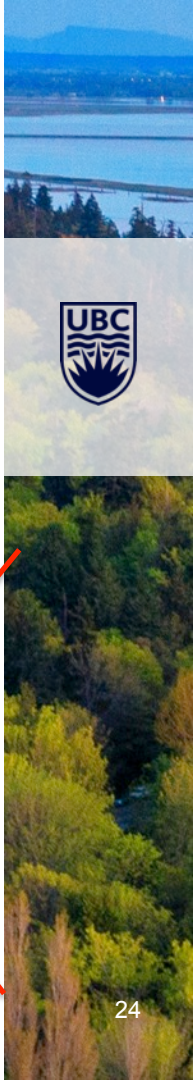
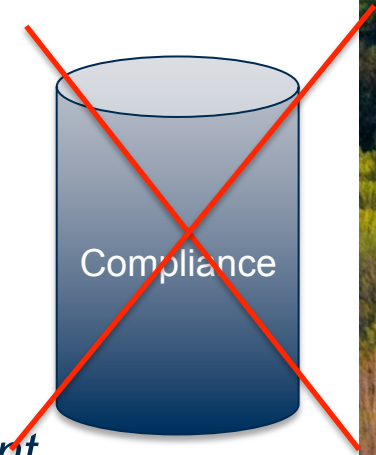
(i) has previously monitored for RCS dust exposure during equivalent work operations and there is no reason to believe that the results of the ~~previous monitoring would not continue to apply, or~~

(ii) has objective exposure monitoring data that was collected during equivalent work operations through industry surveys or peer-reviewed or scientific studies that use sampling and analytical methods described 6.112.3(2).



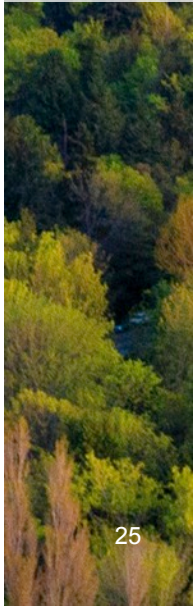
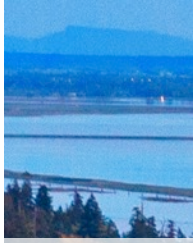
AN ON-LINE SILICA TOOL

- BC Construction Safety Alliance partnership with UBC and WorkSafeBC
- Aim: Reduce occupational exposure to RCS, by:
 - Help construction stakeholders effectively use the “equivalent work operations” clause
 - Ensure quality of exposure data
 - Reduce effort and cost
 - Help produce effective ECP’s
- *A Tool:*
 - *Does not remove need for exposure measurement*
 - *Does not absolve employer of obligations under OHSP*

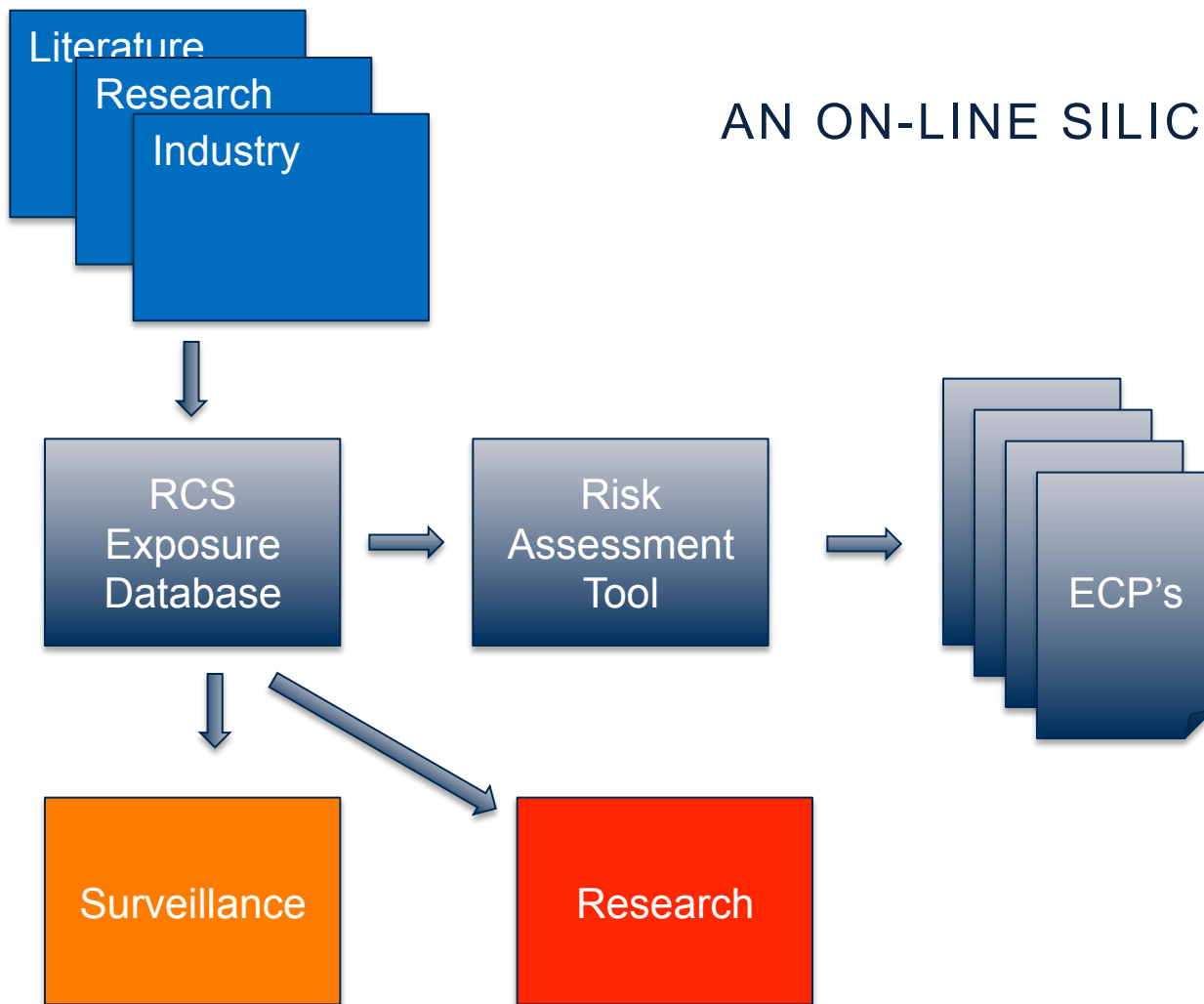


AN ON-LINE SILICA TOOL

- Audience:
 - Employer (BC)
 - Workers, regulators
- Inputs
 - Appropriate exposure measurement data
 - Expert judgement
- Outputs
 - Exposure control plan (ECP)
 - Quantitative task-based risk estimates
 - Quantitative estimation of effect of controls
 - PPE recommendation



