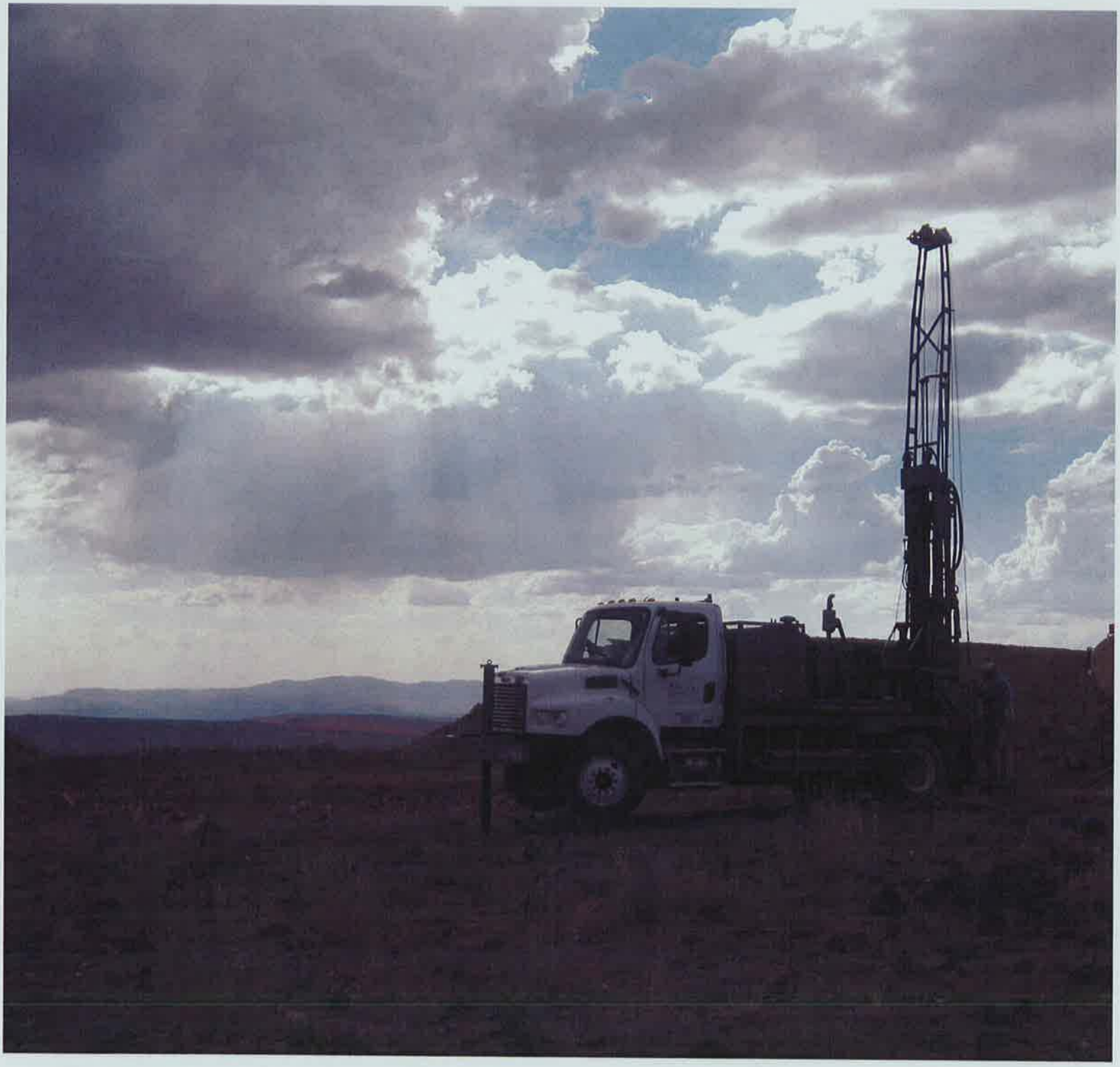
Core Photos

Core Photos
FB-9



Continued.

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-9 Core Photos Wet. Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

Continued

Top

Bottom

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-9 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

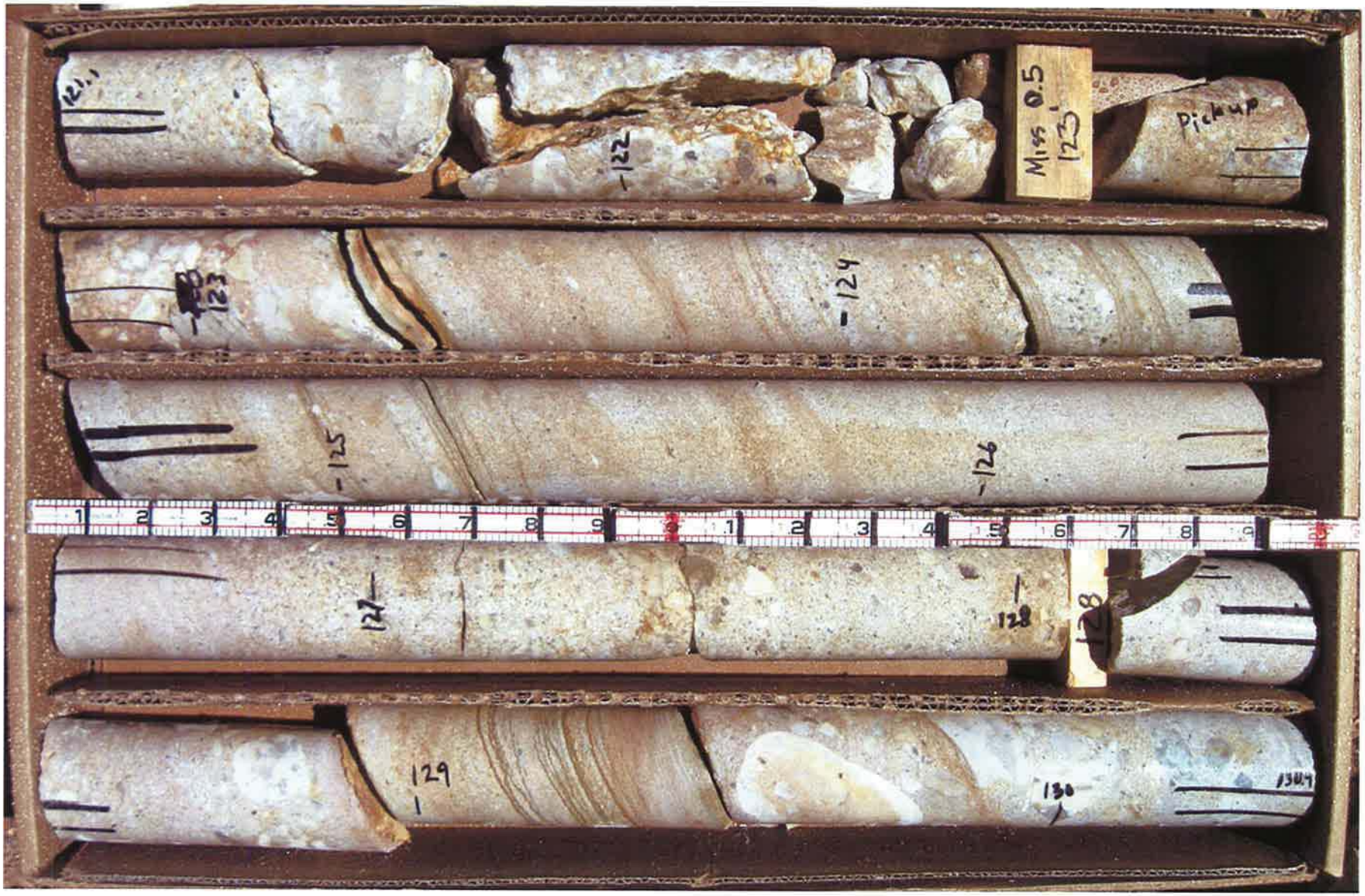
Figure	Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah



RB&G ENGINEERING, INC.

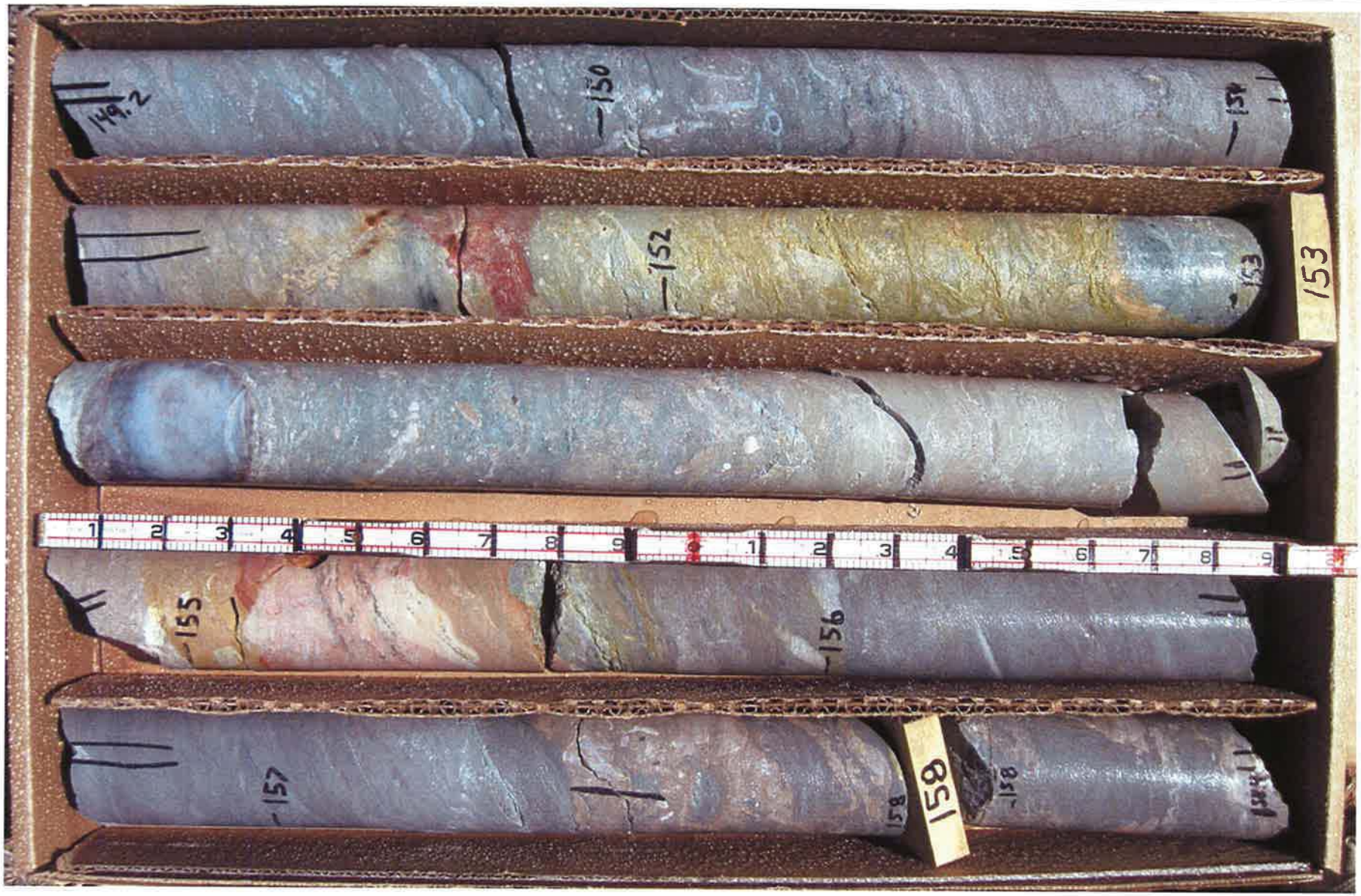
Figure	Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah



RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

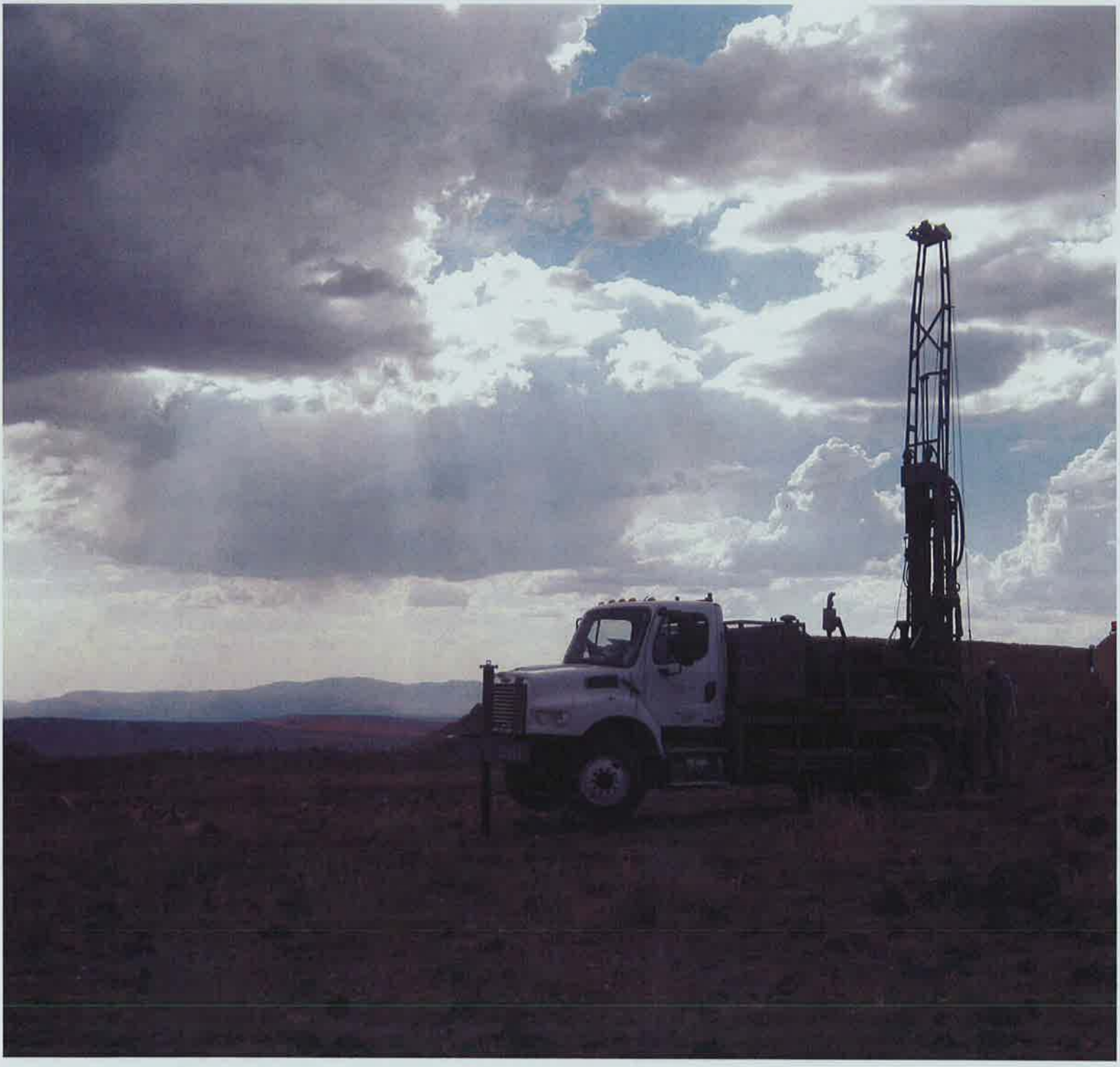
RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-9 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

Core Photos
FB-10



RB&G ENGINEERING, INC.

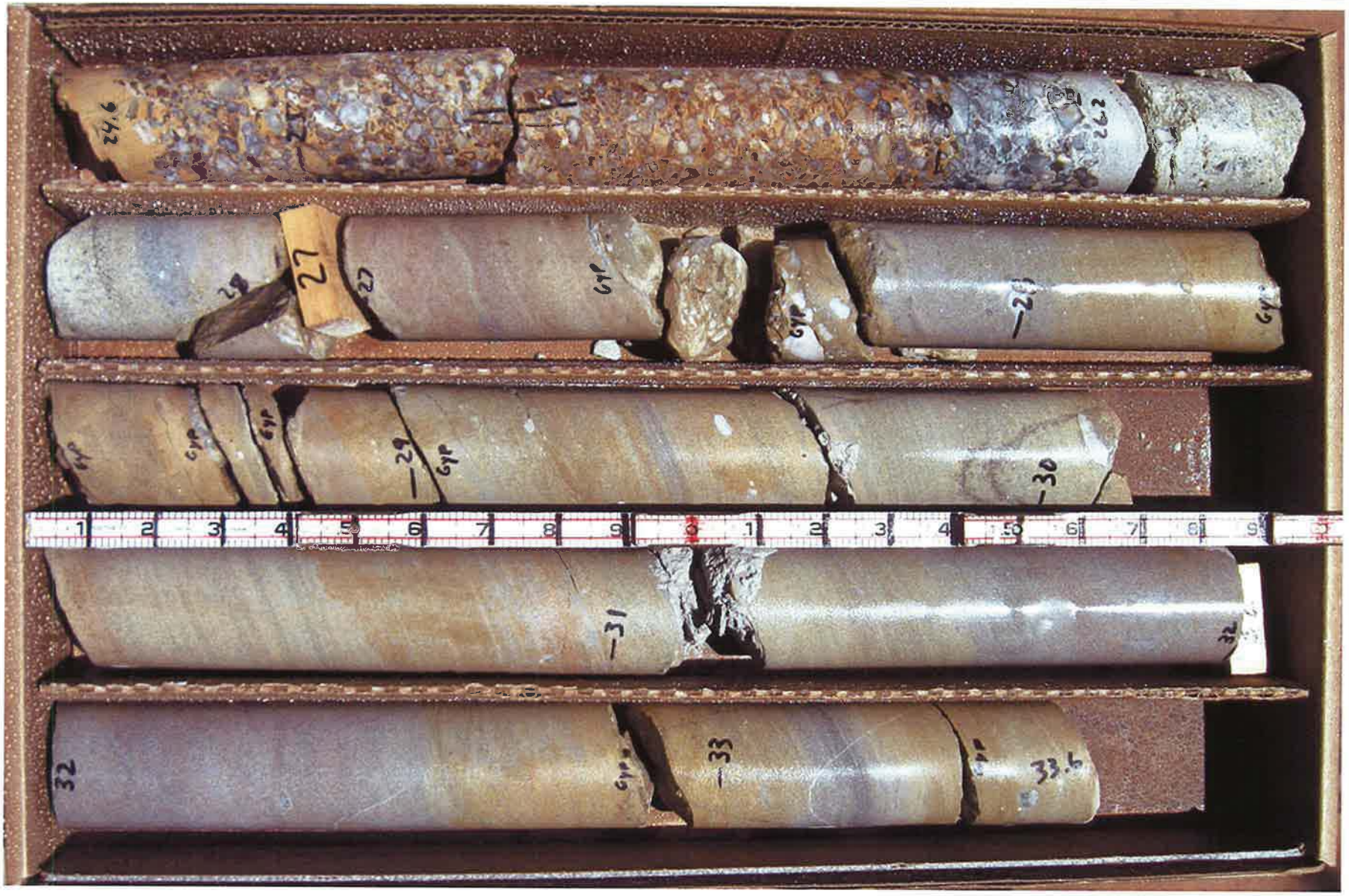
Figure	Drill Hole #09-FB-10 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-10 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-10 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah



RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-10 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

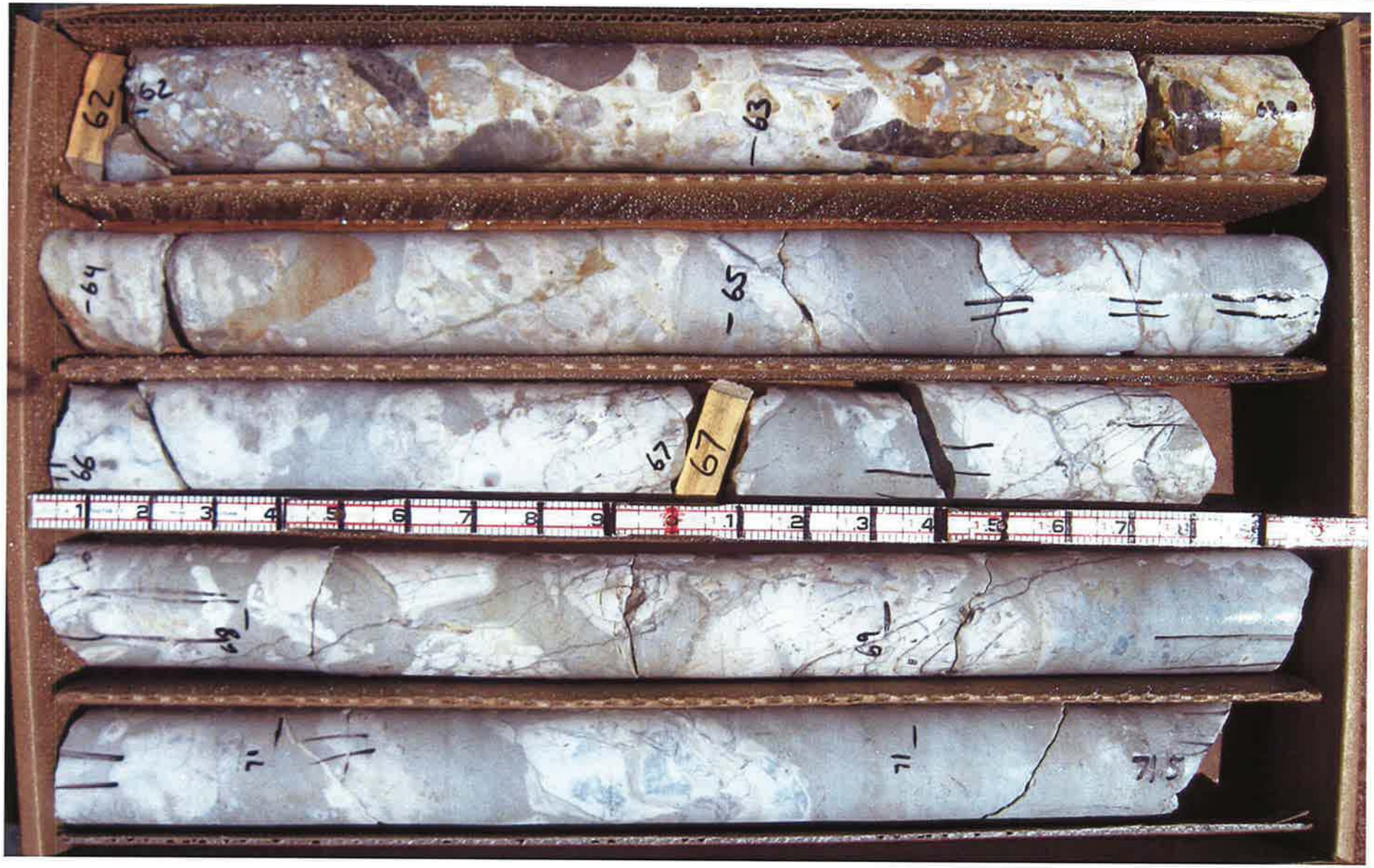
Figure	Drill Hole #09-FB-10 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-10 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