AN ON-LINE SILICA TOOL



Step 1: Exposure Data – Initial data search

	# sources ^{\$}	Respirable Crystalline Silica	Respirable Dust	All
Raw				16,115
Useable (met QA/QC)	114	4,386	3,619	8,005
Matched to CSP*		1,110		

*CSP = “Common Silica Processes”

^{\$}Sources: Quebec DB [Lavoue]; literature; researchers; manufacturers

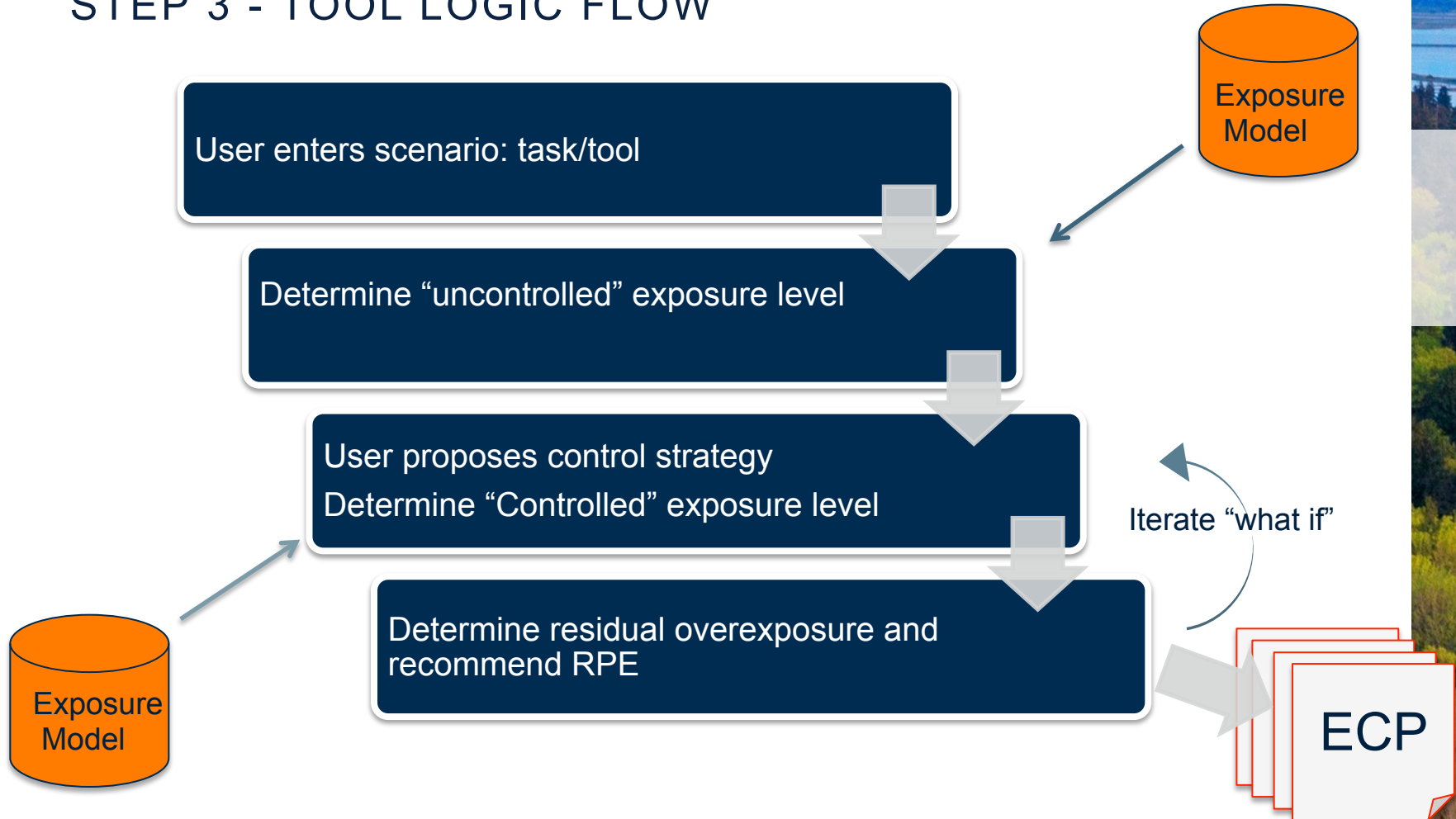


Step 2 – Assign Common “Silica Processes”