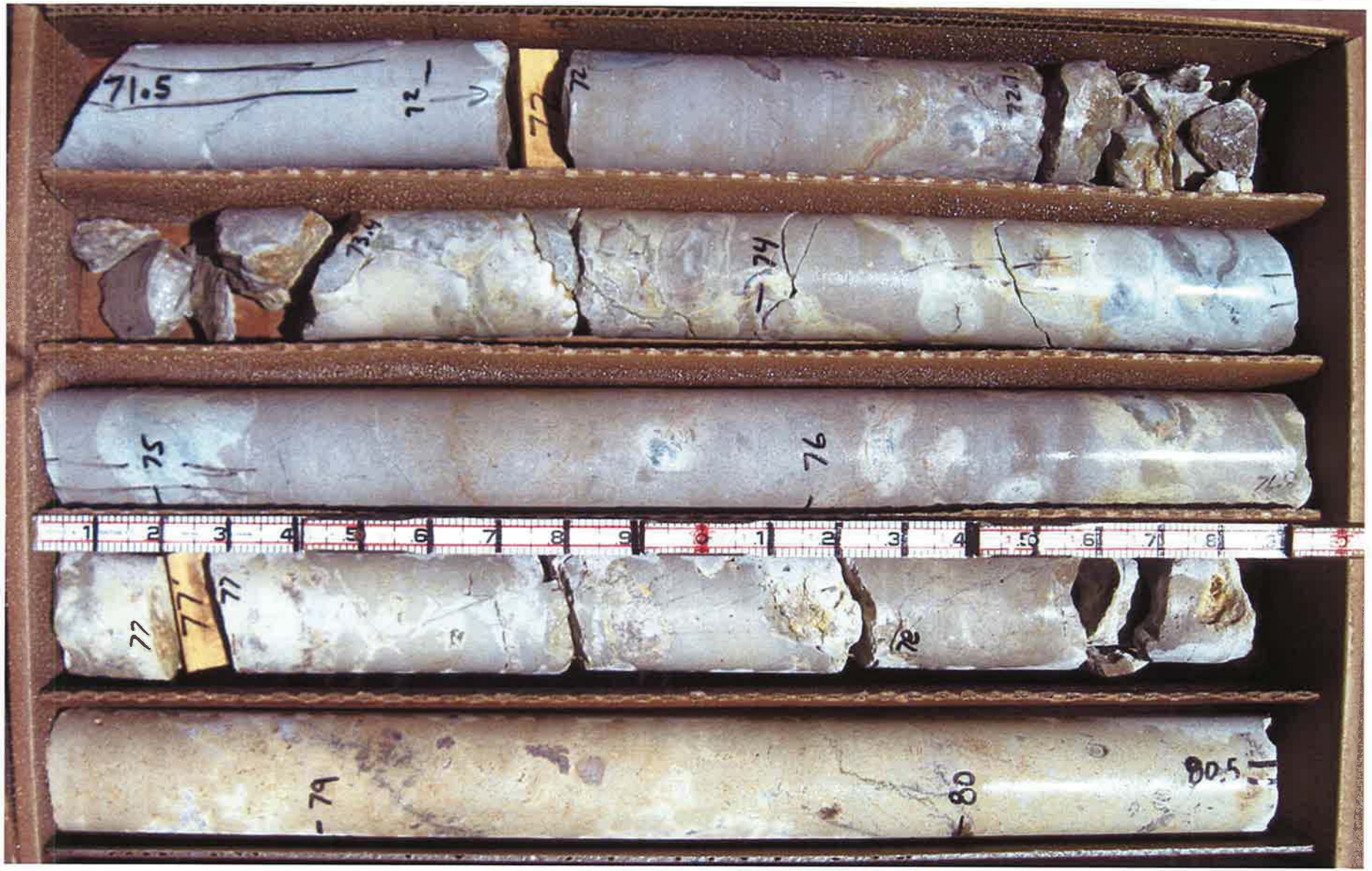
RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-10 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah



RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-10 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah



RB&G ENGINEERING, INC.

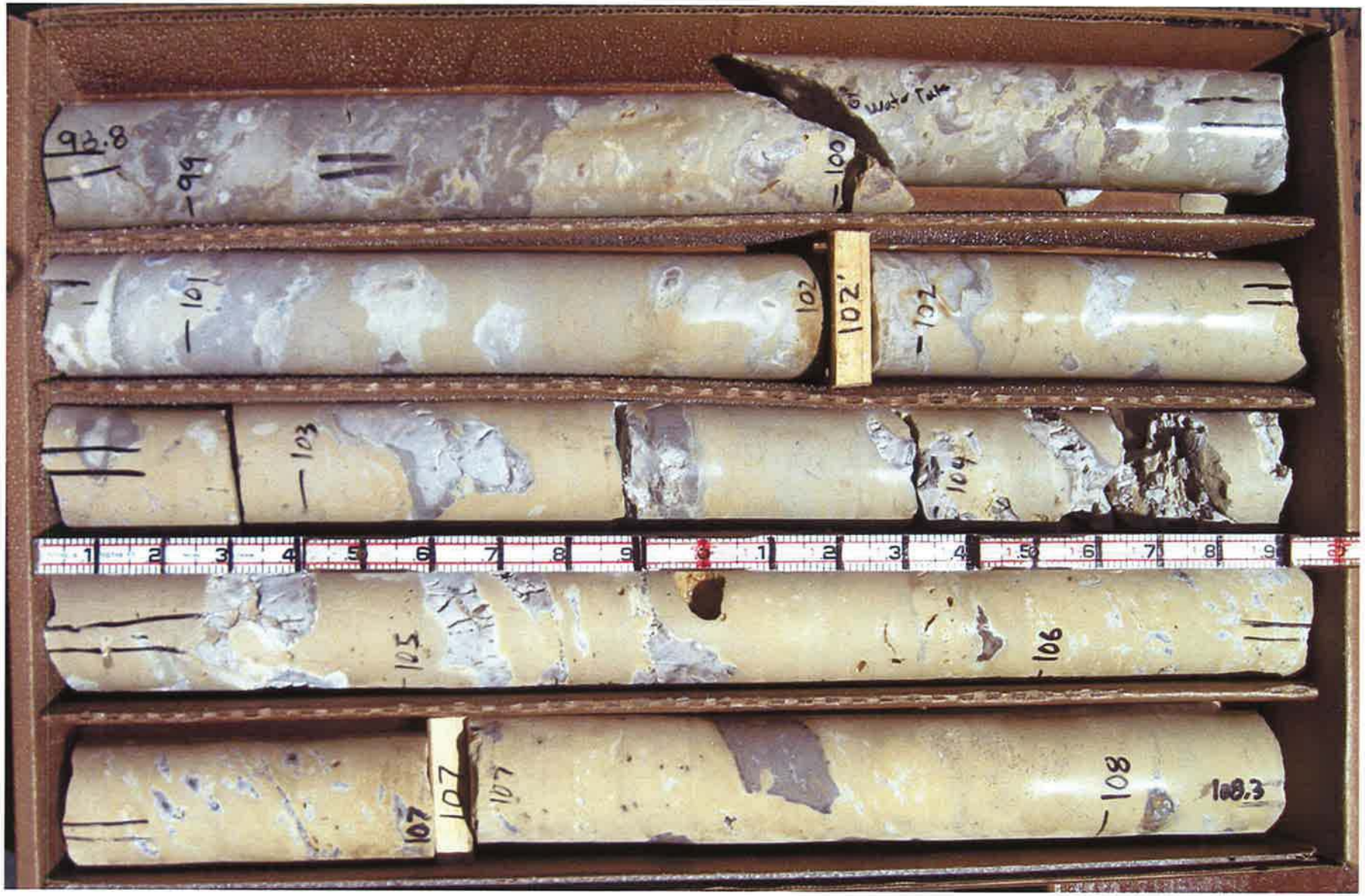
Figure	Drill Hole #09-FB-10 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-10 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-10 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah



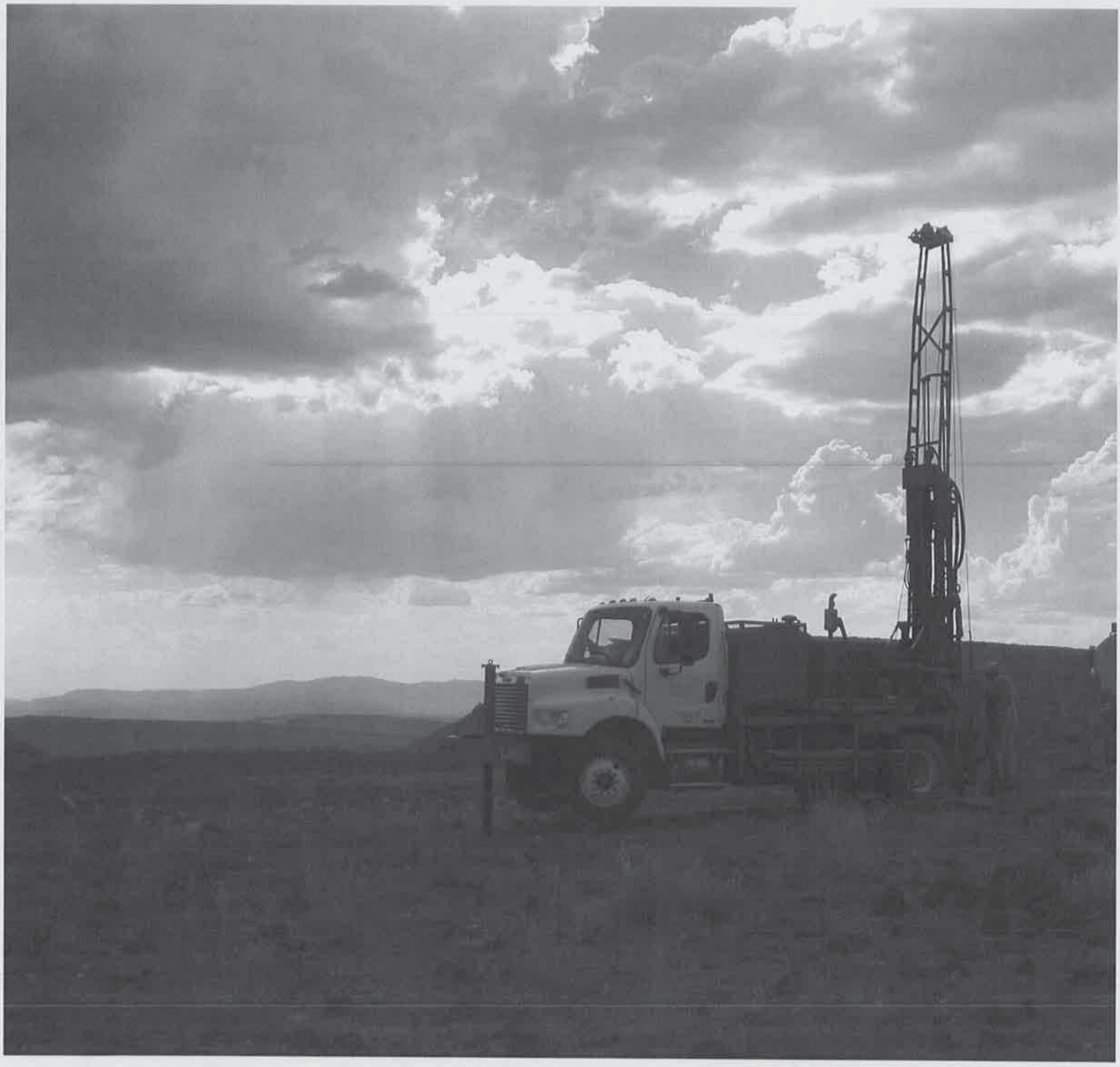
RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-10 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-10 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

Core Photos
FB-11



Top

Bottom

Continued

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

Continued

Top

Bottom

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

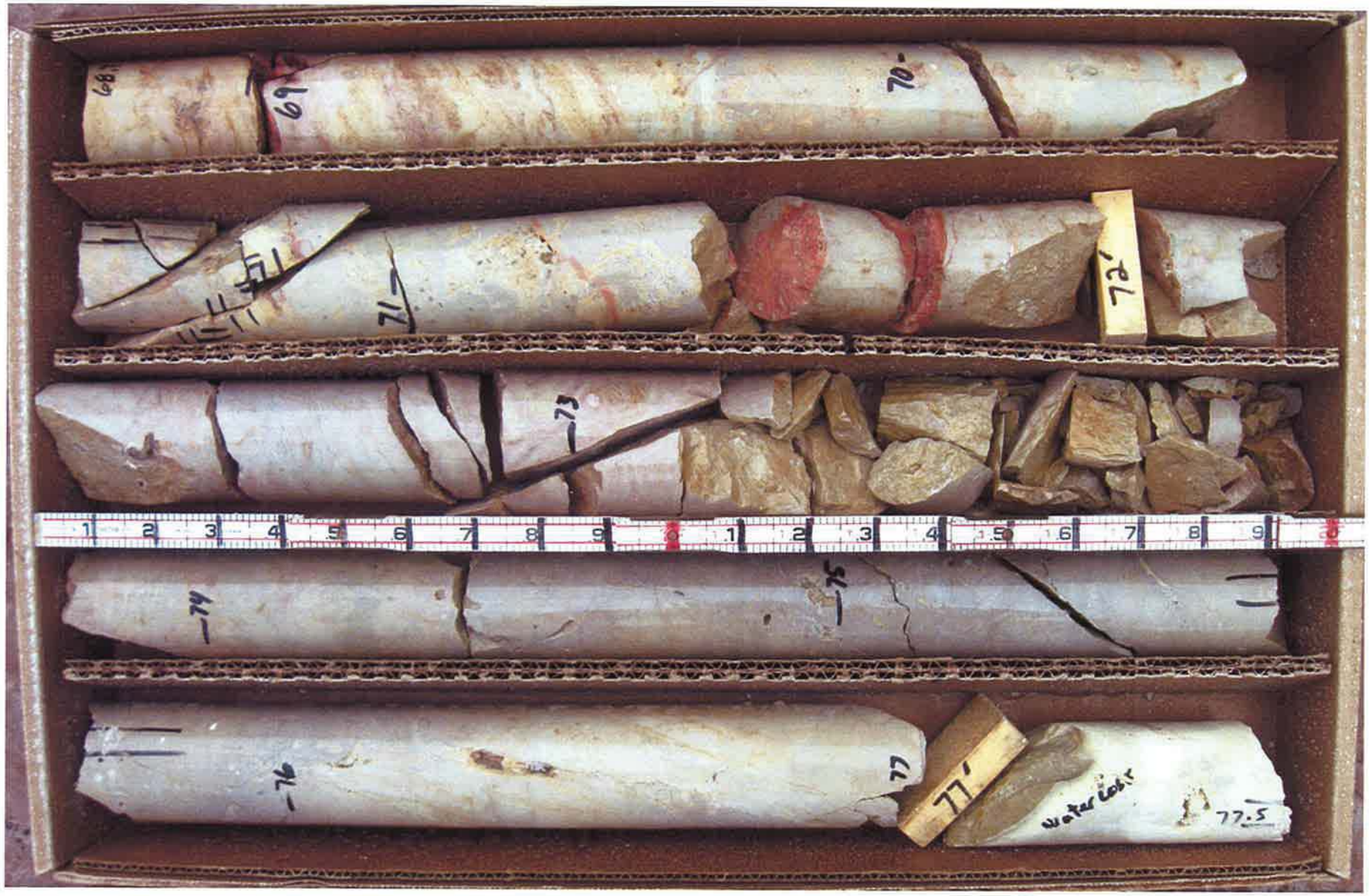
Figure Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah



RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

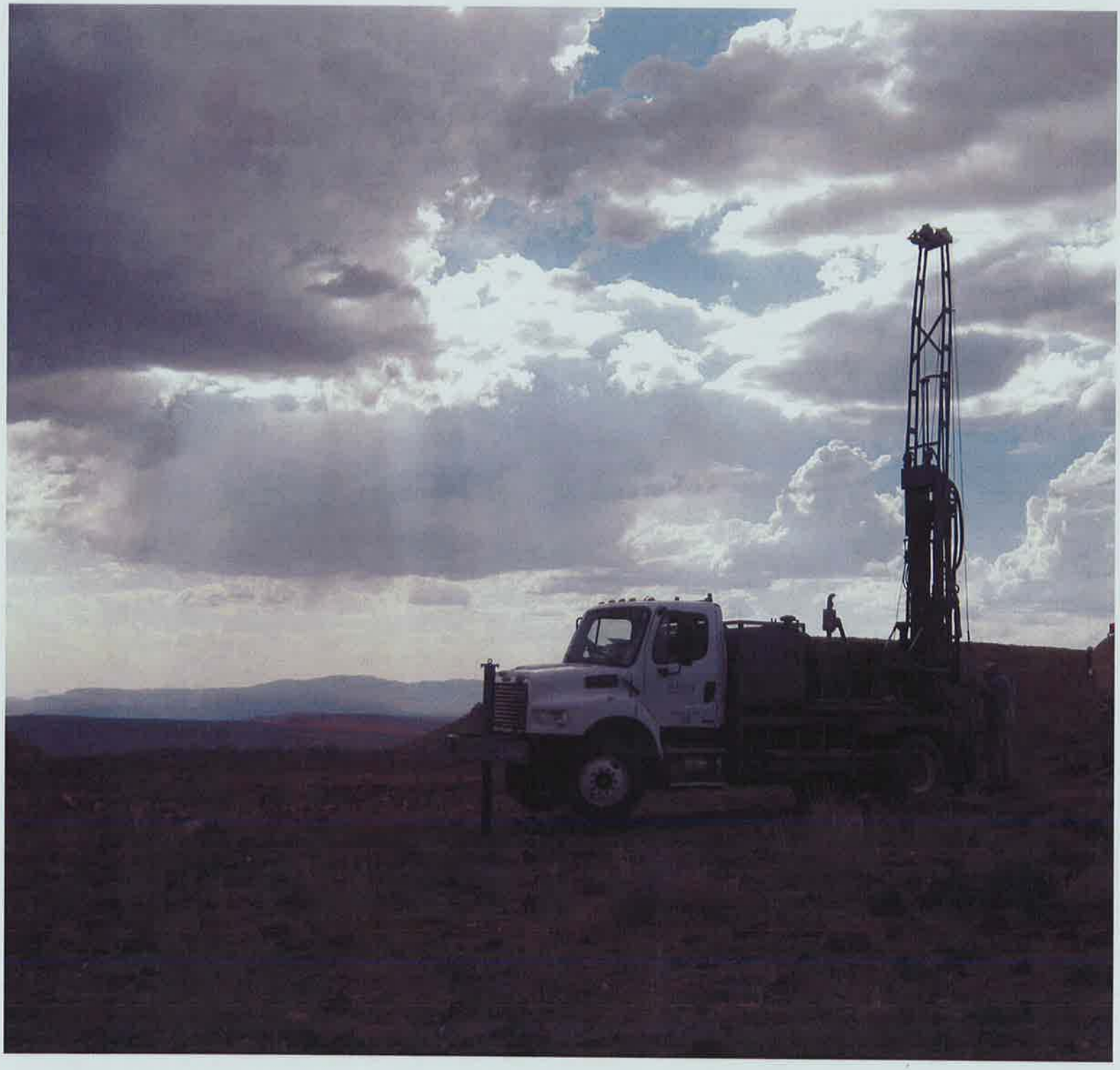
RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-11 Core Photos Wet, Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

Core Photos
FB-12



Continued

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure: Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project: HCH Forebay South Dam Site, WCWCD
Location: Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

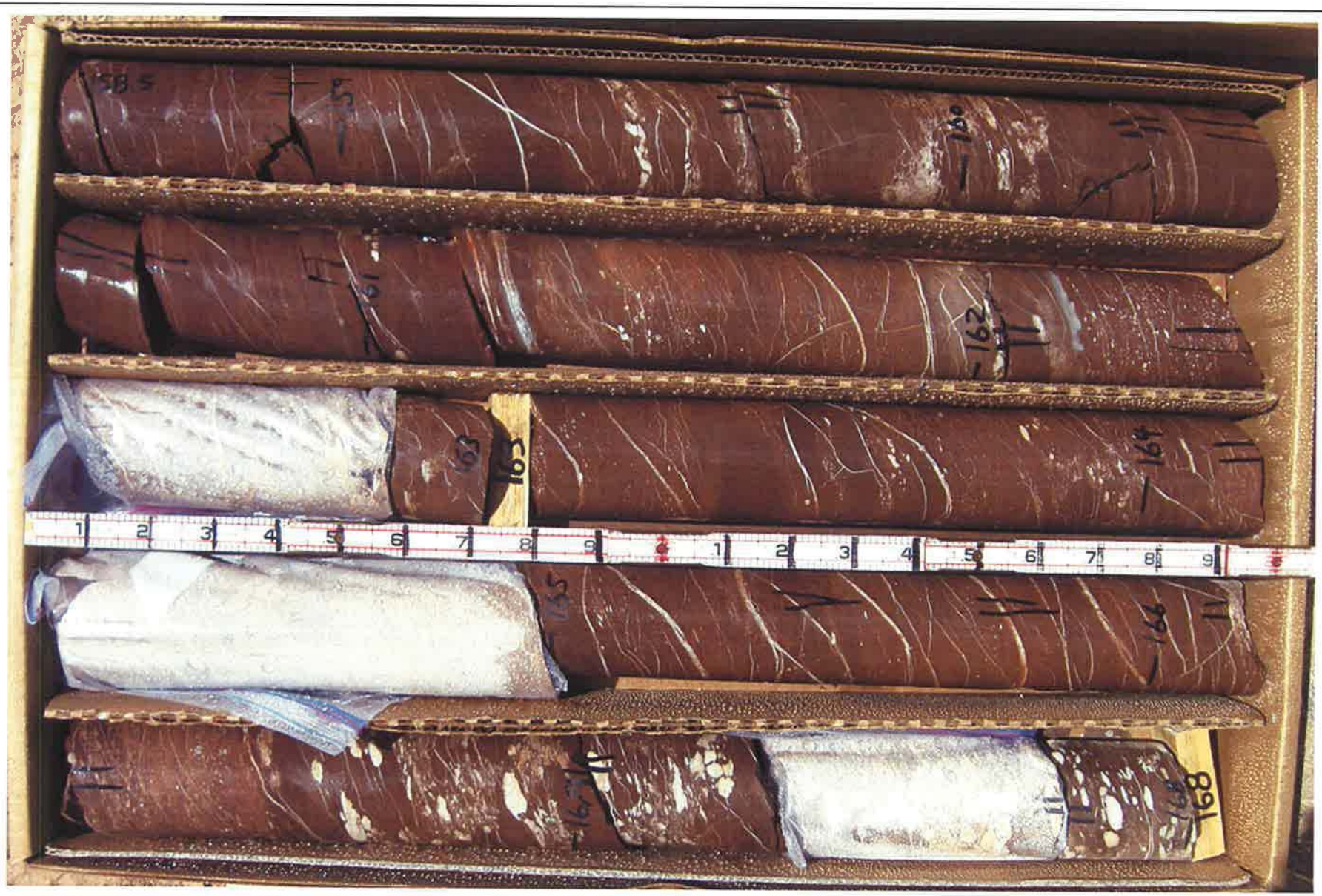
Figure	Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

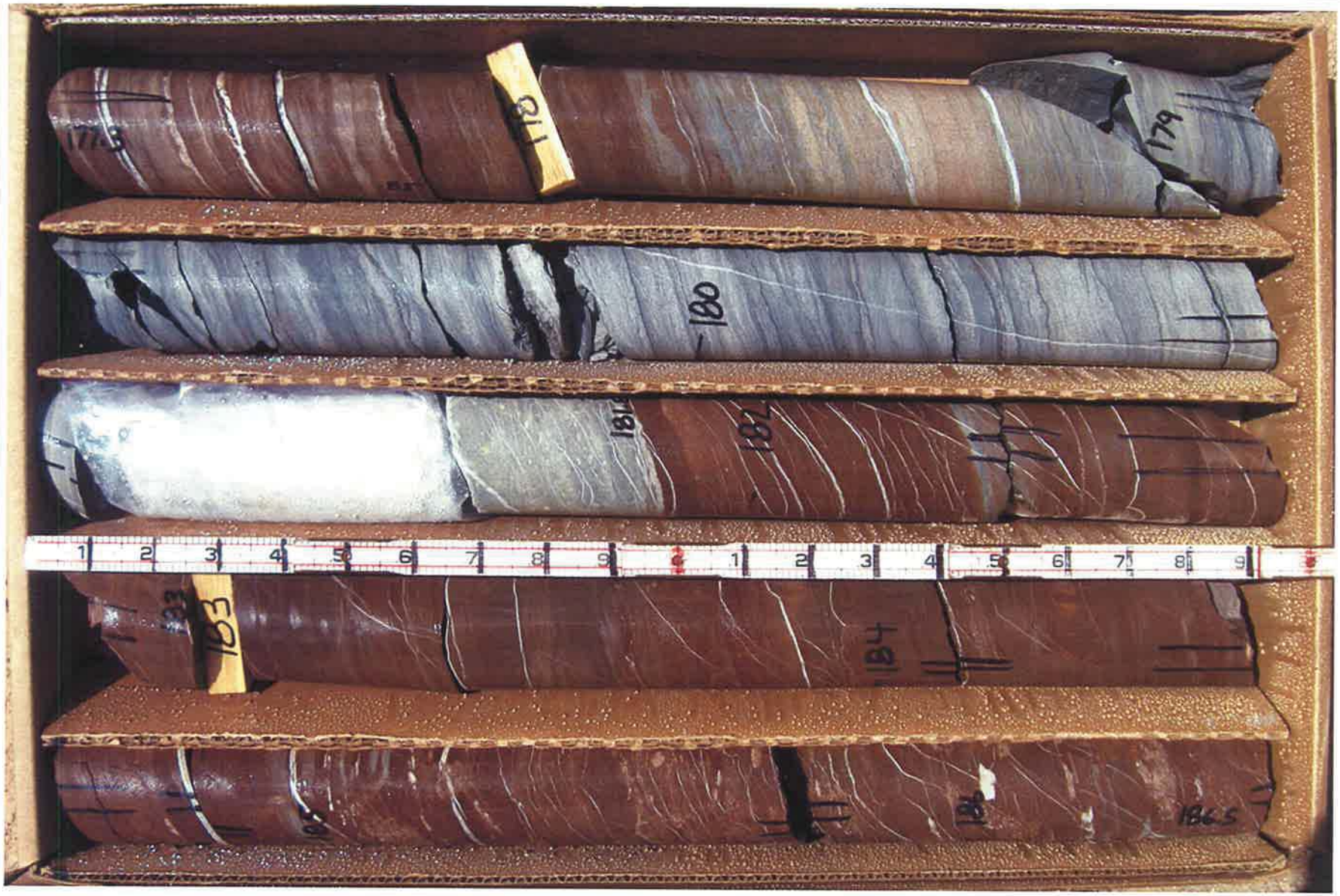


RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah



RB&G ENGINEERING, INC.

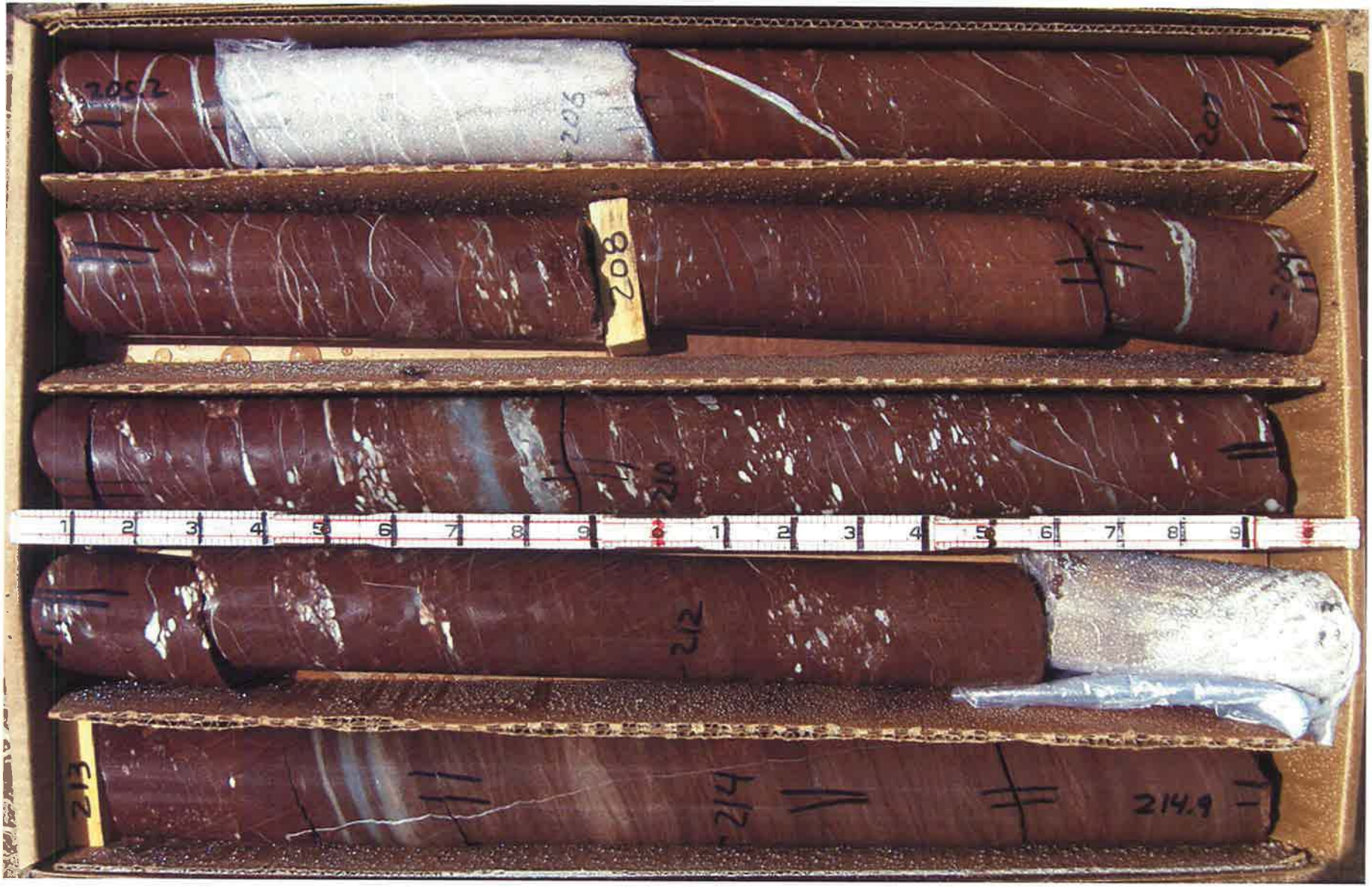
Figure	Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project	HCH Forebay South Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah



RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project HCH Forebay South Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

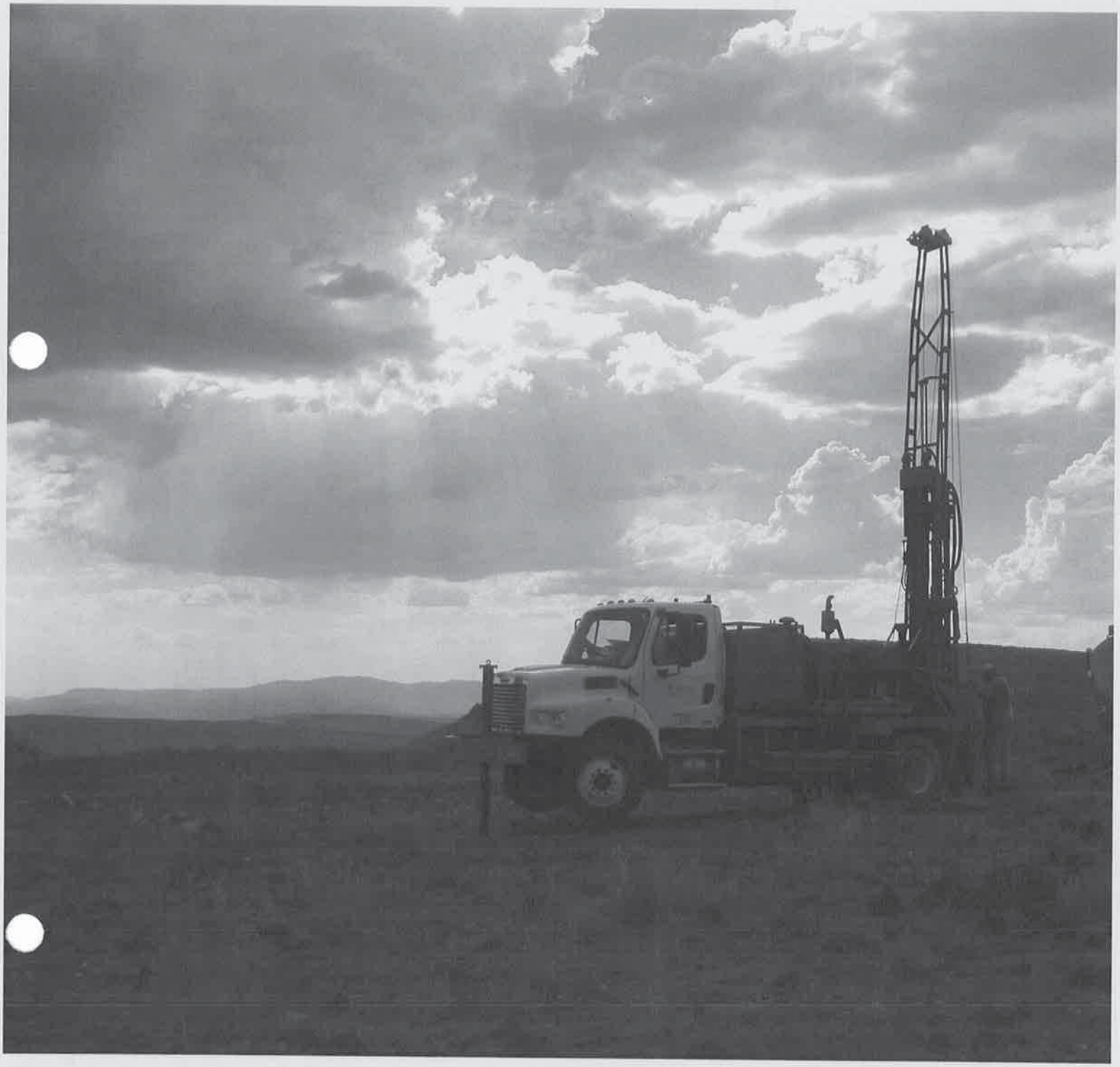
Figure
Project
Location

Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
HCH Forebay South Dam Site, WCWCD
Washington County, Utah

RB&G ENGINEERING, INC.

Figure: Drill Hole #09-FB-12 Core Photos Wet Drilled at a dip of 65 degrees from Horizontal (25 degrees from Vertical)
Project: HCH Forebay South Dam Site, WCWCD
Location: Washington County, Utah

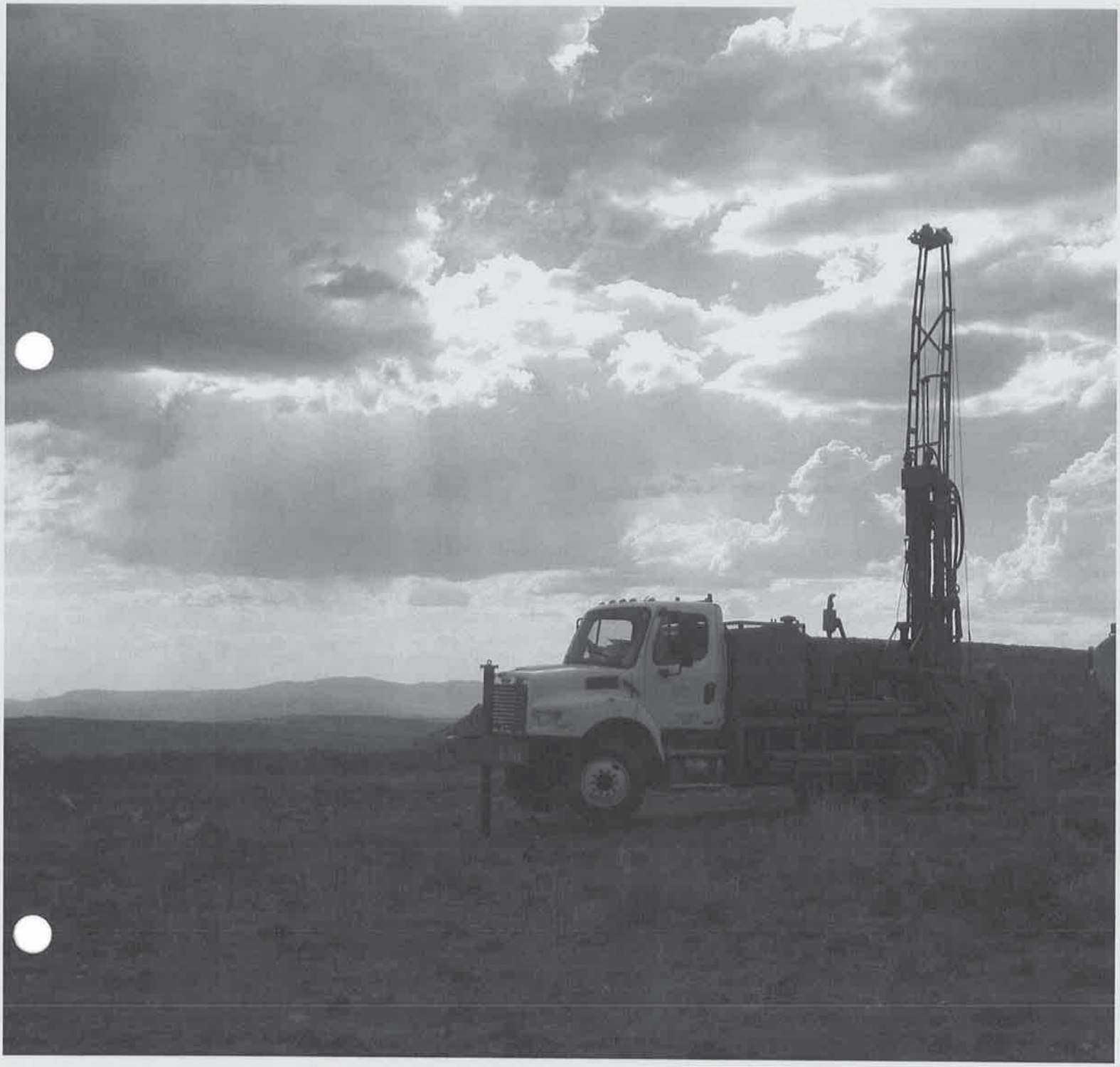
Core Photos
FB-13



RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-13 Core Photos Wet (Vertical)
Project	HCH Forebay Basin, WCWCD
Location	Washington County, Utah

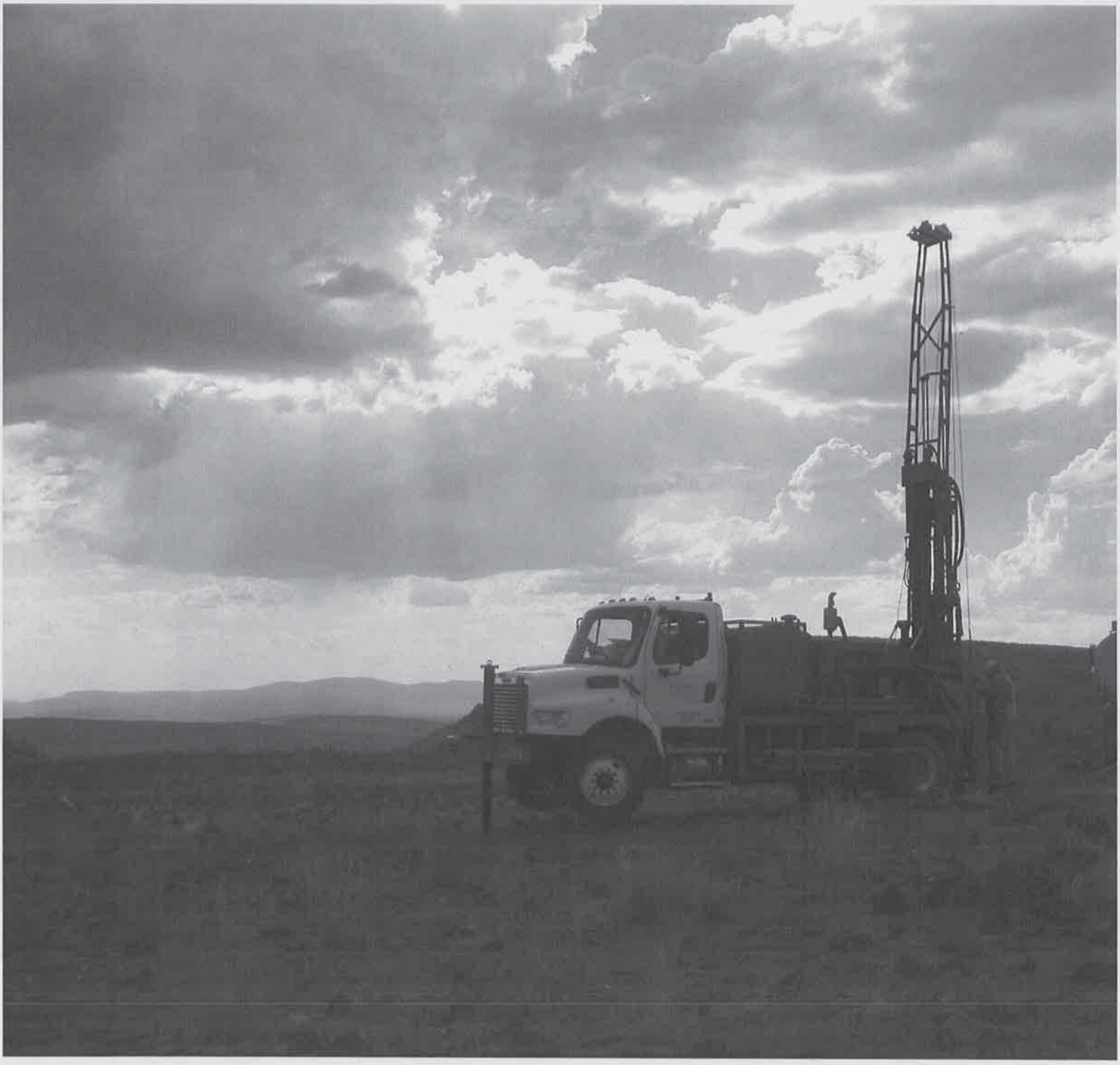
Core Photos
FB-14



RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-14 Core Photos Wet (Vertical)
Project	HCH Forebay Basin, WCWCD
Location	Washington County, Utah

Core Photos
FB-15



Top

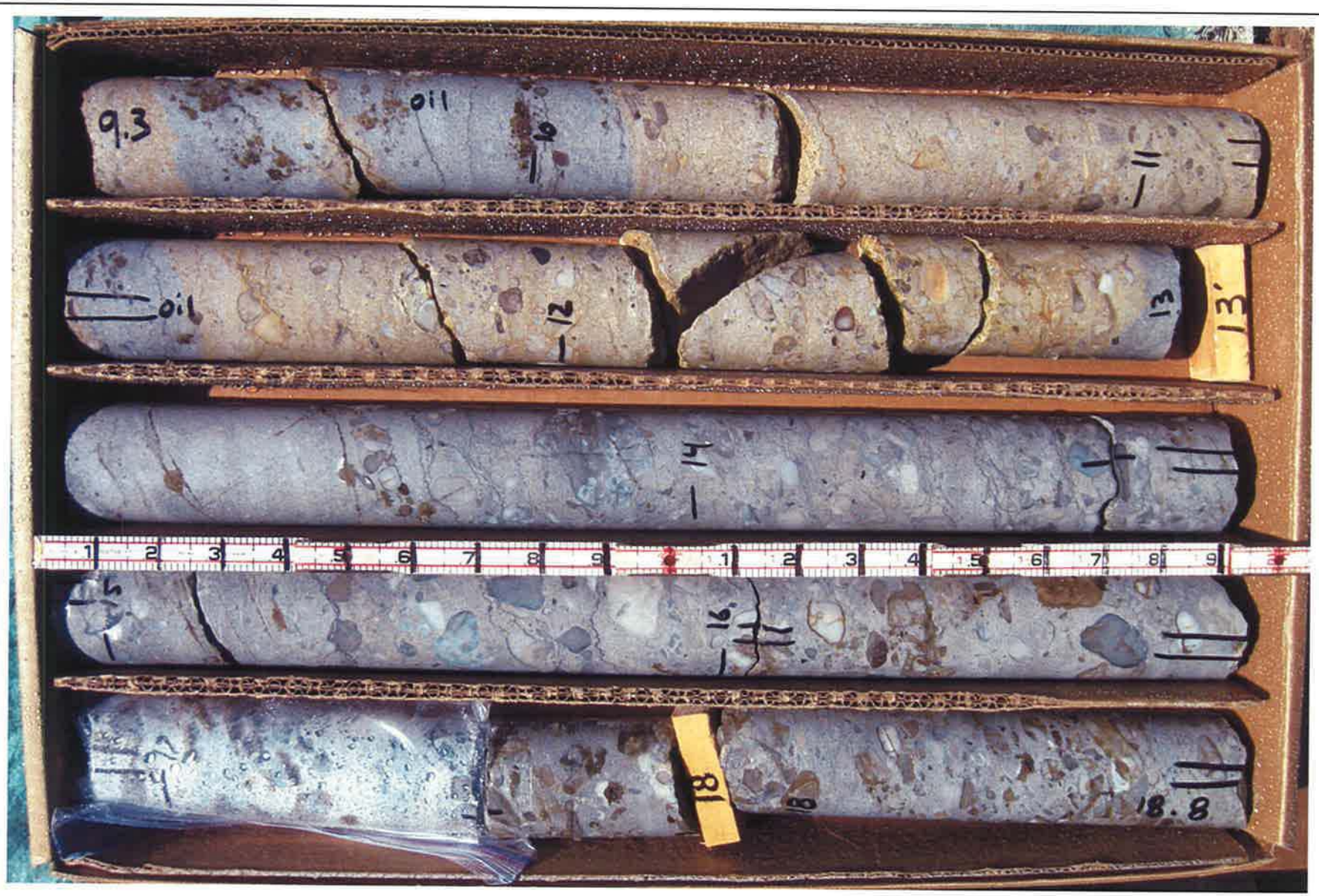
Bottom

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-15 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah