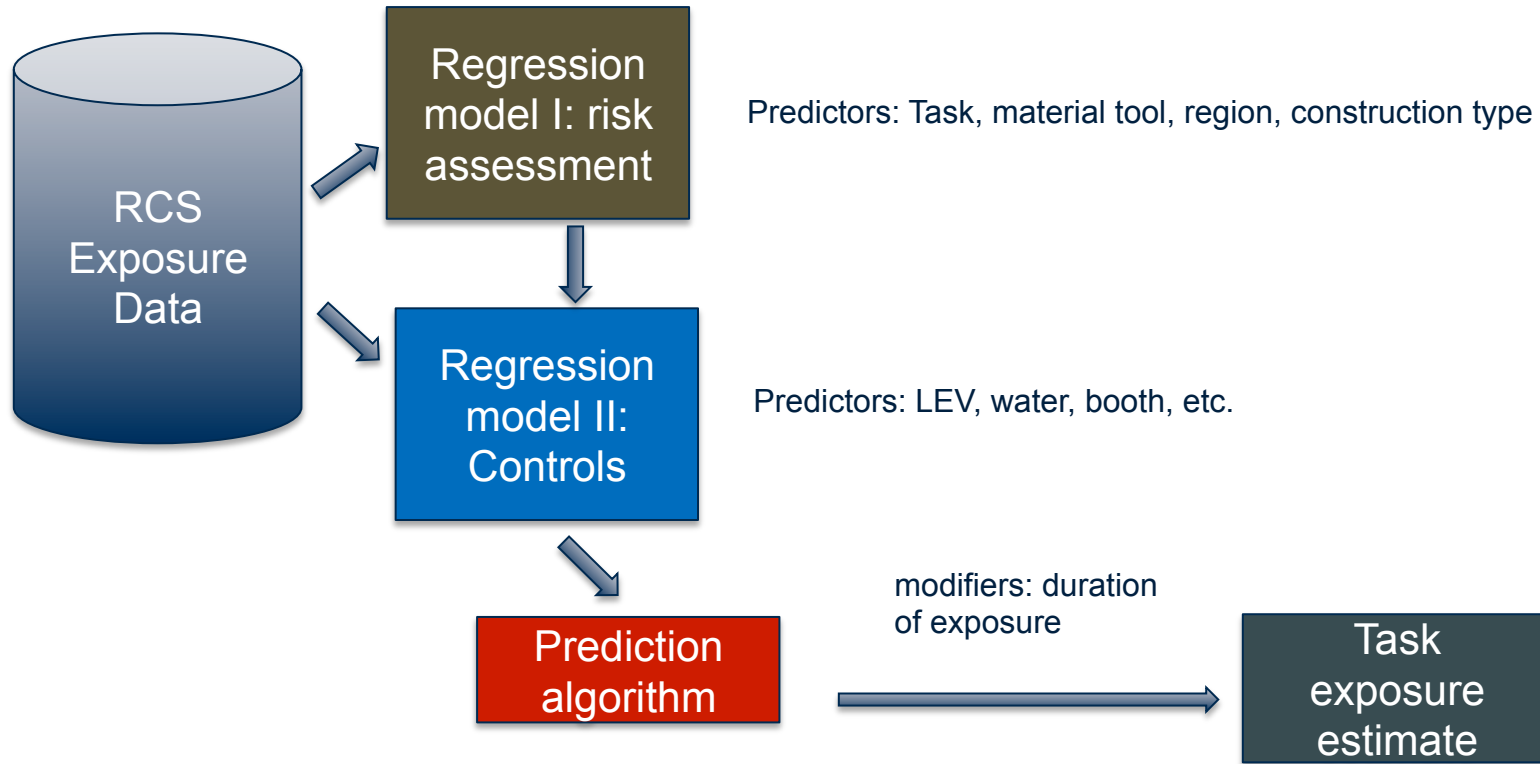
Material	Tool & Task	N Measurements
Asphalt	Cutting with walk-behind saw	3
	Milling with Milling machine	234
Brick	Cutting with water fed table saw	None
	Cutting with gas powered saw	9
Concrete	Coring/cutting with saw	149
	Drilling with electric hammer drill	None
	Grinding with surface, angle or flat grinder	133
Shotcrete	Spraying with compressed air mixture	107
Tiles	Cutting with powered tile saw	89
Rock/Sand/Earth	Manual Handling/loading	128
	Crushing/processing	15
Marble/Granite	Cutting	26
Cementitious Materials	Mixing and pouring	53
Drywall	Grinding	16



STEP 3 - TOOL LOGIC FLOW



EXPOSURE MODEL



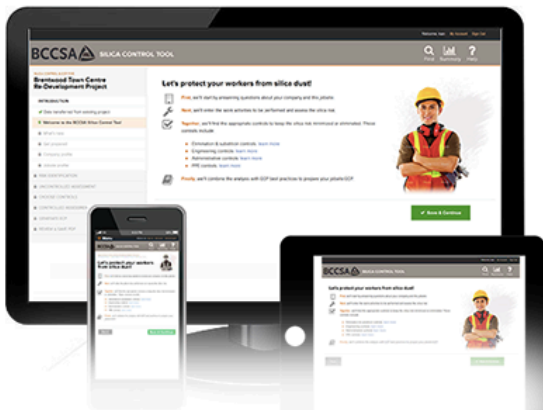
DEMONSTRATION





New to the BCCSA Silica Control Tool?

Receive step-by-step guidance to prepare your ECP



Welcome back

Username:

Password:

[Show Password](#)

[I forgot my username or password](#)

[➔ Sign in](#)

Acknowledgement



Hugh Davies

Account Owner

D.J.'s Construction Ltd.
1252 Willingdon Ave.
Burnaby BC V3B 3G3

- DASHBOARD
- Account information
- Account users

Hi Hugh:



- [Start new planning from scratch](#)
- [Start new planning by importing data](#)
- [Open a planning project](#)
- [Update your account information](#)
- [Manage people in your account](#)

D.J.'s Construction Ltd.

Exposure Control Planning:

#	Work Activity	Jobsite	Modified ▼	What would you like to do?
365	Grinding Concrete with a Surface Grinder	N/A	15/09/2016 11:59 AM	<input type="button" value="Open"/> <input type="button" value="Import"/> <input type="button" value="Delete"/>
200	Cutting Brick with a Table Saw	N/A	08/06/2016 7:32 PM	<input type="button" value="Open"/> <input type="button" value="Import"/> <input type="button" value="Delete"/>
			08/06/2016	



Exposure Control Planning

Jobsite at
December 31st, 1969 to December 31st, 1969

INTRODUCTION

- Welcome
- About this tool
- Get prepared
- Employer Details

SILICA PROCESS

- SILICA EXPOSURE (NO CONTROLS)
- EXPOSURE CONTROL
- SILICA EXPOSURE (WITH CONTROLS)
- RESIDUAL EXPOSURE CONTROL

Protecting your workers from silica dust exposure

Many work activities that create dust can expose workers to high levels of **RCS dust**. Breathing in this fine dust can cause serious lung diseases such as, silicosis, lung cancer, pulmonary tuberculosis, and chronic pulmonary disease. Exposures may also be related to the development of autoimmune disorders, chronic renal diseases, and other adverse health effects.

Acute silicosis can occur just weeks or months after a high exposure, and can be fatal. The other delayed health effects can appear years later.

Each year, more workers in BC workplaces are exposed to RCS dust than to asbestos or lead.

For more information on the exposure risks, see [Exposure Health Risks](#).

Purpose of the ECP

The **Exposure Control Plan (ECP)** sets out the plan the employer will implement to protect workers from hazardous exposure to RCS dust. Required by the Occupational Health & Safety (OHS) Regulation, the ECP identifies and communicates what will be required





Exposure Control Planning

Jobsite at
December 31st, 1969 to December 31st, 1969

INTRODUCTION

SILICA PROCESS

- Get prepared
- Jobsite details
- Work activity**
- Work area & duration
- Silica process summary

- SILICA EXPOSURE (NO CONTROLS)
- EXPOSURE CONTROL
- SILICA EXPOSURE (WITH CONTROLS)

Work Activity

The **work activity** is the combination of *material*, *task* and *tool* that will be performed. Basically, (1) the *material* determines how much **crystalline silica** is present and how easily dust can be created when disturbed; and (2) the *task/tool* determines how much energy is exerted into the material. The combination of (1) and (2) determines how much airborne RCS dust is predicted as a result of the nature of the

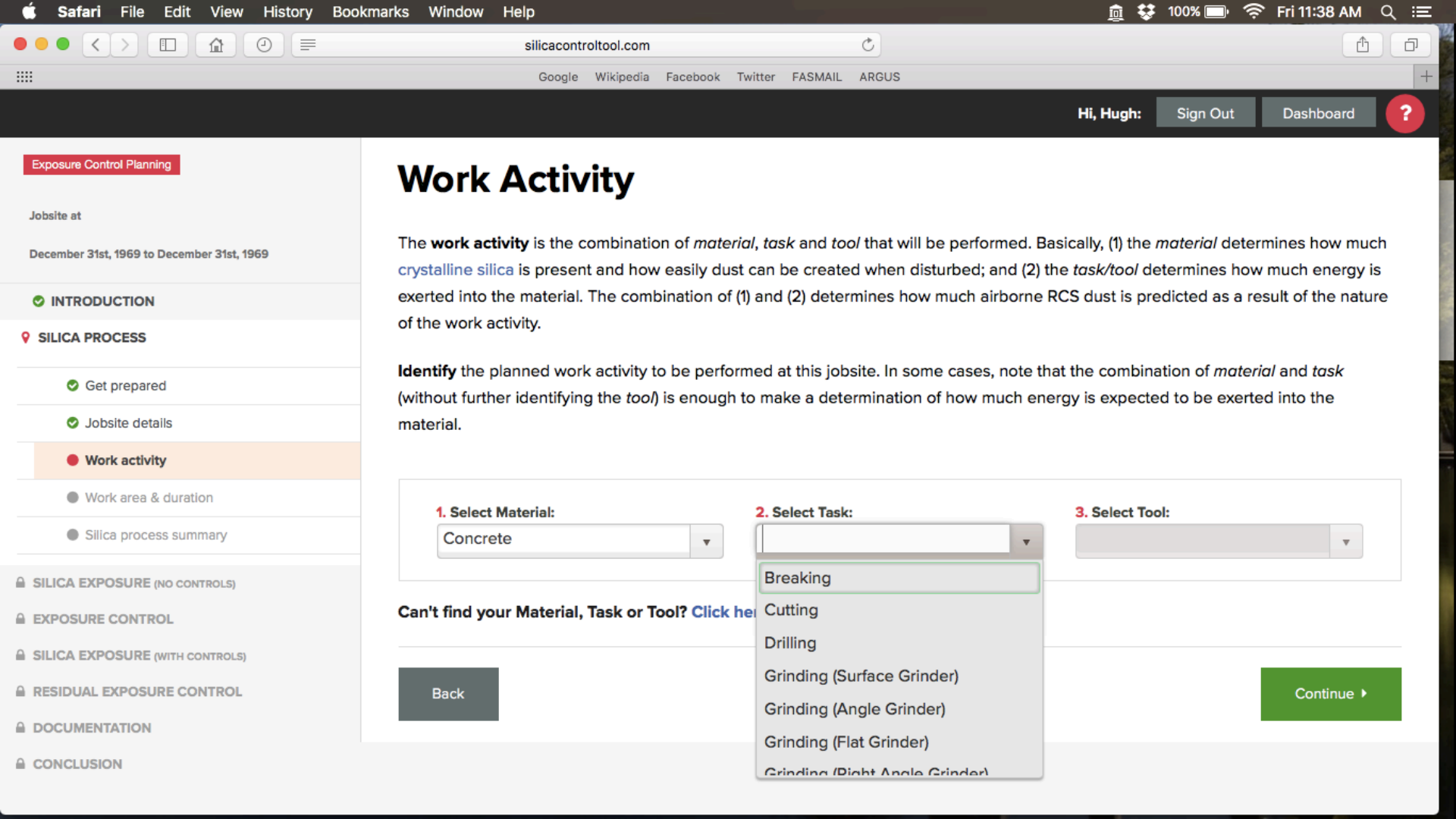
Identify the work activity to be performed at this jobsite. In some cases, note that the combination of *material* and *task* (with the *tool*) may be enough to make a determination of how much energy is expected to be exerted into the material.

Asphalt
Brick
Cementitious Material
Concrete
Drywall
Marble/Granite
Mortar

2. Select Task:

3. Select Tool:

Can't find your Material, Task or Tool? [Click here.](#)



Exposure Control Planning

Jobsite at
December 31st, 1969 to December 31st, 1969

- INTRODUCTION
- SILICA PROCESS
 - Get prepared
 - Jobsite details
 - Work activity**
 - Work area & duration
 - Silica process summary

- SILICA EXPOSURE (NO CONTROLS)
- EXPOSURE CONTROL
- SILICA EXPOSURE (WITH CONTROLS)
- RESIDUAL EXPOSURE CONTROL
- DOCUMENTATION
- CONCLUSION

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Identify the planned work activity to be performed at this jobsite. In some cases, note that the combination of *material* and *task* (without further identifying the *tool*) is enough to make a determination of how much energy is expected to be exerted into the material.