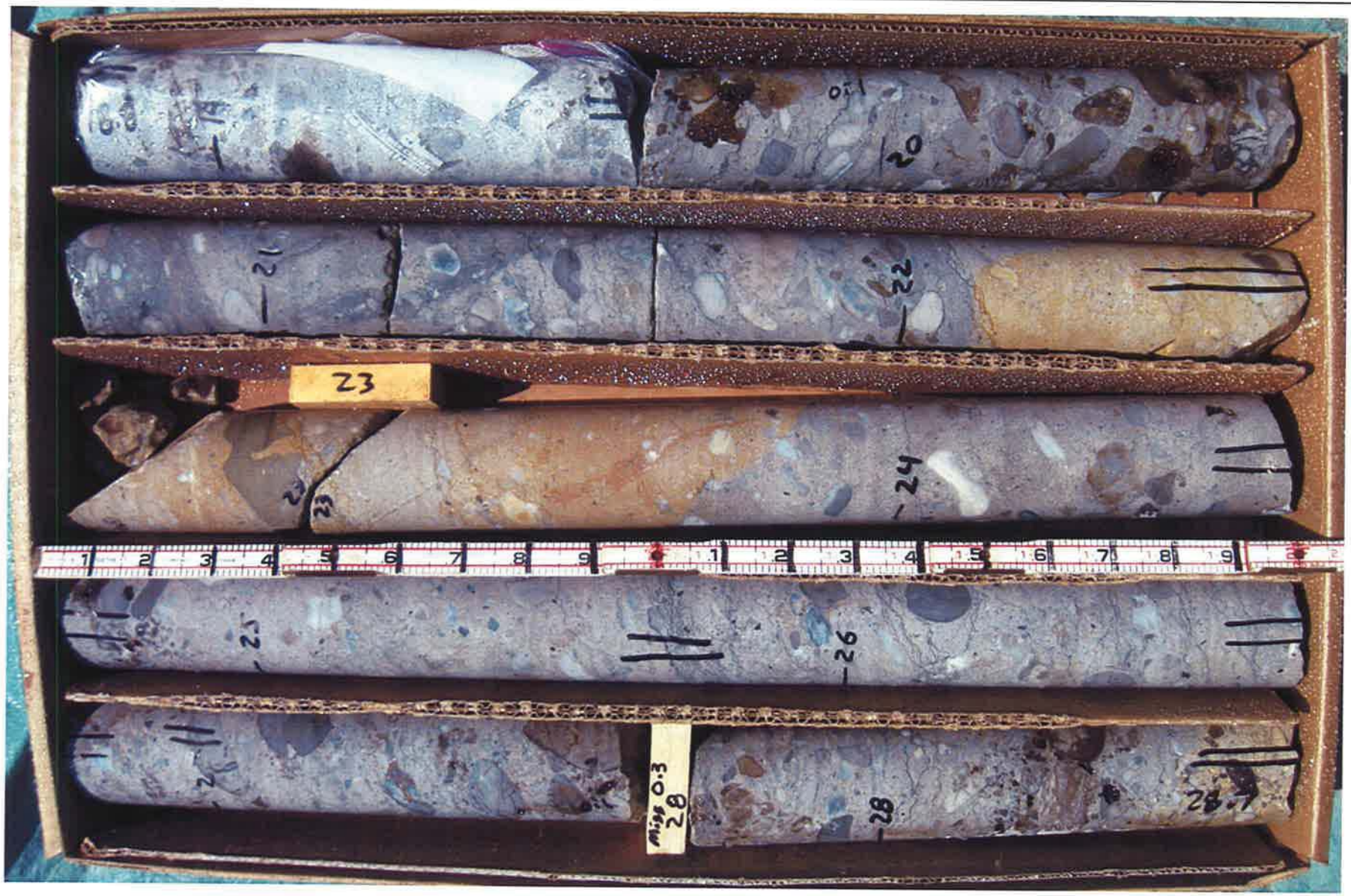
RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-15 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah



RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-15 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah



RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-15 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-15 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

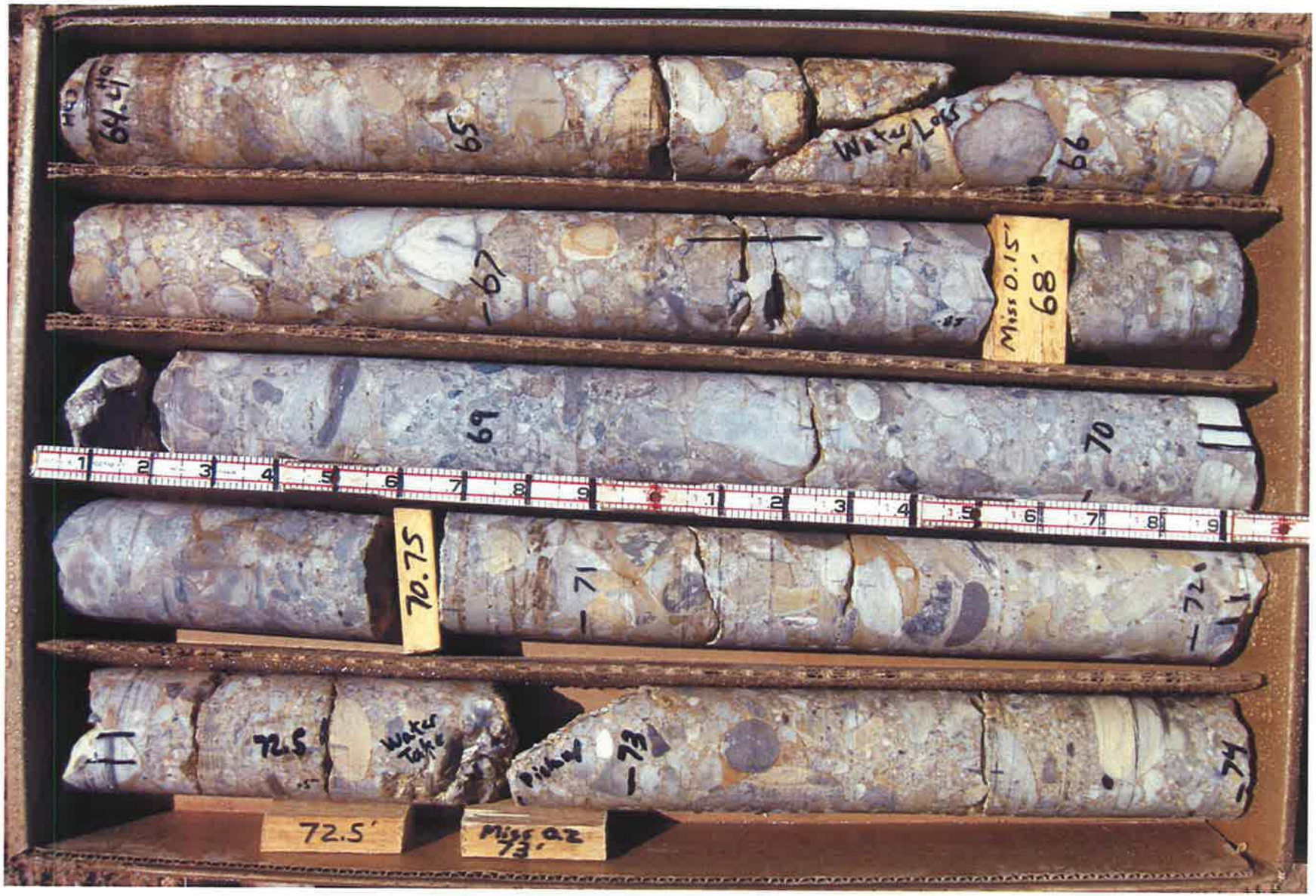
Figure Drill Hole #09-FB-15 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-15 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-15 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah



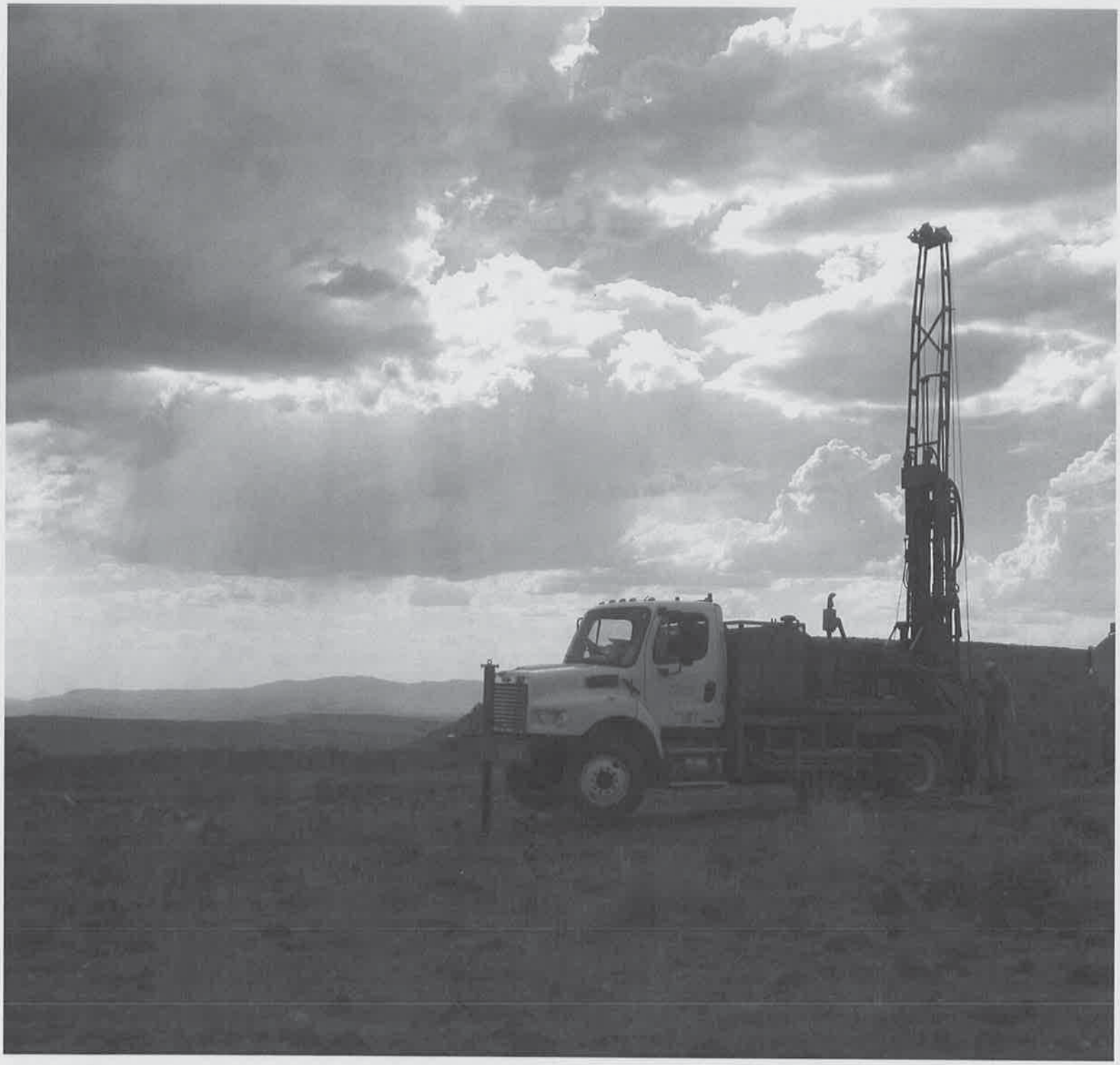
RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-15 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-15 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah

Core Photos
FB-16

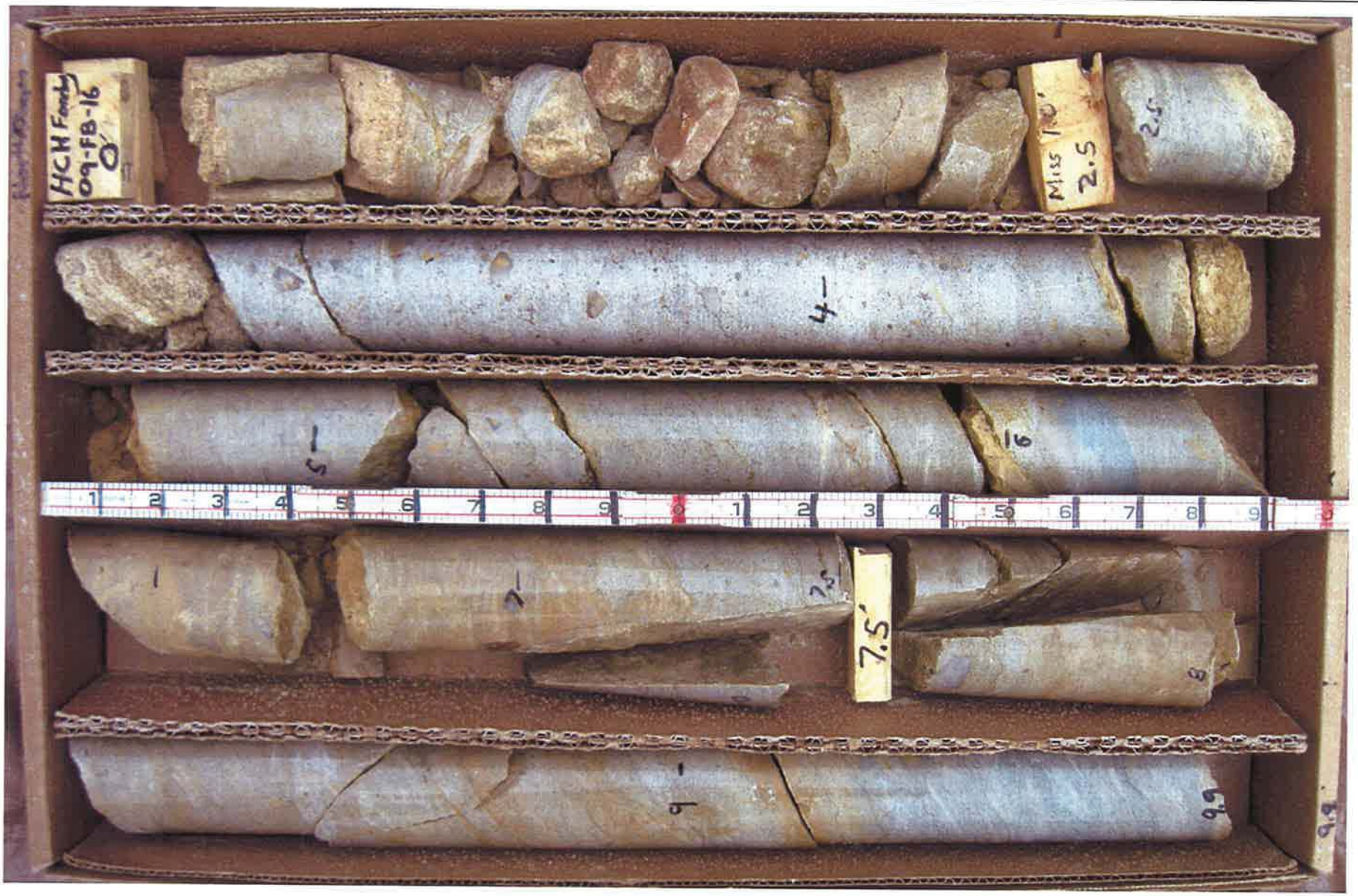


Top

Bottom

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-16 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah



RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-16 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-16 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-16 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-16 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-16 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-16 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure
Project
Location

Drill Hole #09-FB-16 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
HCH Forebay North Dam Site, WCWCD
Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-16 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-16 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah

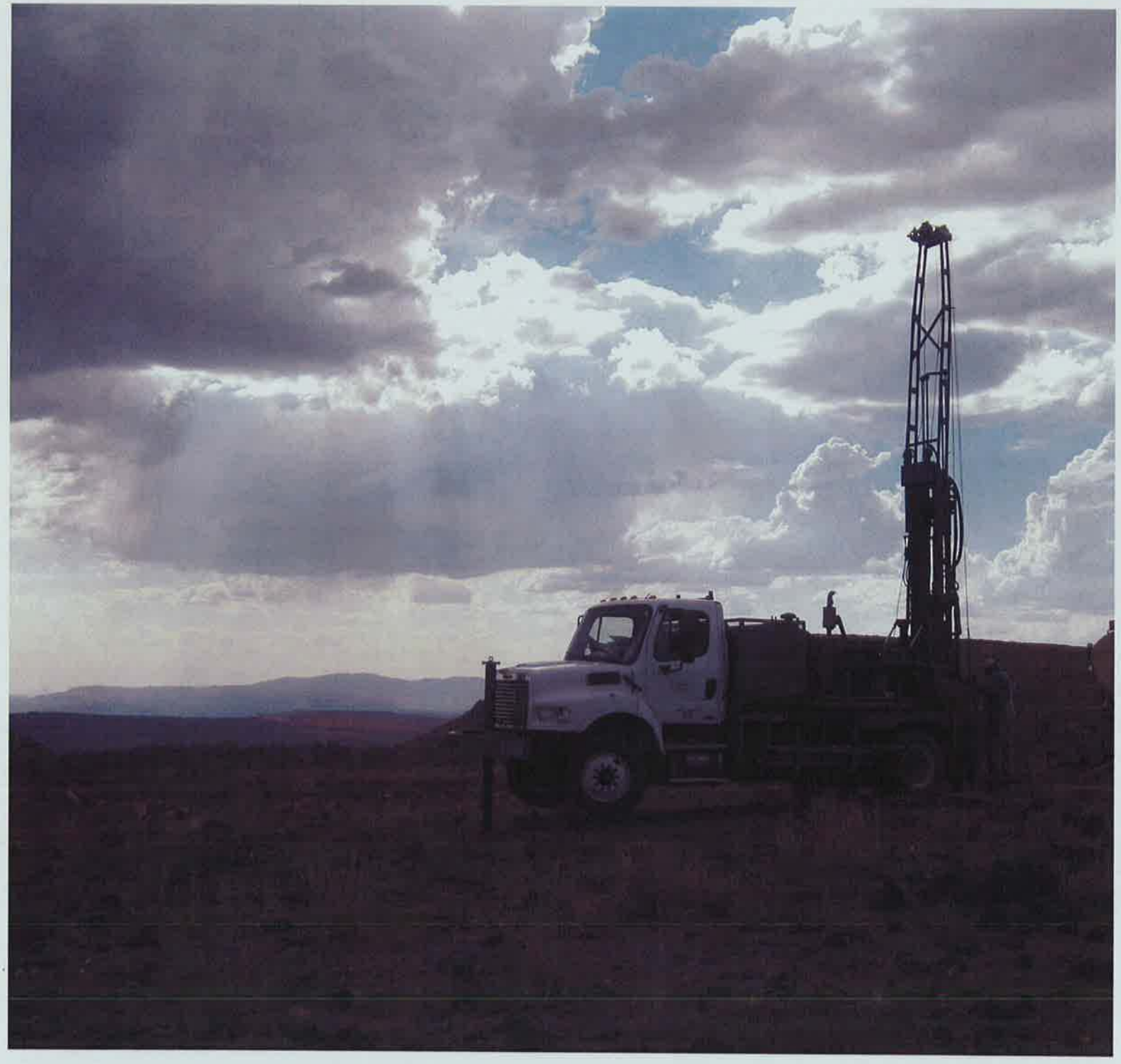
RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-16 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-16 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah

Core Photos
FB-17



RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-17 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-17 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-17 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-17 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-17 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-17 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-17 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-17 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure: Drill Hole #09-FB-17 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project: HCH Forebay North Dam Site, WCWCD
Location: Washington County, Utah

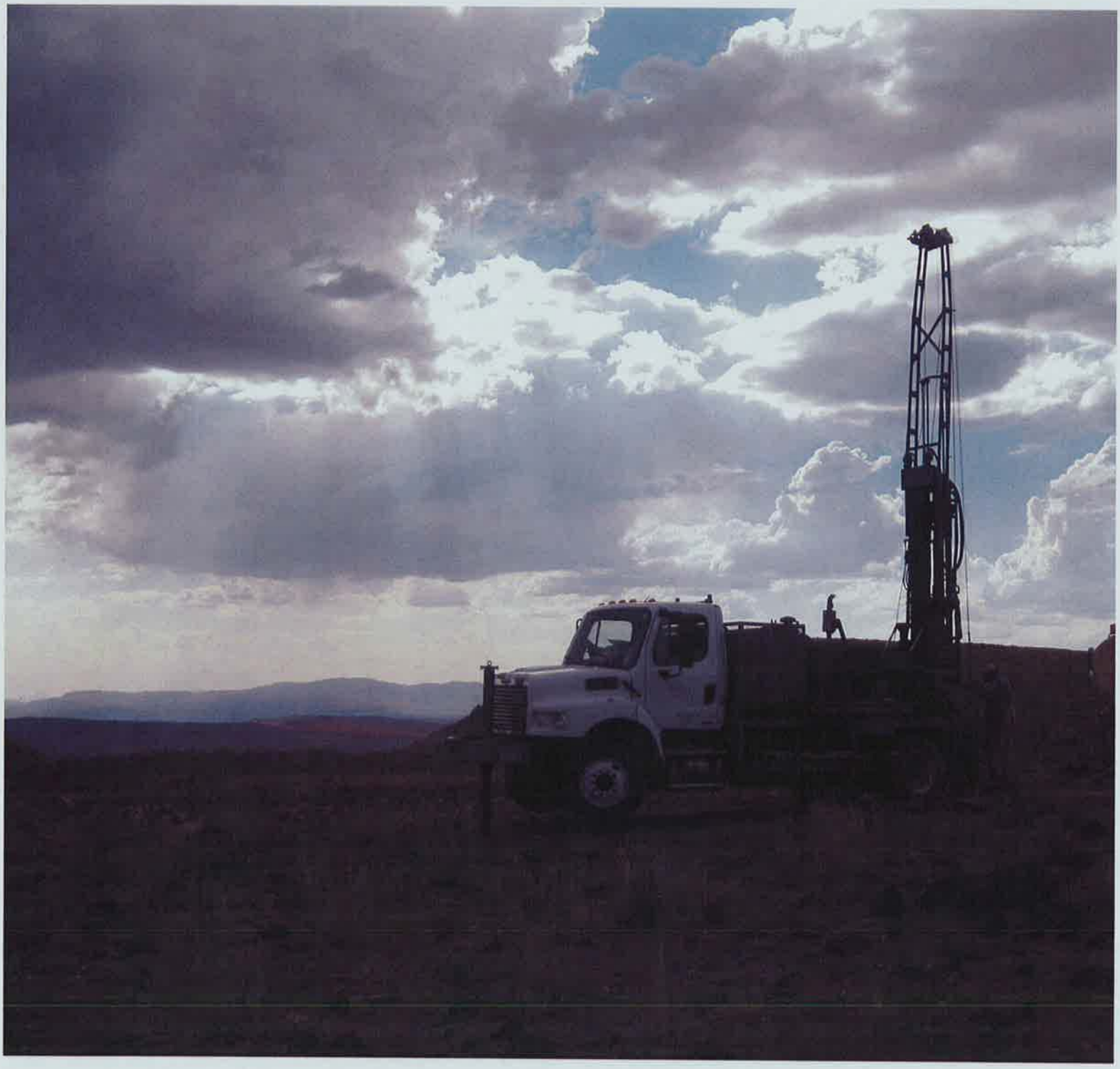
RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-17 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-17 Core Photos Wet Drilled at a dip of 60 degrees from Horizontal (30 degrees from Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah

Core Photos
FB-18



RB&G ENGINEERING, INC.

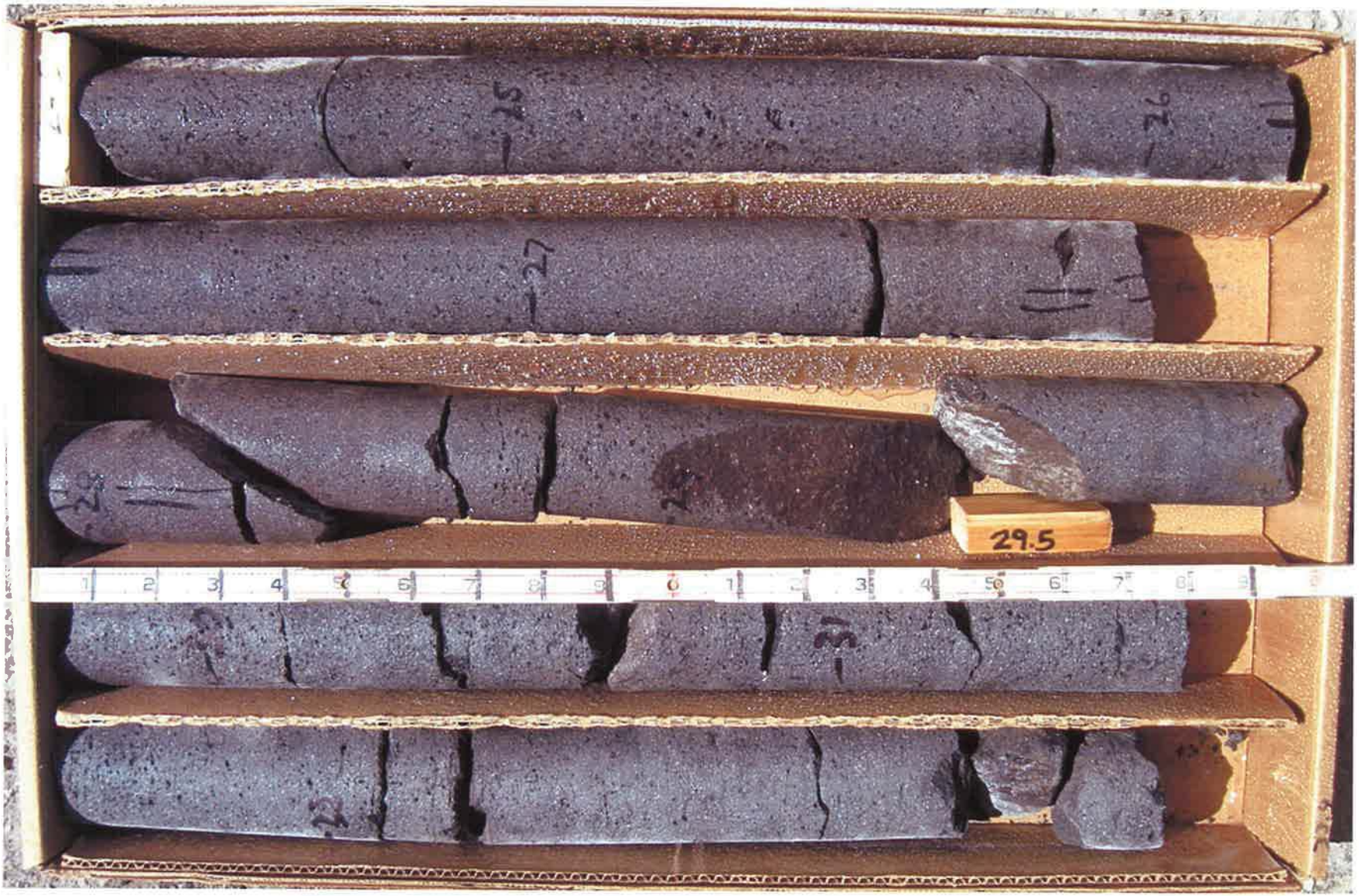
Figure	Drill Hole #09-FB-18 Core Photos Wet (Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-18 Core Photos Wet (Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-18 Core Photos Wet (Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah



RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-18 Core Photos Wet (Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah

RB&G ENGINEERING, INC.

Figure	Drill Hole #09-FB-18 Core Photos Wet (Vertical)
Project	HCH Forebay North Dam Site, WCWCD
Location	Washington County, Utah

RB&G ENGINEERING, INC.

Figure Drill Hole #09-FB-18 Core Photos Wet (Vertical)
Project HCH Forebay North Dam Site, WCWCD
Location Washington County, Utah

Laboratory Testing

RB&G ENGINEERING, INC.

Table 1

SUMMARY OF TEST DATA

PROJECT LOCATION: Hurricane Cliffs Reservoir Sites / Forebay

PROJECT: 200804.007.2 / Foundation Borings

TEST PIT / BORING NO.	DEPTH BELOW GROUND SURFACE (ft)	IN-PLACE		CONSOLIDATION	DISPERSIVE CLAY (PINHOLE TESTS)	SOLUBLE SALTS (%)	SLAKE DURABILITY $I_d(2)$, (%)	POINT LOAD INDEX $I_s(50)$	INDIRECT TENSILE STRENGTH (psi)	UNCONFINED OR UU TRIAXIAL COMPRESSIVE STRENGTH (psi)	CHEMICAL TESTS				ATTERBERG LIMITS			MECHANICAL ANALYSIS			PERCENT FINER THAN 0.005 mm	UNIFIED SOIL CLASSIFICATION SYSTEM / (AASHTO CLASSIFICATION)
		DRY UNIT WEIGHT (pcf)	MOISTURE (%)								pH	RESISTIVITY	SULFATE	CHLORIDE	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY		
Total # of Tests		*51*	*54*	*2*	*0*	*0*	*4*	*75*	*0*	*45*	*0*	*0*	*0*	*0*			*26*				*3*	*7*
09-FB-09	8-9	156.0	0.4				98.9	474		uc 8513							NP					
09-FB-09	16-17	159.2	0.1					1214		uc 9969												
09-FB-09	27-28	158.5	0.4					1748		uc 11123												
09-FB-09	36-37							702														
09-FB-09	49-50	142.0	0.1					854		uc 4724												
09-FB-09	62-63							436														
09-FB-09	74-75	166.5	0.1					1897		uc 7246												
09-FB-09	86-87							759														
09-FB-09	99-100	161.9	0.0					854		uc 8608												
09-FB-09	111-112							759														
09-FB-09	119-120							664														
09-FB-09	124-125	160.0	0.1					1214		uc 13312												
09-FB-09	137-138	163.1	0.1					1043		uc 8873												
09-FB-09	145-146							759														
09-FB-09	151.5-152	161.1	0.1					398		uc 6853					24	15	9					CL
09-FB-09	157-158							28														
09-FB-09	165-166	162.5	0.3				90.3	61		uc 5133					21	13	8					CL
09-FB-09	179-180	168.5	0.0					569		uc 3201												
09-FB-10	10-11	144.0	0.9				46.7	19		uc 1808					28	19	9					CL
09-FB-10	15-16	163.2	0.2					1253		uc 11172												
09-FB-10	18-19	158.1	1.7					683		uc 5913												
09-FB-10	20-21							1632														
09-FB-10	28-29	159.5	0.1					380		uc 9644												
09-FB-10	38-39							1120														
09-FB-10	46-47	167.1	0.2					1613		uc 9945												

NP=Non-Plastic

RB&G ENGINEERING INC

Table 1

SUMMARY OF TEST DATA

PROJECT LOCATION: Hurricane Cliffs Reservoir Sites / Forebay

PROJECT: 200804.007.2 / Foundation Borings

TEST PIT / BORING NO.	DEPTH BELOW GROUND SURFACE (ft)	IN-PLACE		CONSOLIDATION	DISPERSIVE CLAY (PINHOLE TESTS)	SOLUBLE SALTS (%)	SLAKE DURABILITY I_d(2), (%)	POINT LOAD INDEX I_s(50)	INDIRECT TENSILE STRENGTH (psi)	UNCONFINED OR UU TRIAXIAL COMPRESSIVE STRENGTH (psi)	CHEMICAL TESTS				ATTERBERG LIMITS			MECHANICAL ANALYSIS			PERCENT FINER THAN 0.005 mm	UNIFIED SOIL CLASSIFICATION SYSTEM / (AASHTO CLASSIFICATION)
		DRY UNIT WEIGHT (pcf)	MOISTURE (%)								pH	RESISTIVITY	SULFATE	CHLORIDE	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY		
Total # of Tests		*51*	*54*	*2*	*0*	*0*	*4*	*75*	*0*	*45*	*0*	*0*	*0*	*0*			*26*				*3*	*7*
09-FB-10	54-55							1139														
09-FB-10	61-62	161.8	0.0					816		uc 8015												
09-FB-10	69-70							1708														
09-FB-10	74-75	166.2	0.1					399		uc 6536												
09-FB-10	84-85	142.3	0.1					380		uc 8077							NP					
09-FB-10	92-93							512														
09-FB-10	99-100	165.3	0.0					2088		uc 8232												
09-FB-10	107-108	145.6	0.1					626		uc 7869												
09-FB-10	114-115	164.1	0.2					854		uc 10232												
09-FB-10	117-118							949														
09-FB-11	5-6.5		11.5												23	16	7	0	21	79	29	CL-ML (A-4 (3))
09-FB-11	12.5-13.2	100.4	17.7	x											25	21	4	1	30	69	15.2	CL-ML (A-4 (1))
09-FB-11	17.5-18	94.9	20.8	x											26	16	10	14	35	51		CL (A-4 (2))
09-FB-11	25-26	135.1	11.2					4		uc 630					39	17	22	0	34	66	21.2	CL (A-6 (12))
09-FB-11	33-34	132.2	10.5				33.6	6		uc 200					29	19	10	0	25	75		CL (A-4 (6))
09-FB-11	38-39							75														
09-FB-11	44-45							180														
09-FB-11	55-56	164.4	1.4				96.4	15		uc 5210												
09-FB-11	62-63							478														
09-FB-11	70-71							977														
09-FB-11	80-81	170.0	1.1					498		uc 3520												
09-FB-11	90-91							345														
09-FB-11	99-100	162.8	0.4					306		uc 7280							NP					
09-FB-11	112-113	160.3	1.1					943		uc 11630												
09-FB-11	121-122							728														

NP=Non-Plastic

RB&G ENGINEERING, INC.

Table 1

SUMMARY OF TEST DATA

PROJECT LOCATION: Hurricane Cliffs Reservoir Sites / Forebay

PROJECT: 200804.007.2 / Foundation Borings

TEST PIT / BORING NO.	DEPTH BELOW GROUND SURFACE (ft)	IN-PLACE		CONSOLIDATION	DISPERSIVE CLAY (PINHOLE TESTS)	SOLUBLE SALTS (%)	SLAKE DURABILITY I_d(2), (%)	POINT LOAD INDEX I_s(50)	INDIRECT TENSILE STRENGTH (psi)	UNCONFINED OR UU TRIAXIAL COMPRESSIVE STRENGTH (psi)	CHEMICAL TESTS				ATTERBERG LIMITS			MECHANICAL ANALYSIS			PERCENT FINER THAN 0.005 mm	UNIFIED SOIL CLASSIFICATION SYSTEM / (AASHTO CLASSIFICATION)
		DRY UNIT WEIGHT (pcf)	MOISTURE (%)								pH	RESISTIVITY	SULFATE	CHLORIDE	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY		
Total # of Tests		*51*	*54*	*2*	*0*	*0*	*4*	*75*	*0*	*45*	*0*	*0*	*0*	*0*			*26*				*3*	*7*
09-FB-11	130-131	168.4	1.6					345		uc 8580												
09-FB-11	143-144							364														
09-FB-11	152-153.5	138.9	3.2					182		uc 4550												
09-FB-11	162-163							269														
09-FB-11	170-171	107.6	24.4												41	18	23	2	12	86		CL (A-7-6 (20))
09-FB-11	177-178							306														
09-FB-11	186-187	107..6	2.9					329		uc 6090												
09-FB-12	9-10	168.0	0.3					854		uc 13064												
09-FB-12	20-21							1424														
09-FB-12	31-32	162.5	0.4					854		uc 8157												
09-FB-12	39-40							72														
09-FB-12	49-50	166.1	0.2					1651		uc 10005												
09-FB-12	59-60							285														
09-FB-12	69-70	150.9	2.4					38		uc 1713					25	18	7					CL-ML
09-FB-12	79-80	139.1	6.5					84							25	18	7					CL-ML
09-FB-12	90-91							34														
09-FB-12	100-101	137.7	7.2					19		uc 1344					27	21	6					CL-ML
09-FB-12	110-111							121														
09-FB-12	119-120							38														
09-FB-12	125-126	130.1	12.8					19							27	19	8					CL
09-FB-12	145-146	132.8	10.9					27		uc 3258					26	16	10					CL
09-FB-12	154-155							59														
09-FB-12	165-166	134.7	9.7					79		uc 3031							NP					
09-FB-12	179-180	156.2	1.4							uc 1748												
09-FB-12	185-186							6														

NP=Non-Plastic

RB&G ENGINEERING INC

Table 1

SUMMARY OF TEST DATA

PROJECT LOCATION: Hurricane Cliffs Reservoir Sites / Forebay

PROJECT: 200804.007.2 / Foundation Borings

TEST PIT / BORING NO.	DEPTH BELOW GROUND SURFACE (ft)	IN-PLACE		CONSOLIDATION	DISPERSIVE CLAY (PINHOLE TESTS)	SOLUBLE SALTS (%)	SLAKE DURABILITY I_d(2), (%)	POINT LOAD INDEX I_s(50)	INDIRECT TENSILE STRENGTH (psi)	UNCONFINED OR UU TRIAXIAL COMPRESSIVE STRENGTH (psi)	CHEMICAL TESTS				ATTERBERG LIMITS			MECHANICAL ANALYSIS			PERCENT FINER THAN 0.005 mm	UNIFIED SOIL CLASSIFICATION SYSTEM / (AASHTO CLASSIFICATION)
		DRY UNIT WEIGHT (pcf)	MOISTURE (%)								pH	RESISTIVITY	SULFATE	CHLORIDE	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY		
Total # of Tests		*51*	*54*	*2*	*0*	*0*	*4*	*75*	*0*	*45*	*0*	*0*	*0*	*0*			*26*				*3*	*7*
09-FB-12	195-196	160.7	3.4					112		uc 1432					26	19	7					CL-ML
09-FB-12	205-206							19														
09-FB-12	220-221	153.3	3.6					152		uc 2502												
09-FB-12	230-231	154.2	4.1					127		uc 2978												
09-FB-13	0-1.5		1.8												29	19	9	3	40	57		CL
09-FB-13	21-22	135.4	11.0					415		uc 4299												
09-FB-13	26-27	140.6	5.6					231		uc 1732												
09-FB-14	15.3-16.8		10.8												29	17	12	11	16	73		CL (A-6 (7))
09-FB-14	21-22	143.7	1.4					30									NP					
09-FB-14	25-26	161.8	1.3					95		uc 6387												
09-FB-14	28-29	157.8	1.4					136		uc 7869												
09-FB-15	5-6	159.0	0.1					190		uc 4565							NP					
09-FB-15	10-11							1615														
09-FB-15	15-16	164.9	0.1					1518		uc 15454							NP					
09-FB-15	24-25							1898														
09-FB-15	31-32	163.2	0.3					1803		uc 10268												
09-FB-15	39-40	145.9	0.4					475		uc 6136							NP					
09-FB-15	45-46							949														
09-FB-15	52-53	163.0	0.3					930		uc 6521												
09-FB-15	60-61							1025														
09-FB-15	69-70	161.4	0.3					1101		uc 6300												
09-FB-15	76-77	161.8	0.1					949		uc 5283												
09-FB-16	5-6	166.9	0.2				98.8	813		uc 7190							NP					
09-FB-16	15-16							328														
09-FB-16	25-26	167.2	0.2					720		uc 4470												

NP=Non-Plastic

RB&G ENGINEERING INC

Table 1

SUMMARY OF TEST DATA

PROJECT LOCATION: Hurricane Cliffs Reservoir Sites / Forebay

PROJECT: 200804.007.2 / Foundation Borings

TEST PIT / BORING NO.	DEPTH BELOW GROUND SURFACE (ft)	IN-PLACE		CONSOLIDATION	DISPERSIVE CLAY (PINHOLE TESTS)	SOLUBLE SALTS (%)	SLAKE DURABILITY $I_d(2)$, (%)	POINT LOAD INDEX $I_s(50)$	INDIRECT TENSILE STRENGTH (psi)	UNCONFINED OR UU TRIAXIAL COMPRESSIVE STRENGTH (psi)	CHEMICAL TESTS				ATTERBERG LIMITS			MECHANICAL ANALYSIS			PERCENT FINER THAN 0.005 mm	UNIFIED SOIL CLASSIFICATION SYSTEM / (AASHTO CLASSIFICATION)
		DRY UNIT WEIGHT (pcf)	MOISTURE (%)								pH	RESISTIVITY	SULFATE	CHLORIDE	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY		
Total # of Tests		51	54	2	0	0	4	75	0	45	0	0	0	0			26				3	7
09-FB-16	34-35	152.5	0.9				99.0	637		uc 8840							NP					
09-FB-16	40-42	170.5	0.4					958		uc 10190												
09-FB-16	45-46							1344														
09-FB-16	55-56														24	16	8					
09-FB-16	57-59	163.8	1.1					269		uc 7330												
09-FB-16	65-66							1252														
09-FB-16	70-71							230														
09-FB-16	80-82	166.1	0.3					1178		uc 14330					25	17	8					
09-FB-16	85-86							847														
09-FB-16	95-97	165.0	0.4					517		uc 10360												
09-FB-17	15-16	174.1	0.2					1898		uc 13396												
09-FB-17	25-26							968														
09-FB-17	35-36	166.7	0.2					588		uc 11753												
09-FB-17	45-46	114.8	14.5					4		uc 95					36	20	16					CL
09-FB-17	55-56	141.3	8.0							uc 648					30	18	12					CL
09-FB-17	65-66	163.5	0.2					2164		uc 15595												
09-FB-17	76-77	168.7	0.1					475		uc 9536												
09-FB-17	85-86							361														
09-FB-17	93-94	169.0	0.0					512		uc 6466												

NP=Non-Plastic

Test Pits

TEST PIT LOG

TEST PIT NO. FB-15

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4686.9'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4685	0					SC-SM	lt. brown, dry, very stiff SILTY CLAYEY SAND W/GRAVEL pinhole structure, trace gypsum stringers	105.4	5.0						
	5					SC-SM	red-brown, slightly moist, very stiff		5.8	23	7	30	36	34	Proct. DC - ND-3 SS - 3.9%
4680						CL-1	lt. brown, slightly moist SANDY LEAN CLAY W/GRAVEL pinhole structure		6.3	23	9	23	27	50	DC - ND-2 SS - 5.1%
	10					GC	lt. brown, slightly moist, dense CLAYEY GRAVEL W/SAND more dense w/depth, trace gypsum stringers		5.7	24	9	36	31	35	SS - 4.2%
4675	15						Refusal								
4670															

TP_200804.007.2_HURRICANECLIFFSFOREBAY_TP.GPJ_US_EVAL.GDT_11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-16

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4716.4'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
						SC-SM	4" SILTY CLAYEY SAND W/GRAVEL								
4715							LIMESTONE fractured, caliche infilling of fractures								
							Refusal								
	5														
4710															
	10														
4705															

TP_200804.007.2 HURRICANECLIFFSFOREBAY_TP.GPJ US EVAL.GDT 11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE
UNDISTURBED SAMPLE
Bucket ← Type of Sample
0.45 ← Torvane (tsf)

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-17

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4614.3'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4610	0					SC	CLAYEY SAND abundant gypsum stringers lt. red-brown to red, dry to slightly moist	91.6	3.7	23	10	10	43	47	Proct., DC - ND-3 SS - 13.3%
	5					CL-ML	red, slightly moist	80.1	7.7	25	6	0	10	90	DC - ND-3 SS - 9.7%
4605							SILTY CLAY many gypsum stringers, pinhole structure								
	10					CL-ML	red, slightly moist								
						SC	red, slightly moist		8.8	25	8	31	33	36	
4600							VERY WEATHERED SHALE abundant gypsum stringers, more competent w/depth								
	15														
							Refusal								
4595															

TP_200804.007.2 HURRICANECLIFFSFOREBAY_TP.GPJ US EVAL.GDT 11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — Bucket ← Type of Sample
0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-18

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4656.5'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4655	0					CL-ML	lt. brown, dry to slightly moist — SANDY SILTY CLAY, silty sand lenses & layers, abundant gypsum stringers	99.3	7.9	25	4	2	29	69	DC - ND-2 SS - 14.2%
4650	5					SM	lt. brown, dry — SILTY SAND, very slight pinhole structure, occasional boulders, many gypsum stringers		8.4	20	3	3	58	59	Proct.
	10					CL-ML	lt. brown, dry	88.7	7.7	26	5	1	34	65	SS - 13.8%
4645						CL-ML	lt. brown, dry — SANDY SILTY CLAY, abundant gypsum stringers, occasional gravelly layer, occasional boulders								
	15					CL-ML	red, slightly moist — SANDY SILTY CLAY, very weathered shale becoming more competent w/depth, many to abundant gypsum stringers								
4640	20					CL-ML	red, slightly moist, very hard		3.7	25	4	6	32	62	DC - ND-3
4635							Refusal								

TP 200804.007.2 HURRICANECLIFFSFOREBAY TP.GPJ US EVAL.GDT 11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-19

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4669.0'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description		Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4665	5					CL-ML	lt. red-brown, dry, very stiff	SILTY CLAY severe pinhole structure, trace gypsum stringers	76.3	10.6	24	7	0	9	91	Proct. DC - ND-3
						CL-ML	red-brown, slightly moist, stiff									
4660	10					CL	red, slightly moist	MUDSTONE very highly weathered, more competent w/depth, trace gypsum stringers, pinhole structure								
						-		SILTSTONE W/GYPSUM INFILLING								
4655								Refusal								

TP 200804.007.2 HURRICANECLIFFSFOREBAY TP.GPJ US EVAL.GDT 11/12/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-20

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4684.3'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
						CL	red, dry — SANDY LEAN CLAY								
						SC-SM	lt. brown, dry — SILTY CLAYEY SAND								
4680	5					CL-ML	lt. red-brown, dry — SANDY SILTY CLAY, pinhole structure, many gypsum stringers	85.3	5.1	19	6	3	33	64	DC - ND-3 SS - 9.2%
						CL-ML	lt. brown, dry — SILTY CLAY W/SAND, pinhole structure, abundant gypsum stringers	85.9	8.9	27	5	0	23	77	DC - ND-2 SS - 14.1%
4675	10					CL-ML	lt. red-brown, dry, stiff	93.6	5.8	24	5	8	21	71	
4670	15					CL-ML	lt. red-brown, dry, very stiff — SILTY CLAY W/SAND, very weathered shale, more stiff w/depth, more gypsum stringers w/depth, more competent w/depth	115.2	6.4						
4665	20					CL-ML	lt. red-brown, dry, hard								
4660							Refusal								

TP_200804.007.2_HURRICANECLIFFSFOREBAY_TP.GPJ_US_EVAL.GDT_11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — Bucket ◄ Type of Sample; 0.45 ◄ Torvane (tsf)
UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-21

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4710.2'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4710	0					SC-SM	SILTY CLAYEY SAND lt. brown, dry								
4705	5					-	red w/gray layers, dry, very hard SHALE BEDROCK more competent w/depth, abundant gypsum stringers								
							Refusal								
4700	10														

TP_200804.007.2_HURRICANECLIFFSFOREBAY_TP.GPJ_US_EVAL.GDT_11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE
UNDISTURBED SAMPLE
Bucket ← Type of Sample
0.45 ← Torvane (tsf)