1. Select Material:

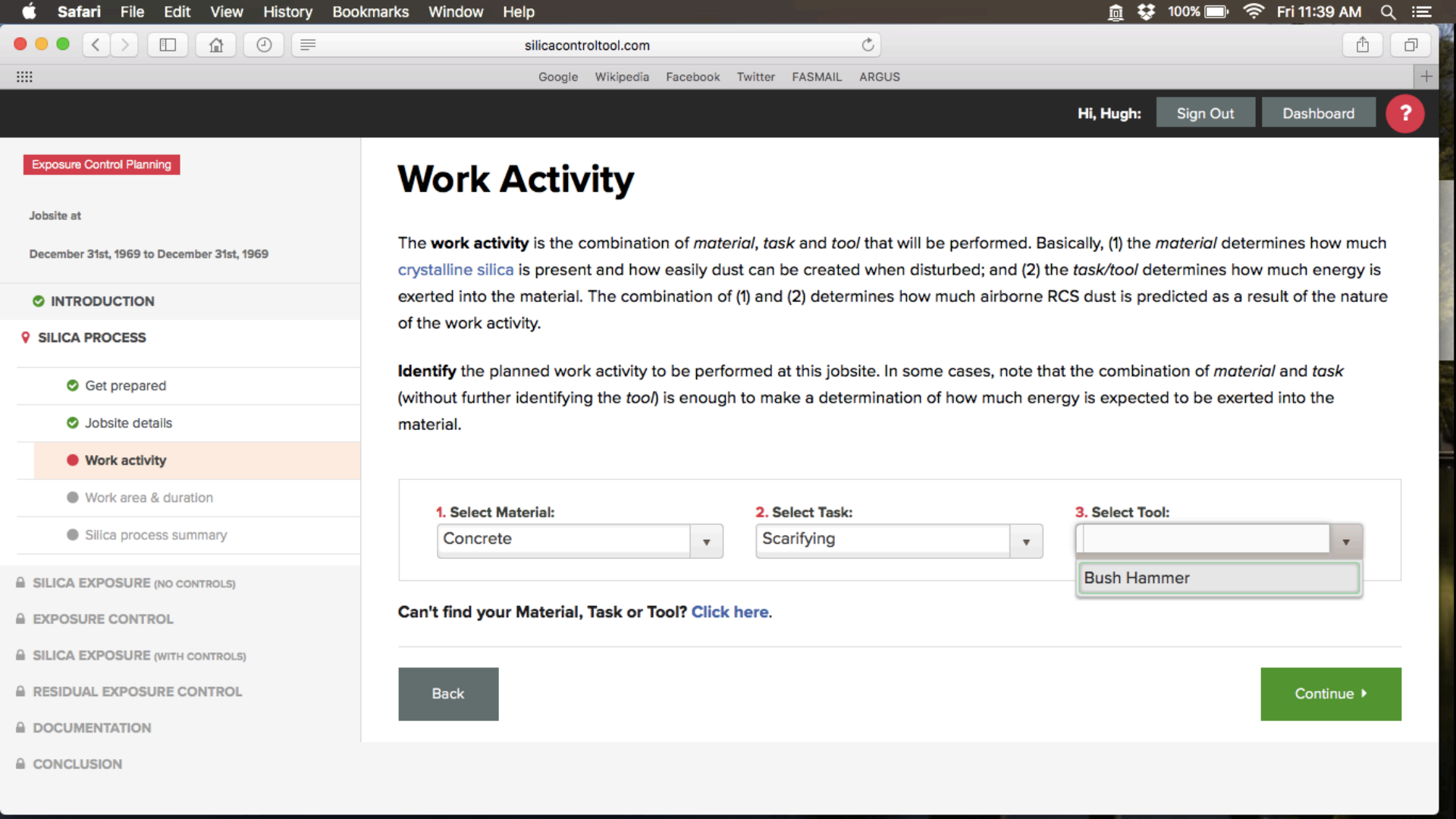
2. Select Task:

3. Select Tool:

Can't find your Material, Task or Tool? [Click here](#)

Back

Continue ▶



- Exposure Control Planning
- Jobsite at
 - December 31st, 1969 to December 31st, 1969
- INTRODUCTION
- SILICA PROCESS
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Identify the planned work activity to be performed at this jobsite. In some cases, note that the combination of *material* and *task* (without further identifying the *tool*) is enough to make a determination of how much energy is expected to be exerted into the material.

1. Select Material: Concrete

2. Select Task: Scarifying

3. Select Tool: Bush Hammer

Can't find your Material, Task or Tool? [Click here.](#)

Back

Continue ▶



Exposure Control Planning

Scarifying or Bush Hammering Concrete with a Bush Hammer

Jobsite at
December 31st, 1969 to December 31st, 1969

INTRODUCTION

SILICA PROCESS

- Get prepared
- Jobsite details
- Work activity
- Work area & duration**
- Silica process summary

Work Area & Duration

Where and how long the work activity takes place can amplify the exposure risk.

Identify the work area and work activity duration for **Scarifying or Bush Hammering Concrete with a Bush Hammer** at .

1. Select Work Area:

2. Select Work Activity Duration (avg. per shift):

Back

Continue ⚙



Exposure Control Planning

Scarifying or Bush Hammering Concrete with a Bush Hammer

Inside for 4 to 8 hours

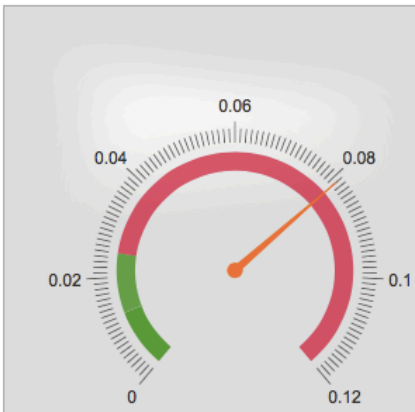
Jobsite at
December 31st, 1969 to December 31st, 1969

- ✓ INTRODUCTION
- ✓ SILICA PROCESS
- 📍 SILICA EXPOSURE (NO CONTROLS)
 - ✓ Get prepared
 - Exposure analysis (No Controls)

- 🔒 EXPOSURE CONTROL
- 🔒 SILICA EXPOSURE (WITH CONTROLS)

Exposure Analysis (No Controls)

RESULTS DETAILS SAVE



EXPOSURE MONITORING DATA EQUIVALENT		
Est. Exposure Level (No Controls)	Exposure Limit	Action Level
0.081 mg/m³	.025 mg/m³ Est. Exposure Level exceeds by 324%	0.0125 mg/m³ Est. Exposure Level exceeds by 648%
Risk Classification		
HAZARDOUS LEVEL		
We recommend to proceed as HAZARDOUS exposure level or perform an air sampling test.		

Exposure Control Planning

Scarifying or Bush Hammering Concrete with a Bush Hammer

Inside for 4 to 8 hours

Jobsite at

December 31st, 1969 to December 31st, 1969

INTRODUCTION

SILICA PROCESS

SILICA EXPOSURE (NO CONTROLS)

EXPOSURE CONTROL

Get prepared

Risk elimination & substitution

Engineering controls

Administrative controls

Exposure control summary

SILICA EXPOSURE (WITH CONTROLS)

Risk Elimination & Substitution

Please answer the question below about exposure elimination or reduction.



If you're not sure how to answer, click INFORMATION for guidelines and tips. Also, you can click YES, WE CAN ELIMINATE to see details. You can always change your answer to NO, WE CANNOT ELIMINATE later.

Elimination and Substitution

Can you eliminate the need for Scarifying or Bush Hammering Concrete with a Bush Hammer by replacing the material and/or task with less RCS dust producing alternatives?