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-22

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4698.3'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4695	0					ML	lt. brown, dry, stiff	89.3	7.3	28	5	7	42	51	SS - 8.5%
	5						SANDY SILT plastic, pinhole structure, many gypsum stringers								
						ML	lt. brown, dry, stiff								
4690															
						ML	lt. brown, dry, stiff								
	10														
						CL-ML	red-brown, slightly moist, very stiff	78.8	11.0	26	5	3	12	85	SS - 14.3%
4685															
	15						SILTY CLAY severe pinhole structure decreasing w/depth, abundant gypsum stringers decreasing w/depth, more stiff w/depth, more competent w/depth, becoming very weathered shale								
						CL-ML	red-brown, slightly moist, very stiff								SS - 6.7%
4680															
	20					CL-ML	red-brown w/gray layers, slightly moist, hard								
							Refusal								
4675															

TP 200804.007.2 HURRICANECLIFFSFOREBAY TP.GPJ US EVAL.GDT 11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-23

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4705.9'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4705	0						SANDY SILTY CLAY slight pinhole structure, few to many gypsum stringers								
						CL-ML	lt. red-brown to red-brown, dry, stiff		3.9	19	5	8	31	61	SS - 4.6%
	5														
4700							SANDY SILTY CLAY pinhole structure, many gypsum stringers, very weathered shale								
						CL-ML	red-brown, slightly moist, very stiff	85.9	9.3						SS - 4.1%
							SANDY SILTSTONE SHALE								
						ML	lt. brown to yellow-brown, dry, dense								
	10														
4695							Refusal								

TP_200804.007.2_HURRICANECLIFFSFOREBAY_TP.GPJ_US_EVAL.GDT 11/4/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE

UNDISTURBED SAMPLE

Bucket ← Type of Sample
0.45 ← Torvane (tsf)

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-24

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4701.4'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4700	0					CL-ML	lt. red-brown, dry — SANDY SILTY CLAY								
						CL-1	red-brown w/gray layers, slightly moist		8.9	30	8	2	16	82	DC - ND-3 SS - 10.6%
	5						LEAN CLAY W/SAND very highly weathered shale, abundant gypsum stringers, more competent w/depth								
4695						CL	red-brown, dry, hard	127.2	4.5						
							Refusal								
4690	10														

TP_200804.007.2_HURRICANECLIFFSFOREBAY_TP.GPJ_US_EVAL.GDT_11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE
UNDISTURBED SAMPLE
Bucket ← Type of Sample
0.45 ← Torvane (tsf)

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-25

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4727.4'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
						CL/CL-ML	lt. brown, dry — SANDY LEAN CLAY TO SANDY SILTY CLAY								
4725						SM	lt. red-brown, dry — SILTY SAND, plastic, very highly weathered shale, many gypsum stringers		11.7	32	7	7	51	42	SS - 7.9%
	5					CL-ML	red-brown w/gray layers, slightly moist, very stiff								
4720							SHALE (SANDY SILTY CLAY) very weathered to competent, abundant gypsum stingers								
	10					CL-ML	red-brown w/gray layers, slightly moist, hard								
4715							Refusal								

TP_200804.007.2 HURRICANECLIFFSFOREBAY_TP.GPJ US EVAL.GDT 11/4/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)

UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-26

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4737.4'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4735	0					CL-1	lt. brown, dry, stiff — SANDY LEAN CLAY, many gypsum stringers, moderate pinhole structure	82.9	4.3	23	8	6	29	65	DC - ND-3 SS - 7.3%
	5					CL-ML	red-brown w/gray layers, dry, very stiff								
4730															
	10					CL-ML	red-brown w/gray layers, dry, hard — SANDY SILTY CLAY, very weathered to competwent shale, abundant gypsum stringers - some frothy								
4725							Refusal								

TP 200804.007.2 HURRICANECLIFFSFOREBAY TP.GPJ US EVAL.GDT 11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — Bucket ← Type of Sample
0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-27

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4648.3'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
						SC	red-brown, dry — CLAYEY SAND W/GRAVEL								
4645						CL-ML	red-brown, dry — SHALE (SILTY CLAY) more competent w/depth								
	5														
							Refusal								
4640															
	10														
4635															

TP_200804.007.2 HURRICANECLIFFSFOREBAY_TP.GPJ US EVAL.GDT 11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-28

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4713.9'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
						CL-ML	SANDY SILTY CLAY W/GRAVEL									
							LIMESTONE W/CHERT GRAVEL caliche infilling of fractures									
							Refusal								
4710															
	5														
4705															
	10														
4700															

TP 200804.007.2 HURRICANECLIFFSFOREBAY TP.GPJ US EVAL.GDT 11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-29

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4711.6'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
						CL-ML/ GC-GM	SANDY SILTY CLAY W/GRAVEL TO SILTY CLAYEY GRAVEL W/SAND								
4710						-	lt. brown, avg. hard rock LIMESTONE fractured, caliche infilling of fractures								
							Refusal								
	5														
4705															
	10														
4700															

TP_200804.007.2 HURRICANECLIFFSFOREBAY_TP.GPJ US EVAL.GDT 11/4/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)

UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-30

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4715.4'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4715	0						WEATHERED SHALE (SANDY SILTY CLAY) more competent w/depth, platey								
						CL-ML	very lt. brown, dry, stiff to hard								
	5						SHALE more competent w/depth, platey								
4710						-	red, dry, hard								
							Refusal								
4705	10														

TP_200804.007.2 HURRICANECLIFFSFOREBAY_TP.GPJ US EVAL.GDT 11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-31

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4729.2'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
						ML	WEATHERED SILTSTONE more competent w/depth, trace to many gypsum stringers gray-brown, dry								SS - 4.8%
4725	5					SM	SILTY SANDSTONE yellow-brown, dry								
4720	10					CL-1	MUDSTONE SHALE (LEAN CLAY) more competent w/depth, trace gypsum stringers red w/gray layers, dry		3.9	27	9				DC - ND-2 SS - 2.1%
4715							Refusal								

TP_200804.007.2_HURRICANECLIFFSFOREBAY_TP.GPJ_US_EVAL.GDT_11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE
UNDISTURBED SAMPLE
Bucket ← Type of Sample
0.45 ← Torvane (tsf)

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-32

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4728.1'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
						CL-ML	red, dry — SILTY CLAY W/SAND, very weathered shale								
4725						ML	lt. yellow-brown, dry, very dense — SANDY SILTSTONE, more competent w/depth, fractured - decreasing w/depth								
	5						Refusal								
4720															
	10														
4715															

TP_200804.007.2_HURRICANECLIFFSFOREBAY_TP.GPJ_US_EVAL.GDT 11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-33

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4727.3'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
						CL-ML	lt. red-brown, dry, stiff — SANDY SILTY CLAY								
4725						SC-SM	lt. brown, dry, dense — SILTY CLAYEY SAND W/GRAVEL large flat gravels, trace gypsum stringers		3.6	27	7	20	31	49	DC - ND-3 SS - 3.2%
	5					SM	yellow-brown, dry, very dense		6.2		NP	27	31	42	
4720							SANDSTONE weathered at top to very competent								
	10						Refusal								
4715															

TP_200804.007.2 HURRICANECLIFFSFOREBAY_TP.GPJ US EVAL.GDT 11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-34

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4722.3'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
						CL-ML	brown, dry — SANDY SILTY CLAY								
						-	gray — LIMESTONE W/THIN SILTSTONE LAYERS; silty clay infilling of fractures								
4720							Refusal								
	5														
4715															
	10														
4710															

TP_200804.007.2_HURRICANECLIFFSFOREBAY_TP.GPJ_US_EVAL.GDT 11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-35

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4708.5'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
							SILTY CLAYEY SAND abundant gypsum stringers								
4705						SC-SM	lt. red-brown, dry, dense	90.4	3.4	20	6	3	55	42	SS - 3.4%
	5						SILTY CLAYEY SAND W/GRAVEL trace gypsum stringers								
						SC-SM	very lt. brown, dry to slightly moist, very dense		7.5	21	6	25	40	35	Proct. SS - 1.5%
4700															
						-	lt. brown, dry, very dense								
	10						SANDSTONE BEDROCK platey								
						-	lt. brown, dry, very dense								
							Refusal								
4695															

TP_200804.007.2_HURRICANECLIFFSFOREBAY_TP.GPJ_US_EVAL.GDT_11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-36

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4721.1'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4720	0					CL-ML	lt. brown, dry, very stiff — SANDY SILTY CLAY								
						CL-ML	red, slightly moist — SILTY CLAY W/SAND very weathered shale, more competent w/depth								
	5					ML	yellow-brown, slightly moist — SILTSTONE								
4715						CL-ML	red — MUDSTONE								
						ML	yellow-brown — SILTSTONE								
							Refusal								
	10														
4710															

TP_200804.007.2_HURRICANECLIFFSFOREBAY_TP.GPJ_US EVAL.GDT 11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-37

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4703.7'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample: Type	Sample: Rec. (in)	Sample: See Legend	Sample: USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Limits: Liquid Limit	Atter. Limits: Plast. Index	Gradation: Gravel (%)	Gradation: Sand (%)	Gradation: Silt/Clay (%)	Other Tests
						ML	gray-brown, dry GRAVELLY SILT W/SAND very weathered siltstone								
4700						ML	gray-brown to lt. brown, dry SILTSTONE platey								
	5					SM	yellow-brown, dry SILTY SANDSTONE platey								
							Refusal								
4695															
	10														
4690															

TP 200804.007.2 HURRICANECLIFFSFOREBAY_TP.GPJ US EVAL.GDT 11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-38

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4638.0'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
						CL-ML	6" SANDY SILTY CLAY W/GRAVEL								
						ML	lt. gray-brown, dry, hard rock — SILTSTONE, thin caliche coating on fractures								
4635							Refusal								
	5														
4630															
	10														
4625															

TP_200804.007.2_HURRICANECLIFFSFOREBAY_TP.GPJ_US_EVAL.GDT_11/4/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-39

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4625.8'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	See Legend	USCS	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4625							SANDY SILTY CLAY W/GRAVEL abundant gypsum stringers, moderate pinhole structure								
						CL-ML	lt. red-brown, dry, stiff	84.0	6.1	23	5	22	22	56	Proct. DC - ND-2 SS - 13.7%
	5														
4620						-	yellow-brown, dry								
							WEATHERED MUDSTONE W/SILTSTONE GRAVELS								
						-	red, dry								
							WEATHERED MUDSTONE								
						-	yellow-brown to green, slightly moist								
							WEATHERED MUDSTONE								
	10						Excavation terminated at 9.5' as per Michael Hansen of RB&G Engineering								
4615															

TP_200804.007.2_HURRICANECLIFFSFOREBAY_TP.GPJ_US_EVAL.GDT_11/4/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)

UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

TEST PIT LOG

TEST PIT NO. FB-40

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - FOREBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DIGGING METHOD: CAT 330 TRACKHOE
OPERATOR: N/A
DEPTH TO WATER - INITIAL: ▽ DRY **AFTER 24 HOURS:** ▼

PROJECT NUMBER: 200804.007.1
DATE STARTED: 6/24/09
DATE COMPLETED: 6/24/09
GROUND ELEVATION: 4624.7'
LOGGED BY: J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	See Legend	USCS	Material Description		Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4620	5					CL-ML	lt. red-brown, dry, very stiff	SANDY SILTY CLAY W/GRAVEL pinhole structure, abundant gypsum stringers								
						-	yellow-brown & red layers, dry	MUDSTONE very weathered, more competent w/depth								
4615	10					-	gray-green, slightly moist	SILTSTONE more competent w/depth								
4610								Excavation terminated at 11' as per Michael Hansen of RB&G Engineering								

TP_200804.007.2_HURRICANECLIFFSFOREBAY_TP.GPJ_US_EVAL.GDT_11/4/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — Bucket ← Type of Sample; 0.45 ← Torvane (tsf)

UNDISTURBED SAMPLE

OTHER TESTS
DC = Dispersive Clay
SS = Soluble Salts
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer

Laboratory Testing

Table 1

SUMMARY OF TEST DATA

PROJECT Hurricane Cliffs Reservoir Sites – Forebay
LOCATION Washington County, Utah
PROJECT NO. 200804-007
FEATURE Forebay Reservoir Basin

TEST PIT NO.	DEPTH BELOW GROUND SURFACE (ft)	IN-PLACE DENSITY (pcf) / MOISTURE (%)	PROCTOR ASTM D 698 MAXIMUM DENSITY (pcf) AT OPTIMUM MOISTURE (%)	DISPERSIVE CLAY	SOLUBLE SALTS (%)	ATTERBERG LIMITS			MECHANICAL ANALYSIS			UNIFIED SOIL CLASSIFICATION SYSTEM (modified)
						LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY	
FB-15	3	105.4/5.0										
	6	5.8	127.4 @ 10.5	ND-3	3.9	23	16	7	30	36	34	SC-SM
	9	6.3		ND-2	5.1	23	14	9	23	27	50	CL-1
	12	5.7			4.2	24	15	9	36	31	35	GC
FB-17	3	91.6/3.7	107.8 @ 18.5	ND-3	13.3	23	13	10	10	43	47	SC
	6	80.1/7.7		ND-3	9.7	25	19	6	0	10	90	CL-ML
	12.5	8.8				25	17	8	31	33	36	SC
FB-18	3	99.3/7.9		ND-2	14.2	25	21	4	2	29	69	CL-ML
	6	8.4	111.8 @ 17.5			20	17	3	3	58	39	SM
	9	88.7/7.7			13.8	26	21	5	1	34	65	CL-ML
	21	3.7		ND-3		25	21	4	6	32	62	CL-ML
FB-19	3	76.3/10.6	112.2 @ 17.8	ND-3		24	17	7	0	9	91	CL-ML
FB-20	3	85.3/5.1		ND-3	9.2	19	13	6	3	33	64	CL-ML
	6	85.9/8.9		ND-2	14.1	27	22	5	0	23	77	CL-ML
	12	93.6/5.8				24	19	5	8	21	71	CL-ML
	15	115.2/6.4										
FB-22	3	89.3/7.3			8.5	28	23	5	7	42	51	ML
	12	78.8/11.0			14.3	26	21	5	3	12	85	CL-ML
	15				6.7							
FB-23	3	3.9			4.6	19	14	5	8	31	61	CL-ML
	6	85.9/9.3			4.1							
FB-24	3	8.9		ND-3	10.6	30	22	8	2	16	82	CL-ML
	6	127.2/4.5										
FB-25	3	11.7			7.9	32	25	7	7	51	42	SM
FB-26	3	82.9/4.3		ND-3	7.3	23	15	8	6	29	65	CL-1
FB-31	3				4.8							
	9	3.9		ND-2	2.1	27	18	9				CL-1
FB-33	3	3.6		ND-3	3.2	27	20	7	20	31	49	SC-SM
	6	6.2						NP	27	31	42	SM
FB-35	3	90.4/3.4			3.4	20	14	6	3	55	42	SC-SM
	6	7.5	105.5 @ 18.5		1.5	21	15	6	25	40	35	SC-SM
FB-39	3	84.0/6.1	117.6 @ 13.6	ND-2	13.7	23	18	5	22	22	56	CL-ML

NP=Nonplastic

RB&G ENGINEERING, INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200804.007.1

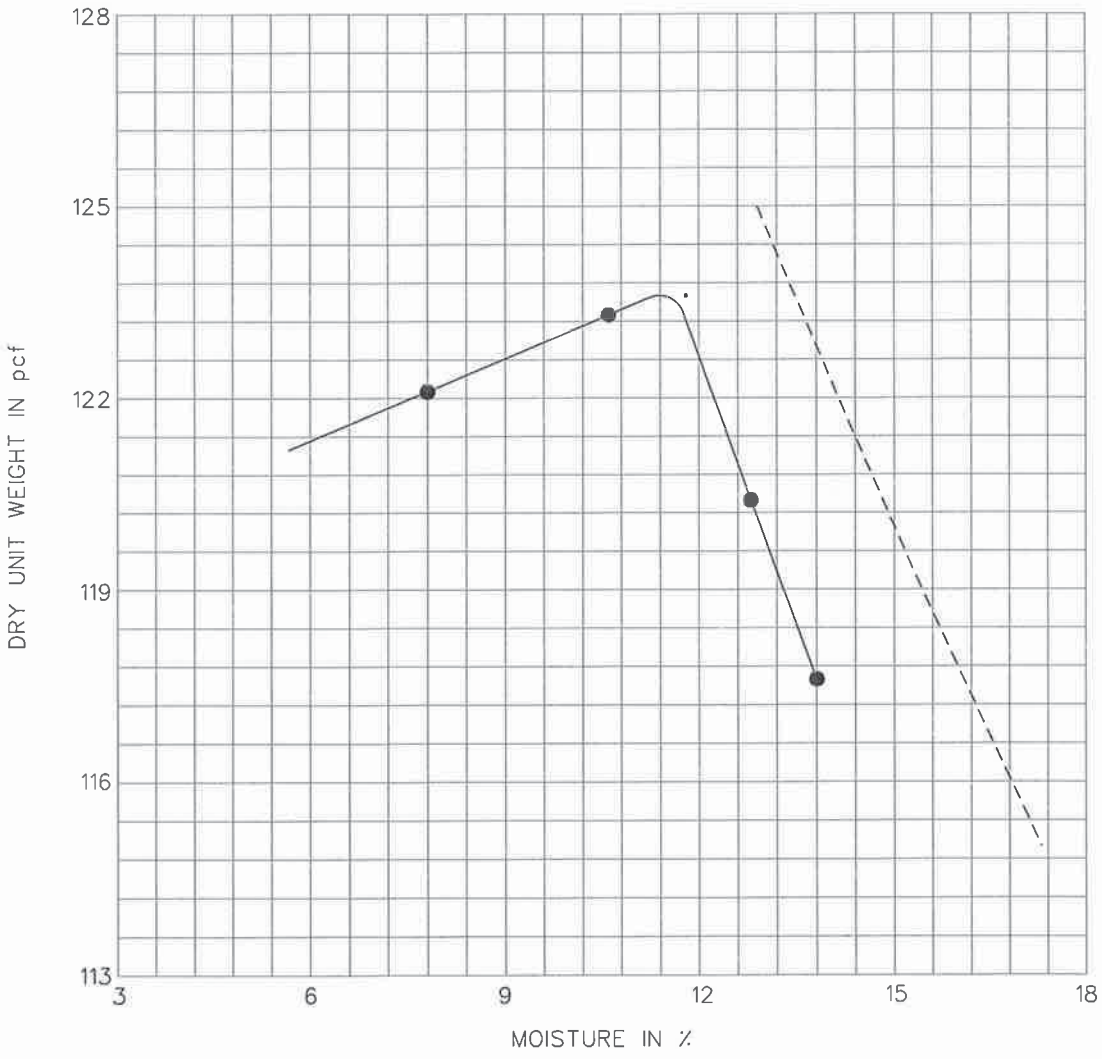
MOISTURE-DENSITY RELATION (PROCTOR)

Project	HURRICANE CLIFFS RESERVOIR SITES - FOREBAY			Date	6/24/2009
Location / No.	TEST PIT FB-15 AT 6'			Technician	J. LINDO
Material Description	RED-BROWN SANDY SILTY CLAY W/GRAVEL	USCS	SC-SM	Method	ASTM D 698

Procedure Used[1]	C
Classification Procedure[2]	Test

[1] A-No. 4 Sieve, B-3/8" Sieve, C-3/4" Sieve
[2] Visual as per ASTM D 2488, Test as per ASTM D 2487

Preparation Method	Moist
Rammer Used	Manual
As-Received Moisture Content (%)	6.5



Maximum Dry Density (pcf)	123.6
Optimum Moisture Content (%)	11.8
Corrected Maximum Density (pcf)	127.4
Corrected Optimum Moisture Content (%)	10.5

----- 100% Saturation Curve

Specific Gravity of Soil	2.70	Est.

OVERSIZE CORRECTION-ASTM D 4718

Specific Gravity of Soil +3/4	2.70	Est.
Percent Oversize	11.9	

Type of Specific Gravity is BULK Unless Otherwise Indicated

RB&G ENGINEERING, INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200804.007.1

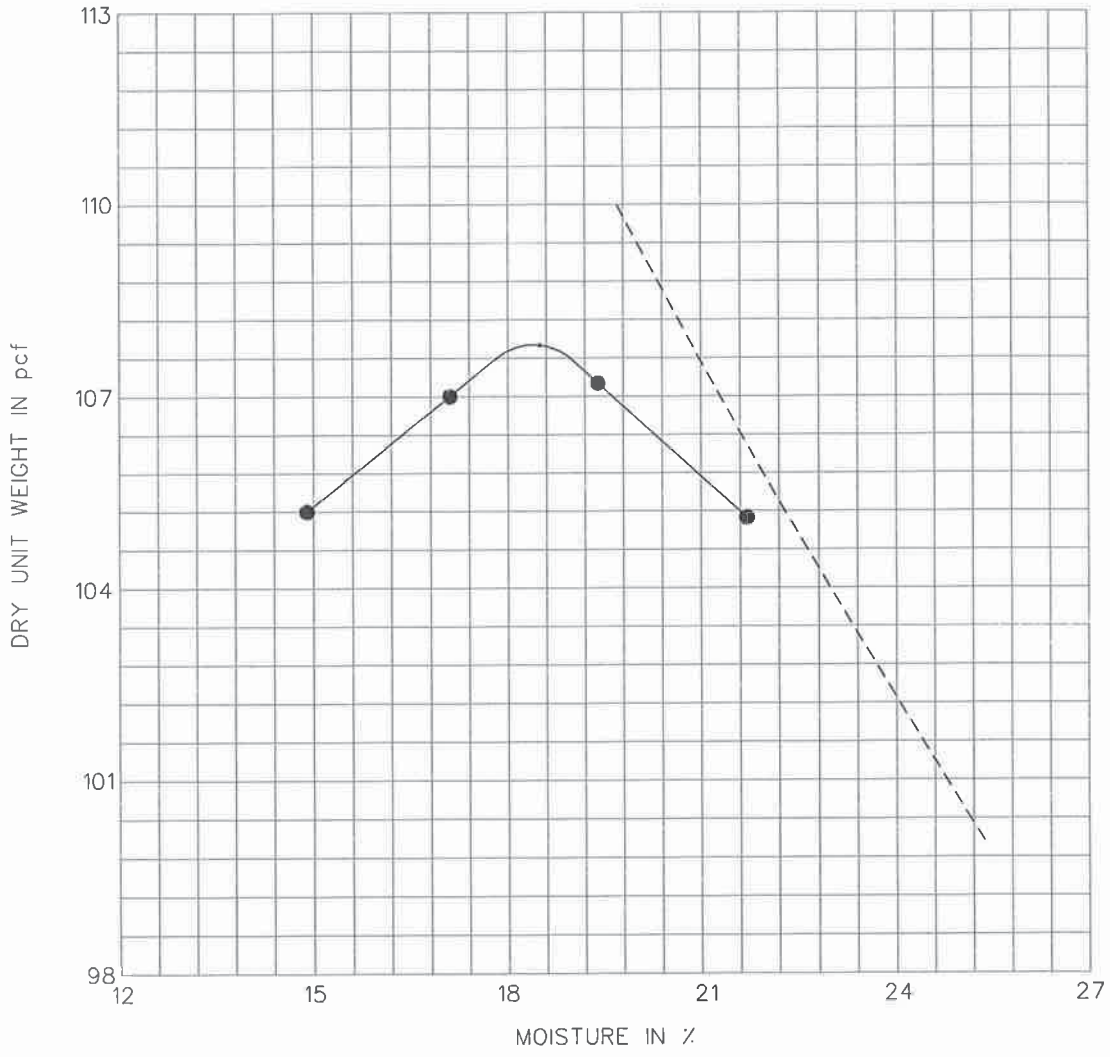
MOISTURE-DENSITY RELATION (PROCTOR)

Project	HURRICANE CLIFFS RESERVOIR SITES - FOREBAY			Date	6/30/2009
Location / No.	TEST PIT FB-17 AT 3'			Technician	S. GUNNELL, K. MARTINEZ
Material Description	LT. BROWN CLAYEY SAND	USCS	SC	Method	ASTM D 698

Procedure Used[1]	B
Classification Procedure[2]	Test

[1] A-No. 4 Sieve, B-⅜" Sieve, C-¾" Sieve
[2] Visual as per ASTM D 2488, Test as per ASTM D 2487

Preparation Method	Moist
Rammer Used	Manual
As-Received Moisture Content (%)	7.1



Maximum Dry Density (pcf)	107.8
Optimum Moisture Content (%)	18.5
Corrected Maximum Density (pcf)	107.8
Corrected Optimum Moisture Content (%)	18.5

----- 100% Saturation Curve

Specific Gravity of Soil	2.70	Est.

OVERSIZE CORRECTION-ASTM D 4718

Specific Gravity of Soil +¾	2.70	Est.
Percent Oversize	0.0	

Type of Specific Gravity is BULK Unless Otherwise Indicated

RB&G ENGINEERING, INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200804.007.1

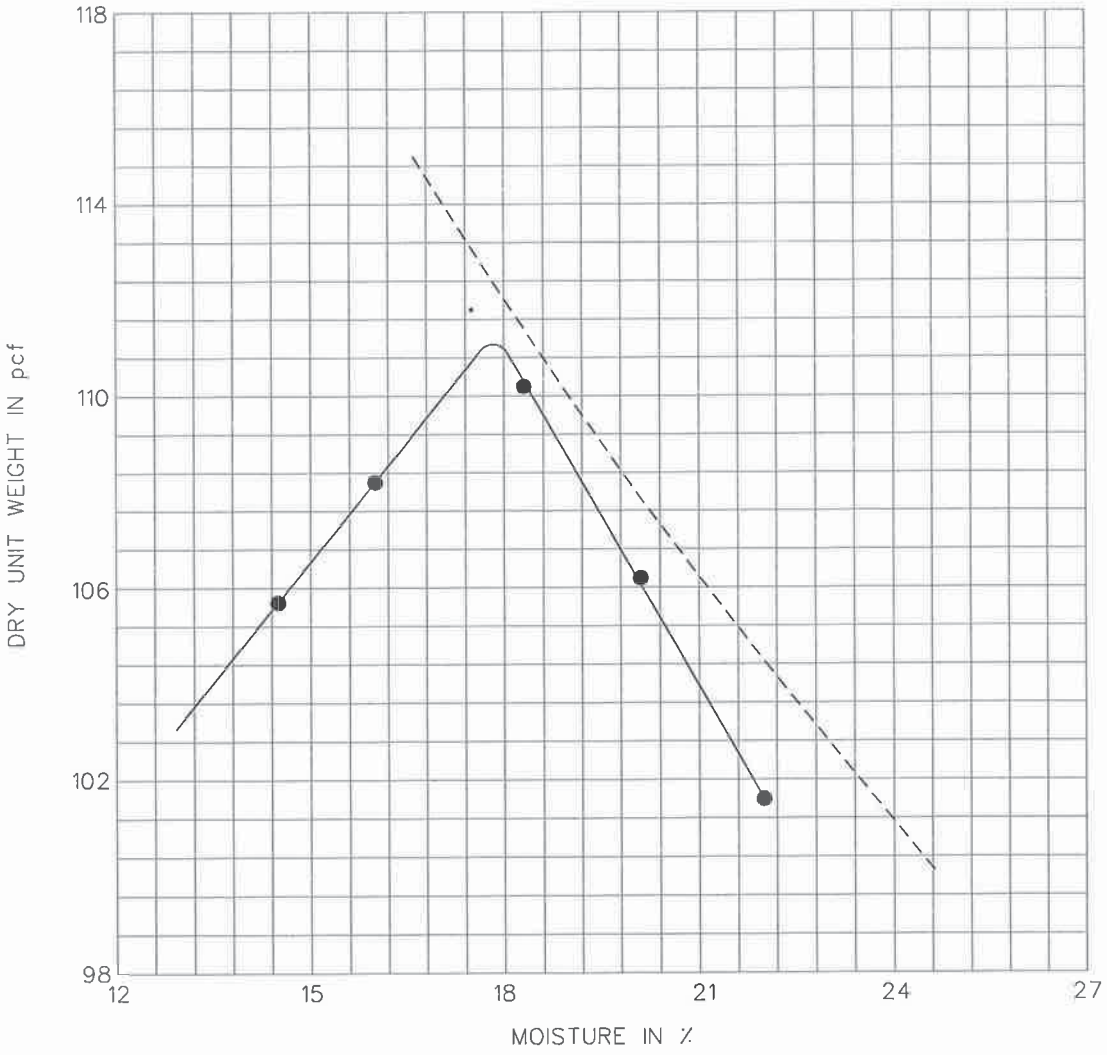
MOISTURE-DENSITY RELATION (PROCTOR)

Project	HURRICANE CLIFFS RESERVOIR SITES - FOREBAY			Date	6/30/2009
Location / No.	TEST PIT FB-18 AT 6'			Technician	M. JOHNSON
Material Description	BROWN SILTY SAND	USCS	SM	Method	ASTM D 698

Procedure Used[1]	C
Classification Procedure[2]	Test

[1] A-No. 4 Sieve, B-3/8" Sieve, C-3/4" Sieve
[2] Visual as per ASTM D 2488, Test as per ASTM D 2487

Preparation Method	Moist
Rammer Used	Manual
As-Received Moisture Content (%)	8.4



Maximum Dry Density (pcf)	111.8
Optimum Moisture Content (%)	17.5
Corrected Maximum Density (pcf)	111.8
Corrected Optimum Moisture Content (%)	17.5

----- 100% Saturation Curve

Specific Gravity of Soil	2.65	Est.

OVERSIZE CORRECTION-ASTM D 4718

Specific Gravity of Soil +3/4	2.65	Est.
Percent Oversize	0.0	

Type of Specific Gravity is BULK Unless Otherwise Indicated

RB&G ENGINEERING, INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200804.007.1

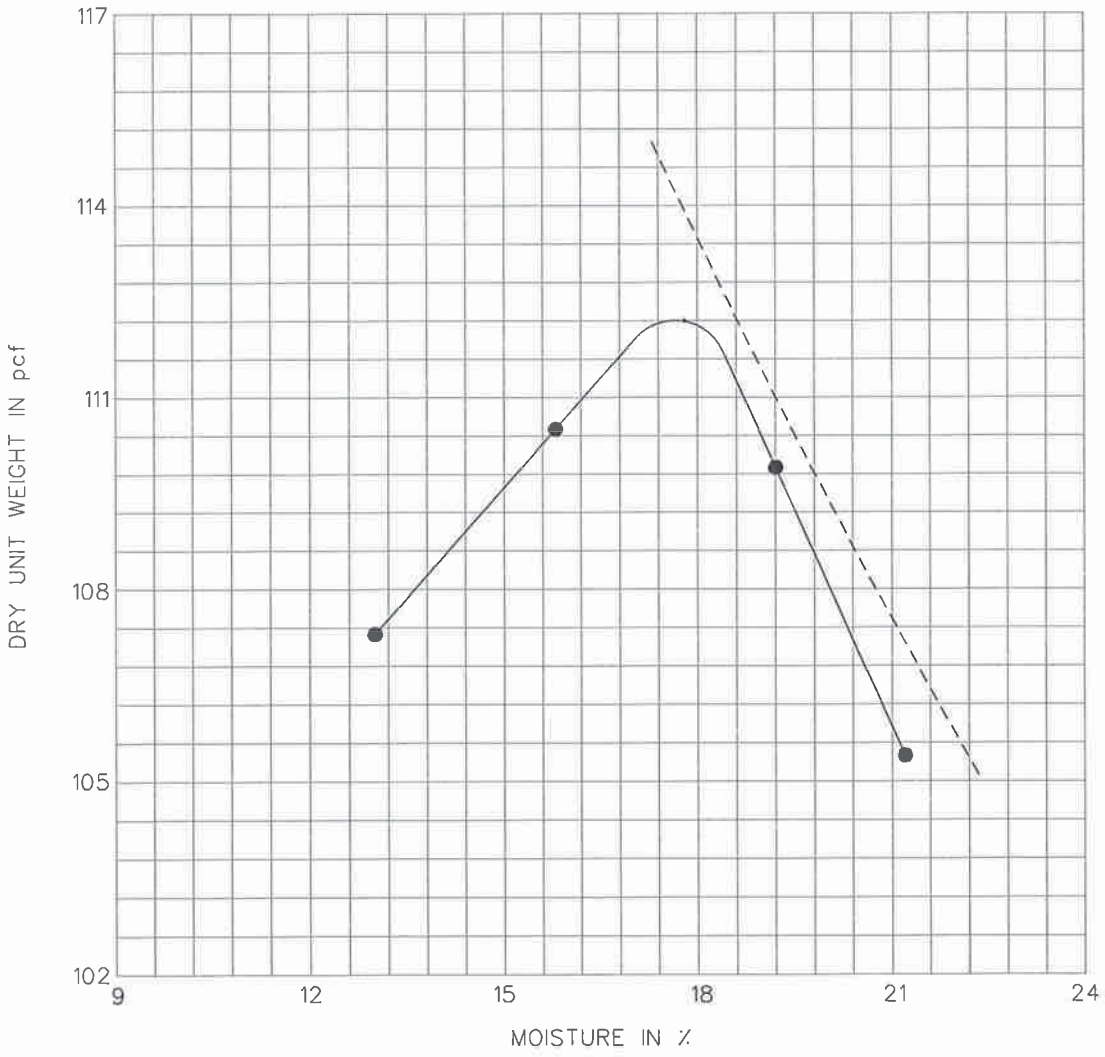
MOISTURE-DENSITY RELATION (PROCTOR)

Project	HURRICANE CLIFFS RESERVOIR SITES - FOREBAY			Date	6/25/2009
Location / No.	TEST PIT FB-19 AT 3'			Technicion	J. LINDO
Material Description	RED-BROWN SILTY CLAY	USCS	CL-ML	Method	ASTM D 698

Procedure Used[1]	A
Classification Procedure[2]	Test

[1] A-No. 4 Sieve, B-3/8" Sieve, C-3/4" Sieve
[2] Visual as per ASTM D 2488, Test as per ASTM D 2487

Preparation Method	Moist
Rammer Used	Manual
As-Received Moisture Content (%)	10.0



Maximum Dry Density (pcf)	112.2
Optimum Moisture Content (%)	17.8
Corrected Maximum Density (pcf)	**112.2**
Corrected Optimum Moisture Content (%)	**17.8**

----- 100% Saturation Curve

Specific Gravity of Soil	2.70	Est.

OVERSIZE CORRECTION-ASTM D 4718

Specific Gravity of Soil +3/4	2.70	Est.
Percent Oversize	0.0	

Type of Specific Gravity is BULK Unless Otherwise Indicated

RB&G ENGINEERING, INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200804.007.1

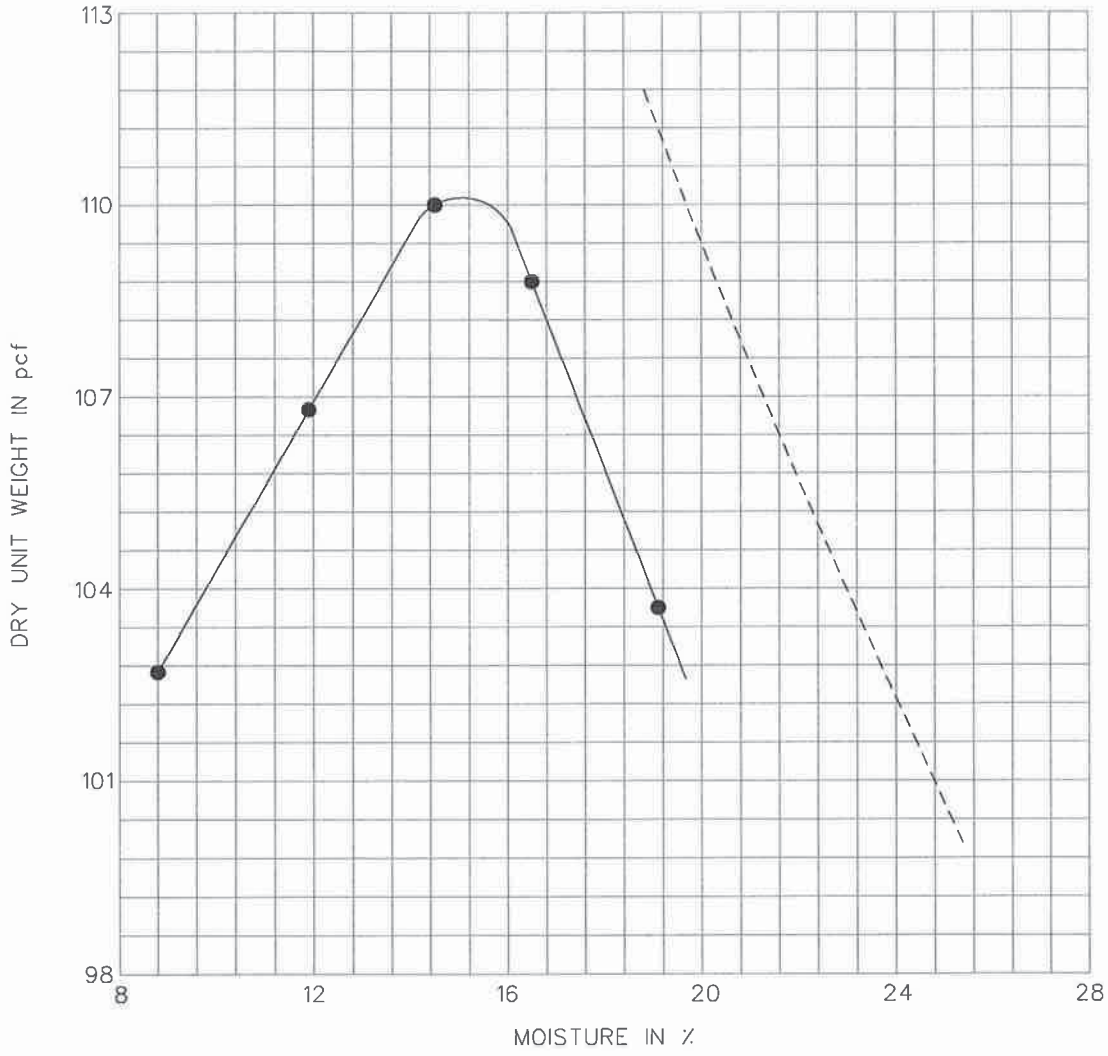
MOISTURE-DENSITY RELATION (PROCTOR)

Project	HURRICANE CLIFFS RESERVOIR SITES - FOREBAY			Date	10/29/09
Location / No.	TEST PIT FB-26			Technician	D. WALKER
Material Description	RED LEAN CLAY	USCS	CL-1	Method	ASTM D 698

Procedure Used[1]	A
Classification Procedure[2]	Test

[1] A-No. 4 Sieve, B-3/8" Sieve, C-3/4" Sieve
[2] Visual as per ASTM D 2488, Test as per ASTM D 2487

Preparation Method	Moist
Rammer Used	Manual
As-Received Moisture Content (%)	3.8



Maximum Dry Density (pcf)	110.0
Optimum Moisture Content (%)	14.5
Corrected Maximum Density (pcf)	**110.0**
Corrected Optimum Moisture Content (%)	**14.5**

– – – – – 100% Saturation Curve

Specific Gravity of Soil	2.70	Est.

OVERSIZE CORRECTION-ASTM D 4718

Specific Gravity of Soil +3/4	2.70	Est.
Percent Oversize	0.0	

Type of Specific Gravity is BULK Unless Otherwise Indicated

RB&G ENGINEERING, INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200804.007.1

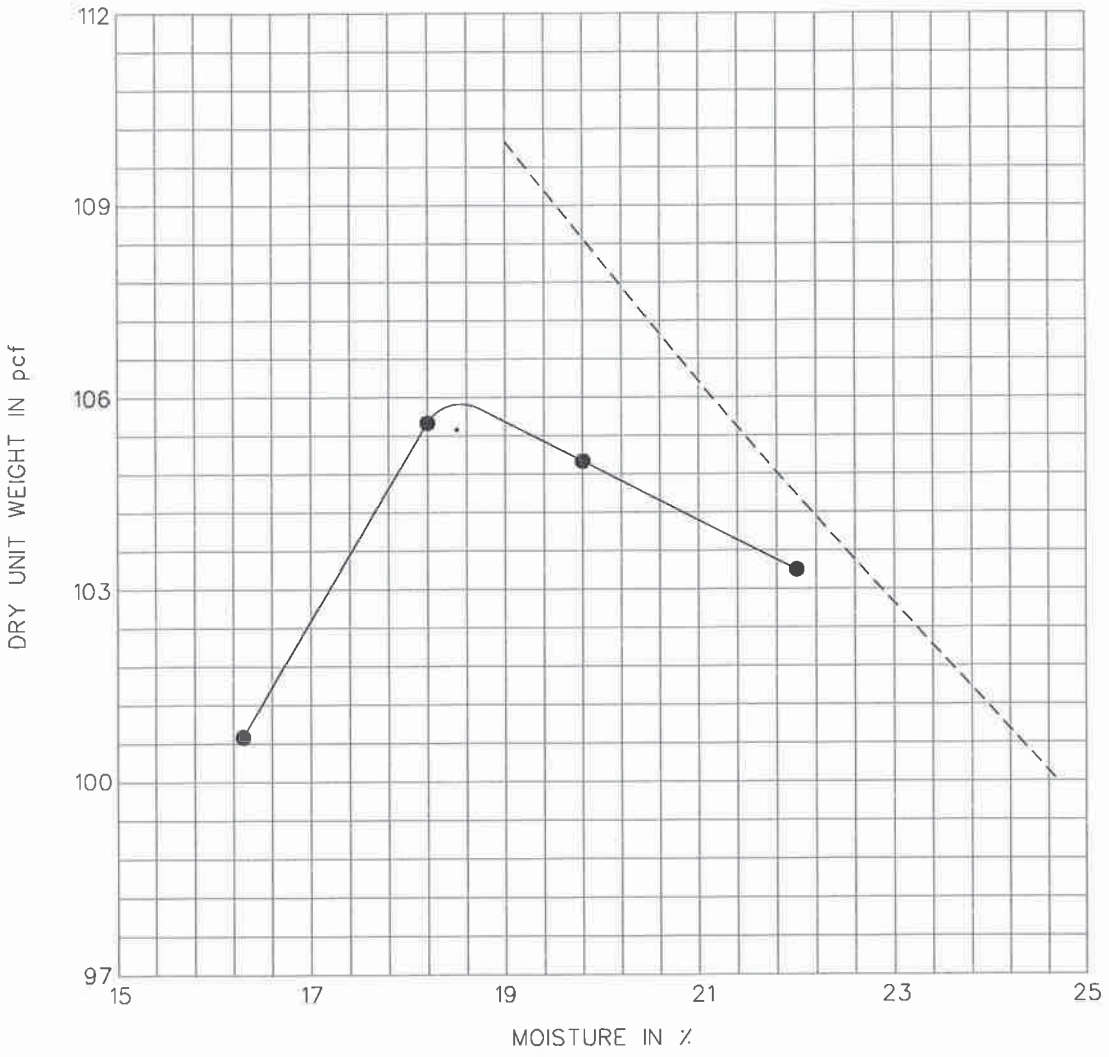
MOISTURE-DENSITY RELATION (PROCTOR)

Project	HURRICANE CLIFFS RESERVOIR SITES - FOREBAY			Date	6/26/2009
Location / No.	TEST PIT FB-35 AT 6'			Technician	K. MARTINEZ
Material Description	LT. BROWN SILTY CLAYEY SAND	USCS	SC-SM	Method	ASTM D 698

Procedure Used[1]	C
Classification Procedure[2]	Test

[1] A-No. 4 Sieve, B-3/8" Sieve, C-3/4" Sieve
[2] Visual as per ASTM D 2488, Test as per ASTM D 2487

Preparation Method	Moist
Rammer Used	Manual
As-Received Moisture Content (%)	3.2



Maximum Dry Density (pcf)	105.5
Optimum Moisture Content (%)	18.5
Corrected Maximum Density (pcf)	105.5
Corrected Optimum Moisture Content (%)	18.5

– – – – – 100% Saturation Curve

Specific Gravity of Soil	2.65	Est.

OVERSIZE CORRECTION-ASTM D 4718

Specific Gravity of Soil +3/4	2.65	Est.
Percent Oversize	0.0	

Type of Specific Gravity is BULK Unless Otherwise Indicated

RB&G ENGINEERING, INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200804.007.1

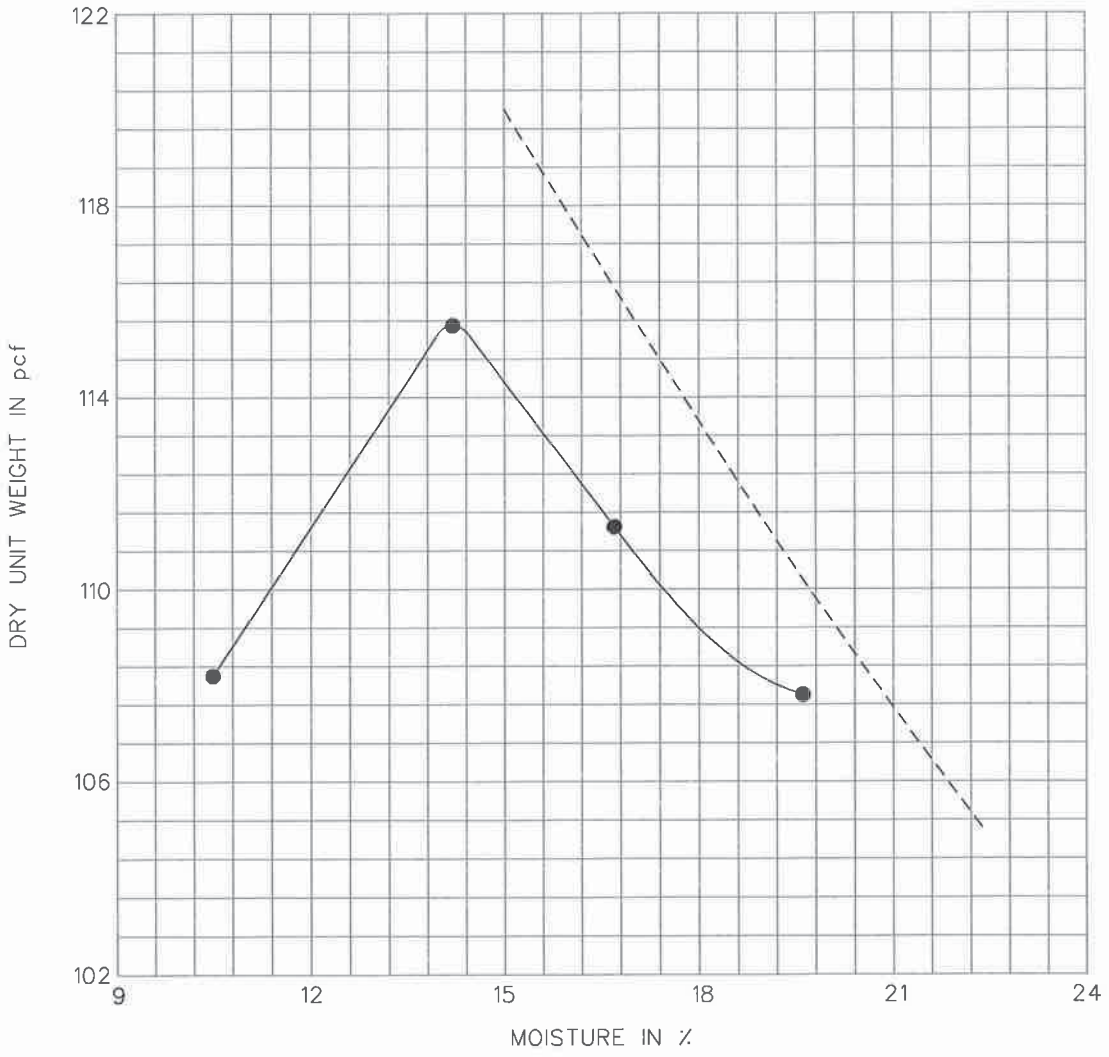
MOISTURE-DENSITY RELATION (PROCTOR)

Project	HURRICANE CLIFFS RESERVOIR SITES - FOREBAY			Date	6/30/2009
Location / No.	TEST PIT FB-39 AT 3'			Technician	M. JOHNSON
Material Description	LT. BROWN SANDY SILTY CLAY W/GRAVEL	USCS	CL-ML	Method	ASTM D 698

Procedure Used[1]	C
Classification Procedure[2]	Test

[1] A-No. 4 Sieve, B-3/8" Sieve, C-3/4" Sieve
[2] Visual as per ASTM D 2488, Test as per ASTM D 2487

Preparation Method	Moist
Rammer Used	Manual
As-Received Moisture Content (%)	5.5



Maximum Dry Density (pcf)	115.5
Optimum Moisture Content (%)	14.2
Corrected Maximum Density (pcf)	**117.6**
Corrected Optimum Moisture Content (%)	**13.6**

----- 100% Saturation Curve

Specific Gravity of Soil	2.70	Est.