ANSWER

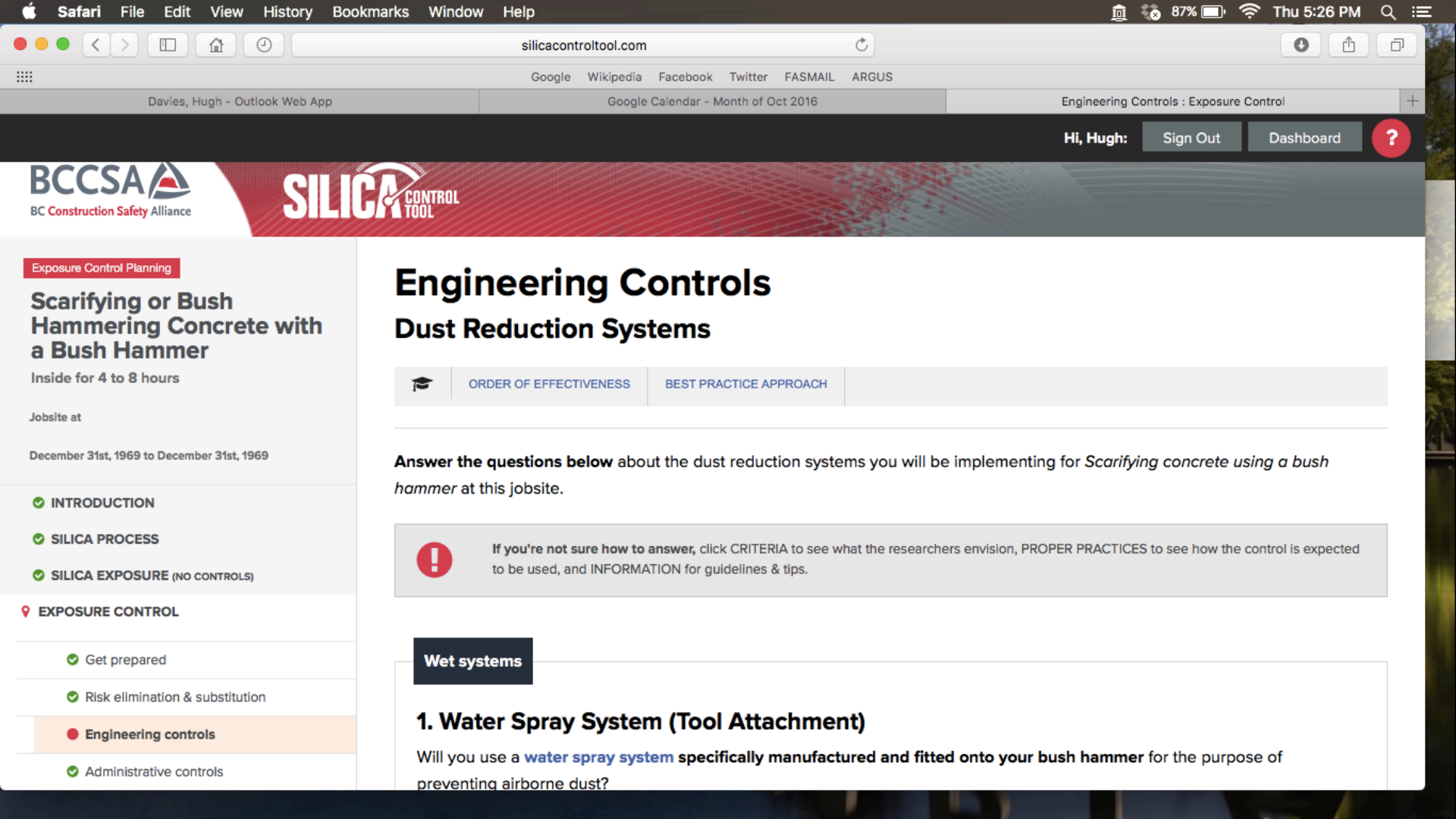
INFORMATION

- Yes, we can eliminate
- No, we cannot eliminate

Now, we'll ask questions about your available engineering controls.

Back

Continue



Exposure Control Planning

Scarifying or Bush Hammering Concrete with a Bush Hammer

Inside for 4 to 8 hours

Jobsite at

December 31st, 1969 to December 31st, 1969

- INTRODUCTION
- SILICA PROCESS
- SILICA EXPOSURE (NO CONTROLS)

EXPOSURE CONTROL

- Get prepared
- Risk elimination & substitution
- Engineering controls**
- Administrative controls

Engineering Controls Dust Reduction Systems

- ORDER OF EFFECTIVENESS
- BEST PRACTICE APPROACH

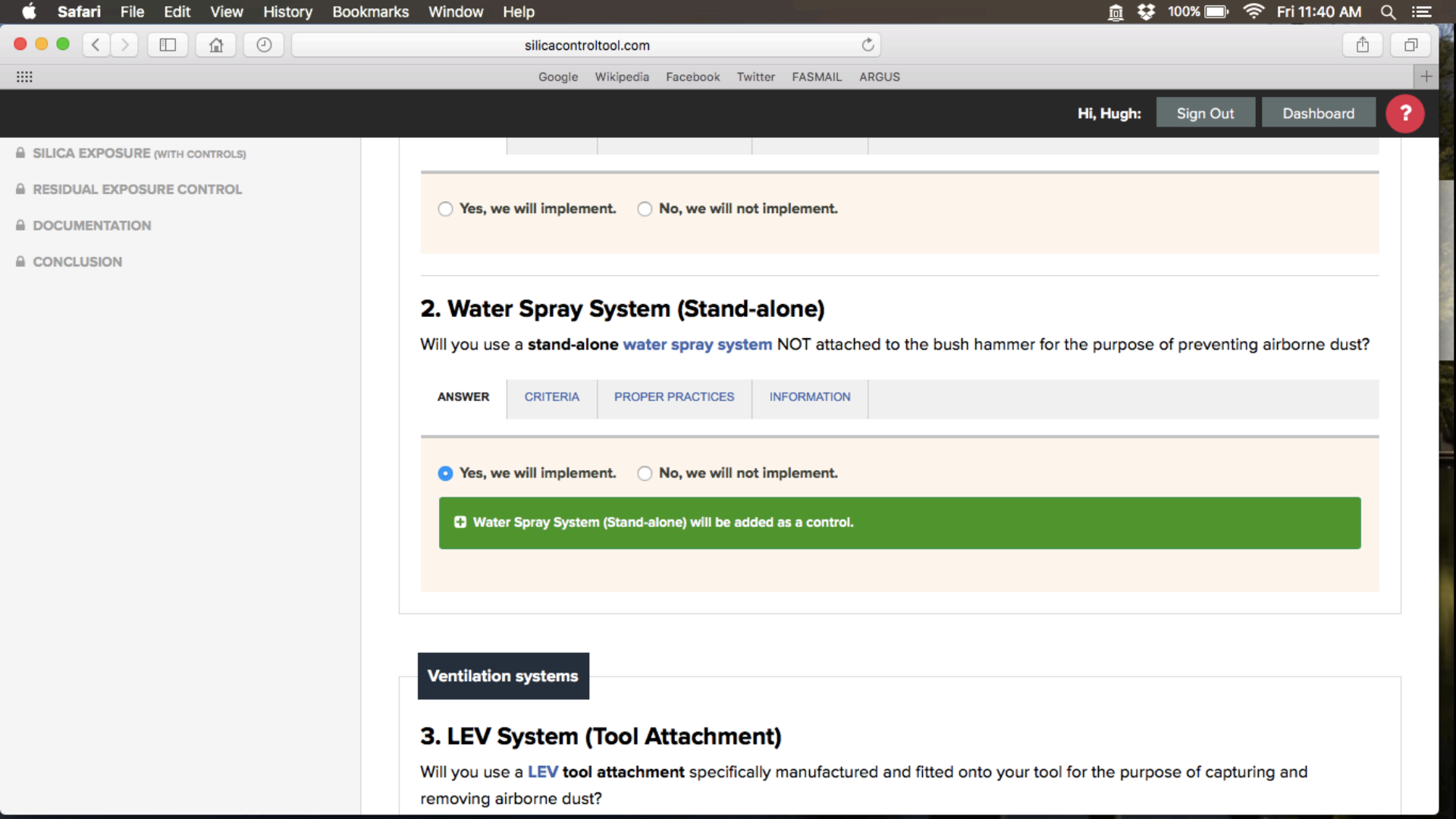
Answer the questions below about the dust reduction systems you will be implementing for *Scarifying concrete using a bush hammer* at this jobsite.

! If you're not sure how to answer, click **CRITERIA** to see what the researchers envision, **PROPER PRACTICES** to see how the control is expected to be used, and **INFORMATION** for guidelines & tips.

Wet systems

1. Water Spray System (Tool Attachment)

Will you use a **water spray system** specifically manufactured and fitted onto your bush hammer for the purpose of preventing airborne dust?



SILICA EXPOSURE (WITH CONTROLS)

RESIDUAL EXPOSURE CONTROL

DOCUMENTATION

CONCLUSION

Yes, we will implement. No, we will not implement.

2. Water Spray System (Stand-alone)

Will you use a **stand-alone water spray system** NOT attached to the bush hammer for the purpose of preventing airborne dust?

ANSWER

CRITERIA

PROPER PRACTICES

INFORMATION

Yes, we will implement. No, we will not implement.

Water Spray System (Stand-alone) will be added as a control.

Ventilation systems

3. LEV System (Tool Attachment)

Will you use a **LEV tool attachment** specifically manufactured and fitted onto your tool for the purpose of capturing and removing airborne dust?



Exposure Control Planning

Scarifying or Bush Hammering Concrete with a Bush Hammer

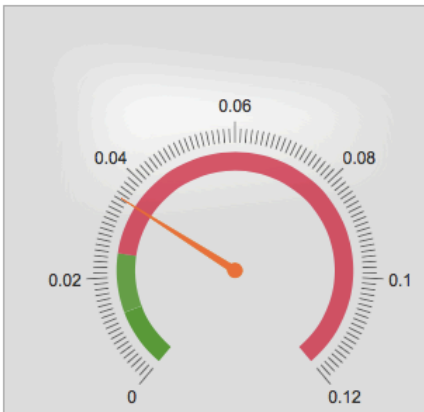
Inside for 4 to 8 hours

Jobsite at
December 31st, 1969 to December 31st, 1969

- ✓ INTRODUCTION
- ✓ SILICA PROCESS
- ✓ SILICA EXPOSURE (NO CONTROLS)
- ✓ EXPOSURE CONTROL
- 📍 SILICA EXPOSURE (WITH CONTROLS)
 - ✓ Get prepared
 - Exposure Analysis (With Controls)

Exposure Analysis (with Controls)

RESULTS DETAILS



EXPOSURE MONITORING DATA EQUIVALENT		
Est. Exposure Level (with Controls)	Exposure Limit	Control impact on dust
0.035 mg/m³	.025 mg/m³ Est. Exposure Level exceeds by 41.13%	0.0457 mg/m³ Dust reduced by 56.44%
Risk Classification		
HAZARDOUS LEVEL		
We recommend to proceed as HAZARDOUS exposure level or perform an air sampling test.		



Exposure Control Planning

Scarifying or Bush Hammering Concrete with a Bush Hammer

Inside for 4 to 8 hours

Jobsite at
 December 31st, 1969 to December 31st, 1969

- ✔ INTRODUCTION
- ✔ SILICA PROCESS
- ✔ SILICA EXPOSURE (NO CONTROLS)
- ✔ EXPOSURE CONTROL
- ✔ SILICA EXPOSURE (WITH CONTROLS)

RESIDUAL EXPOSURE CONTROL

✔ Get prepared

Respirators & Other PPE

Please answer these questions about the PPE controls you have available for this jobsite.

Respiratory Protection

RESPIRATOR SELECTION		
Respirator Usage	Required Protection Factor	Respirator Type & Filter
Protection Required	10	REQUIRED Half facepiece, non powered with N95 filter

→ Respirators

Will your workers in the work area have respirators available?

ANSWER

CRITERIA	PROPER PRACTICES	INFORMATION
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Hammering Concrete with a Bush Hammer
 Inside for 4 to 8 hours

Jobsite at

December 31st, 1969 to December 31st, 1969

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- ✔ SILICA EXPOSURE (NO CONTROLS)
- ✔ EXPOSURE CONTROL
- ✔ SILICA EXPOSURE (WITH CONTROLS)
- ✔ RESIDUAL EXPOSURE CONTROL

- 📍 DOCUMENTATION
- ✔ Get prepared
 - ECP Summary
 - ✔ Generate ECP

🔒 CONCLUSION

EXPOSURE CONTROL PLAN (ECP) SUMMARY

A summary of your exposure control planning is below. Please review the summary carefully for omissions or errors. If all looks correct, you may decide to [Save a PDF version](#) of this summary.

EMPLOYER DETAILS			ECP CONTACT
	D.J.'s Construction Ltd. 1252 Willingdon Ave. Burnaby, BC V3B 3G3	(604) 291-1234 info@djs-construction.ca www.djs-construction.ca	Hugh Davies hugh.davies@ubc.ca
<p><i>Any details to edit?</i></p> <p>Edit Employer Details</p>			

SILICA PROCESS			
Work Activity	Work Area	Duration per shift (avg.)	
Scarifying or Bush Hammering Concrete with a Bush Hammer	Inside	4 to 8 hours	
Jobsite Location	Jobsite Sector	Project Type	
December 31st, 1969 to December 31st, 1969	, AB	Residential	Renovation



Exposure Control Planning

Scarifying or Bush Hammering Concrete with a Bush Hammer

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- SILICA PROCESS
- SILICA EXPOSURE (NO CONTROLS)
- EXPOSURE CONTROL
- SILICA EXPOSURE (WITH CONTROLS)
- RESIDUAL EXPOSURE CONTROL

DOCUMENTATION

Generate ECP for:



Scarifying or Bush Hammering Concrete with a Bush Hammer

Inside for 4 to 8 hours work shifts

December 31st, 1969 - December 31st, 1969

To generate your ECP document, click the GENERATE ECP button below. Your ECP will be downloaded to your computer or device as a PDF file.

GENERATE ECP

Next, we'll conclude this exposure control planning project.

GETTING MORE FROM THE TOOL

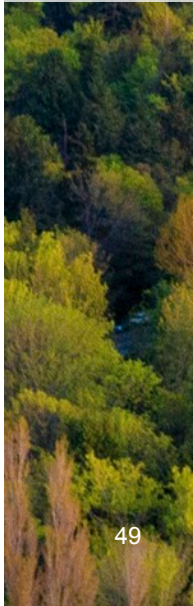
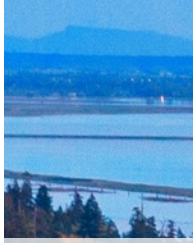
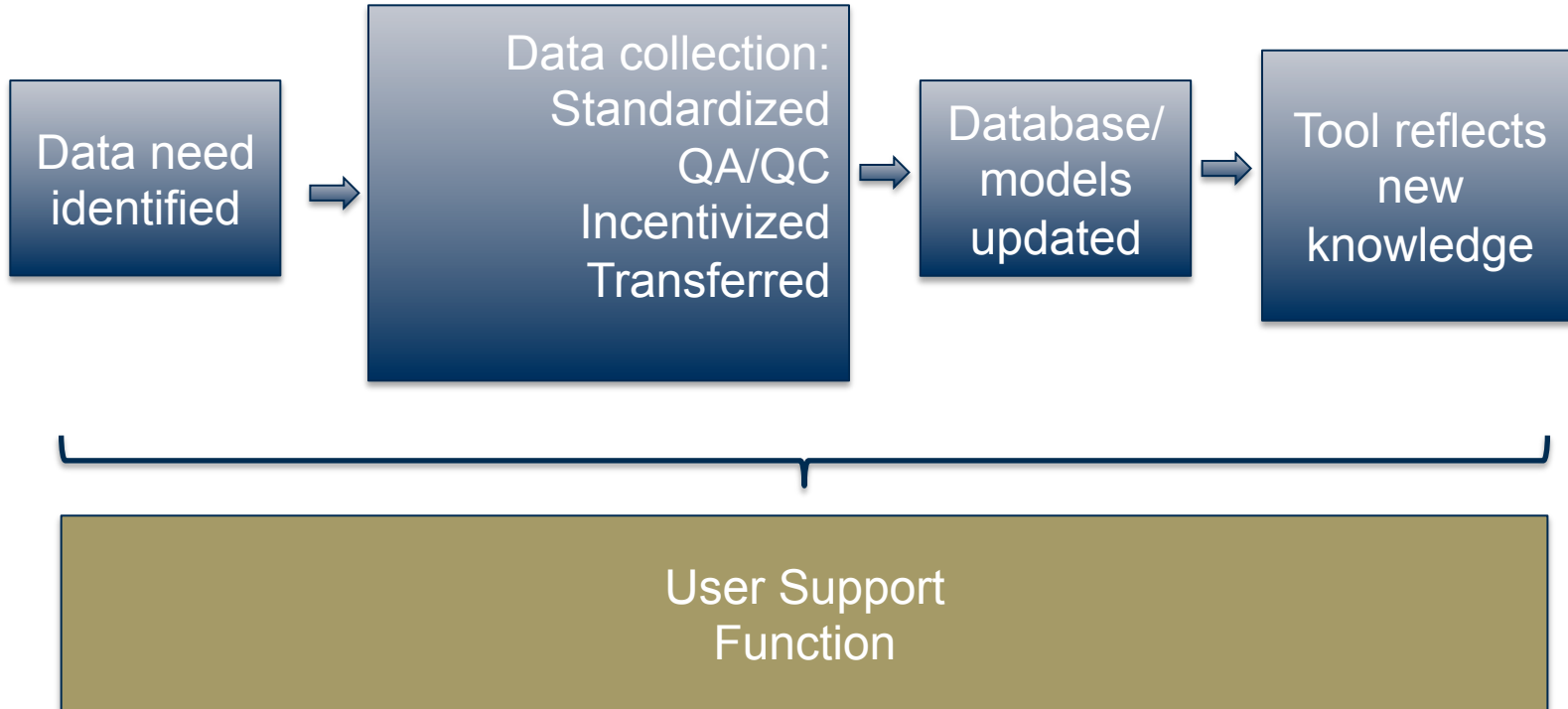


EXPOSURE DATA RENEWAL

- Goals:
 - Reflect changing exposure conditions
 - Best practice
 - Surveillance/evaluation
 - Research
- Challenges:
 - Data sharing
 - Secure data storage
 - Data stewardship
 - Responsive data collection
 - Standardized measurement/analysis



DATA BASE UPDATES



CONCLUSION

- The RCS Risk Assessment On-Line Tool:
 - *Quantitative* risk assessment & control selection
 - Aid to employers and employees
 - Easy to use
 - Generates standardized ECP's
 - Educational
 - Updateable database
 - Potential to drive best practice



CONCLUSIONS

- Joint venture of industry, regulator and researchers
- New paradigm for exposure data
- Also potential for
 - Surveillance
 - Research
- Potential model for other substances

- Currently in “beta” testing
- Roll-out in Fall 2016



ACKNOWLEDGMENTS

Project Steering Committee:

- Nancy Harwood (Project Manager)
- Mike McKenna (Executive Director, BCCSA)
- Jeff Lyth (BCCSA)
- Colin Murray (WorksafeBC)
- Don Schouten (WorksafeBC)

Dr. Melanie Gorman-Ng, UBC

Dr. Jérôme Lavoué, Université de Montréal

Mili Baghela, Marybeth MacDonald, Brendan Talbot

Cooperation of many BC Construction Companies





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