OVERSIZE CORRECTION-ASTM D 4718

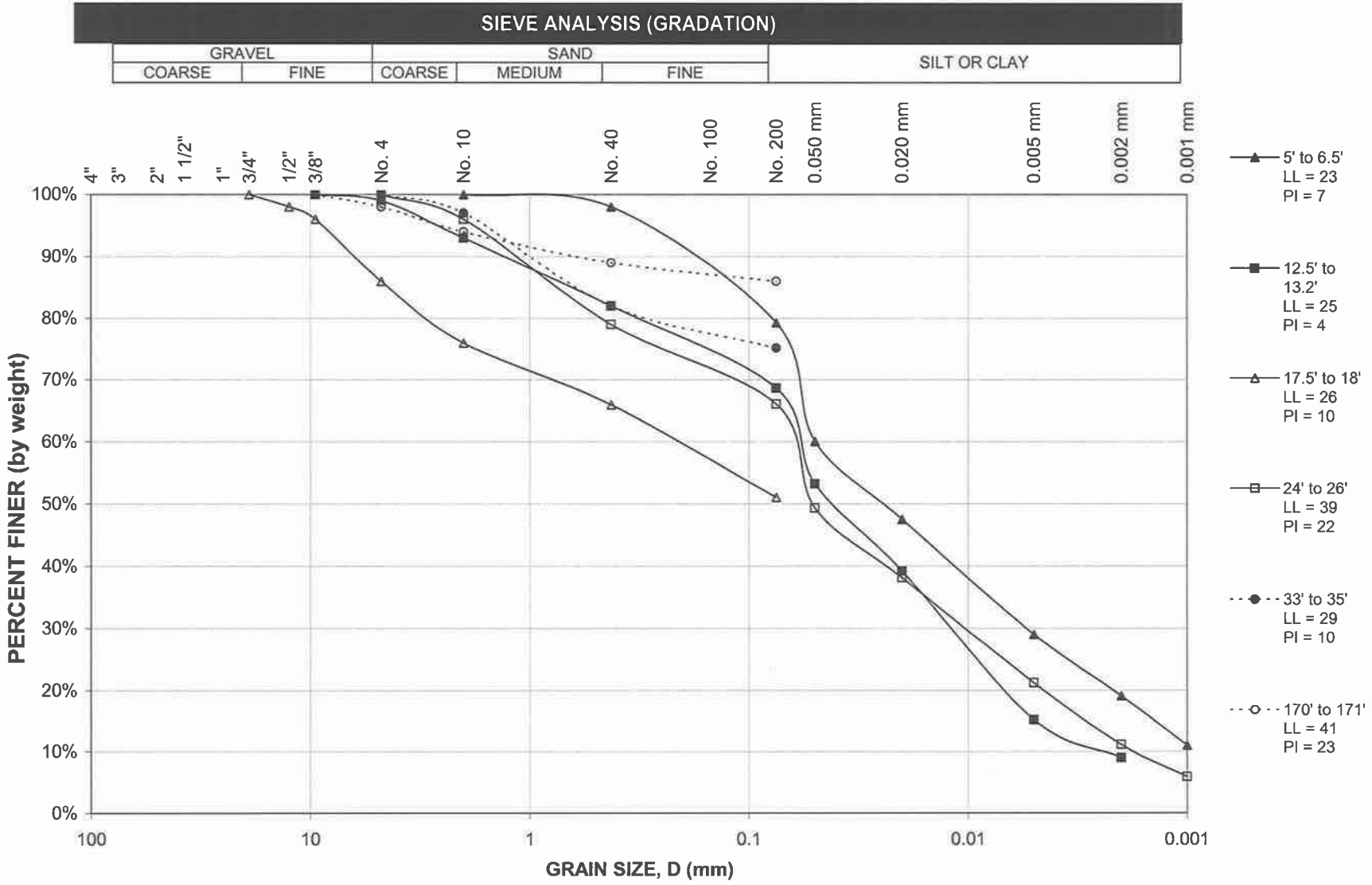
Specific Gravity of Soil +3/4	2.70	Est.
Percent Oversize	5.8	

Type of Specific Gravity is BULK Unless Otherwise Indicated

RB&G ENGINEERING, INC

Hurricane Cliffs Reservoir Sites, Fore Bay

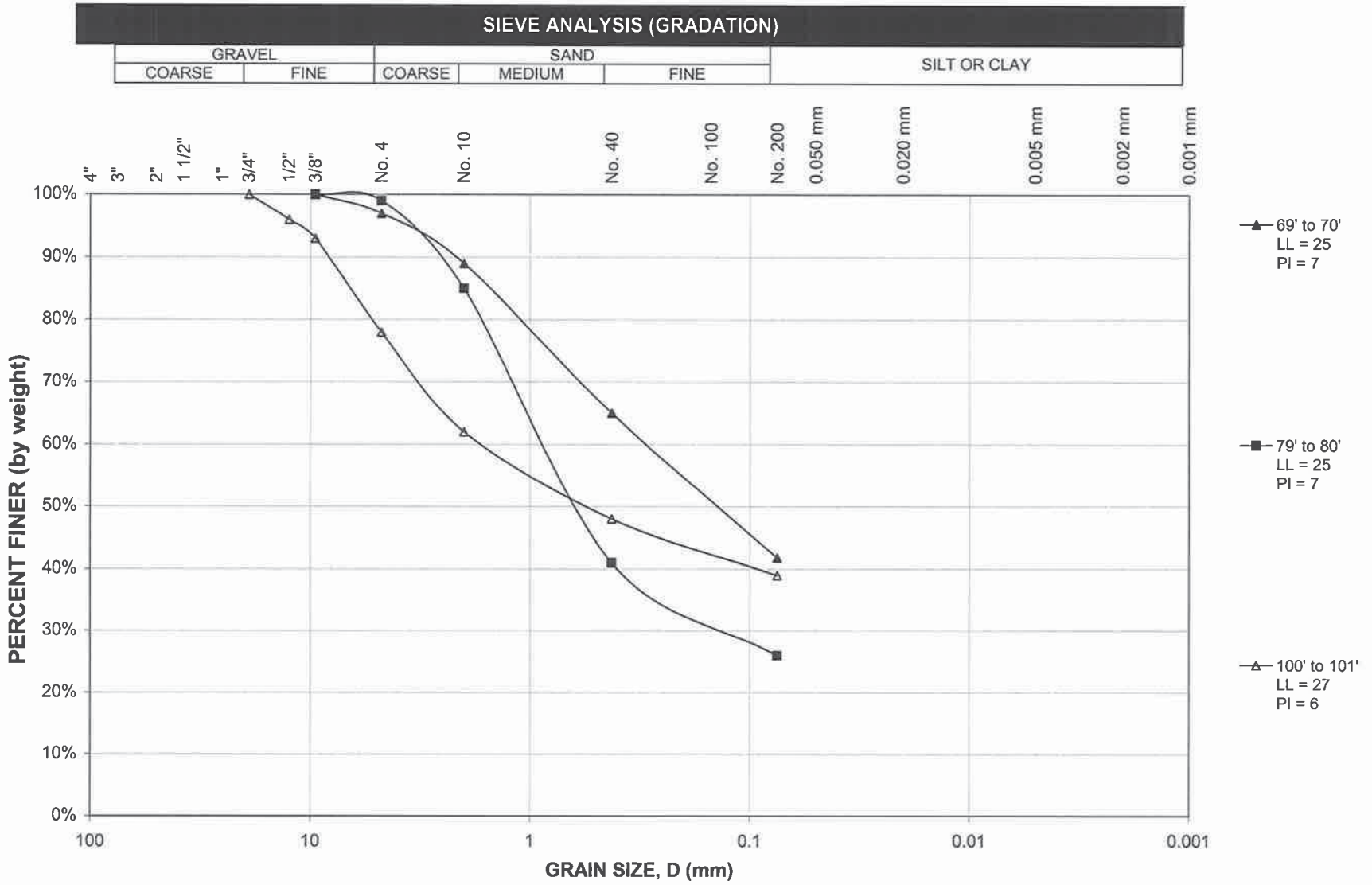
09-FB11



RB&G ENGINEERING, INC.

Hurricane Cliffs Reservoir Sites, Fore Bay

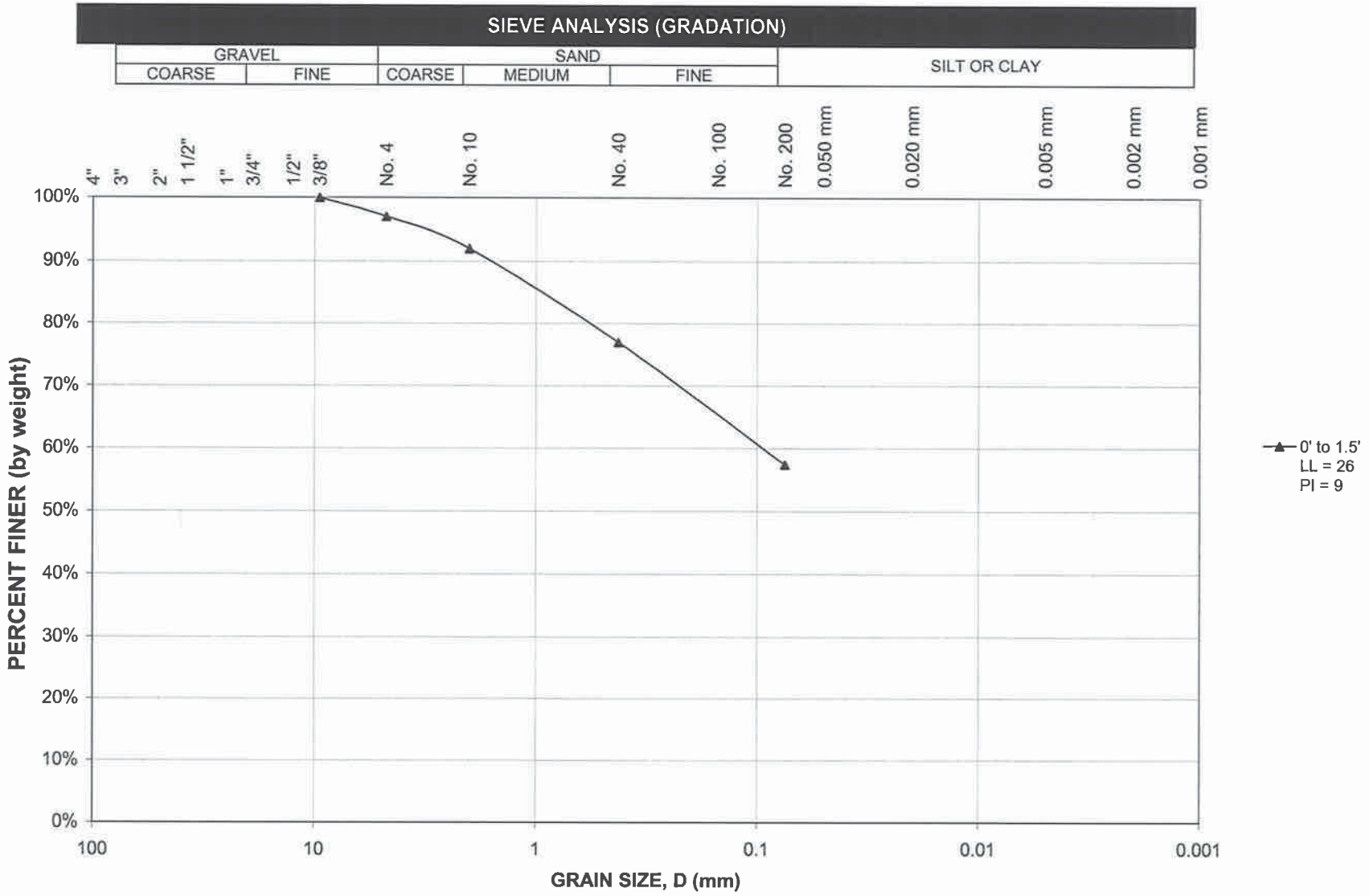
09-FB12



RB&G ENGINEERING, INC.

Hurricane Cliffs Reservoir Sites, Fore Bay

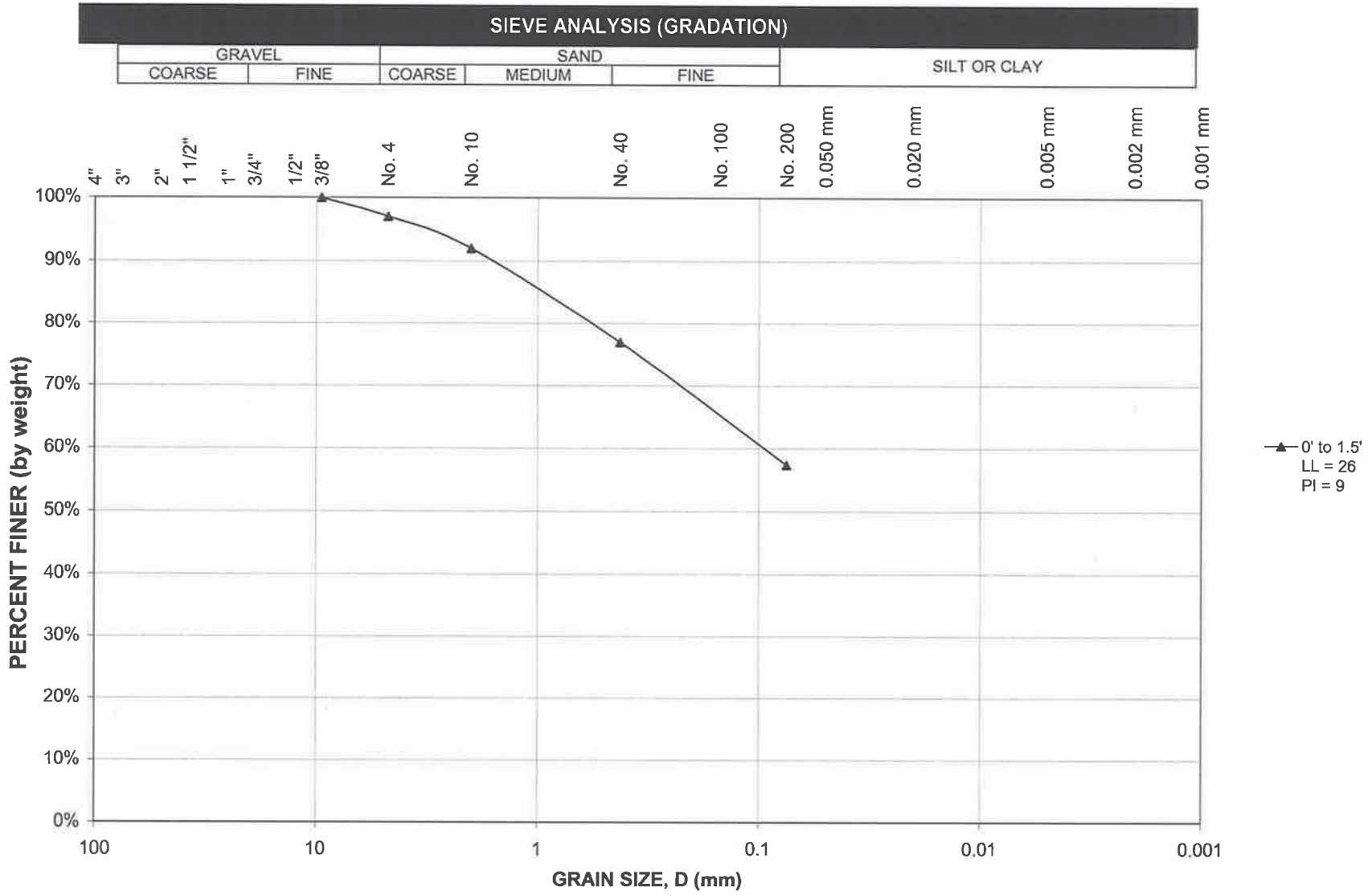
09-FB13



RB&G ENGINEERING, INC.

Hurricane Cliffs Reservoir Sites, Fore Bay

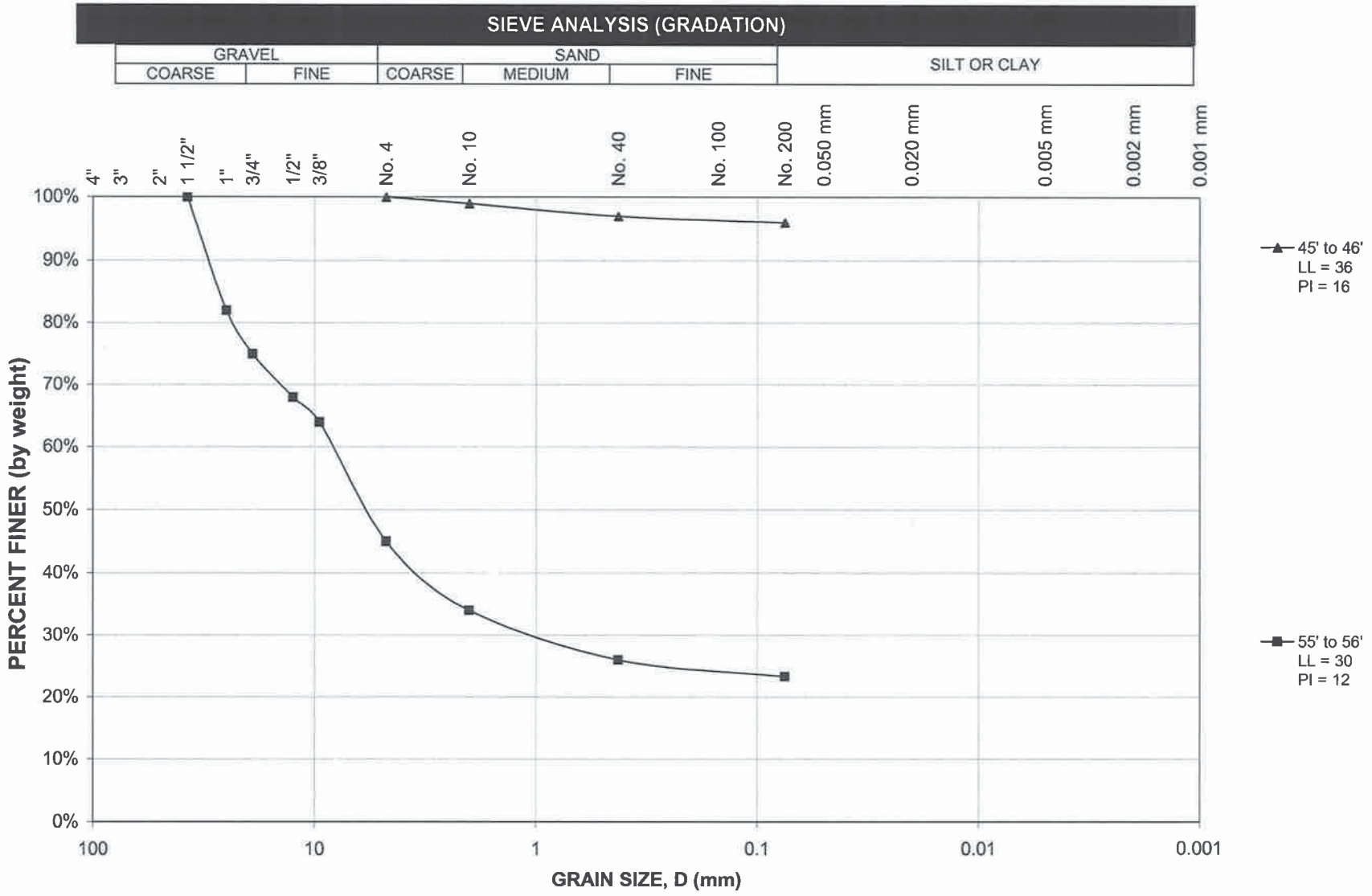
09-FB14



RB&G ENGINEERING, INC.

Hurricane Cliffs Reservoir Sites, Fore Bay

09-FB17



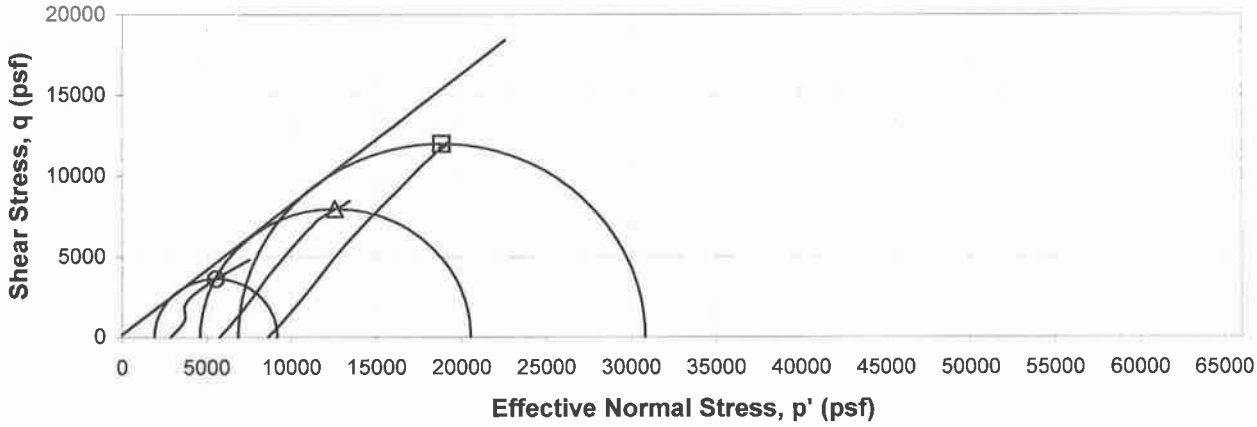
RB&G ENGINEERING INC.

MULTI-STAGE CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

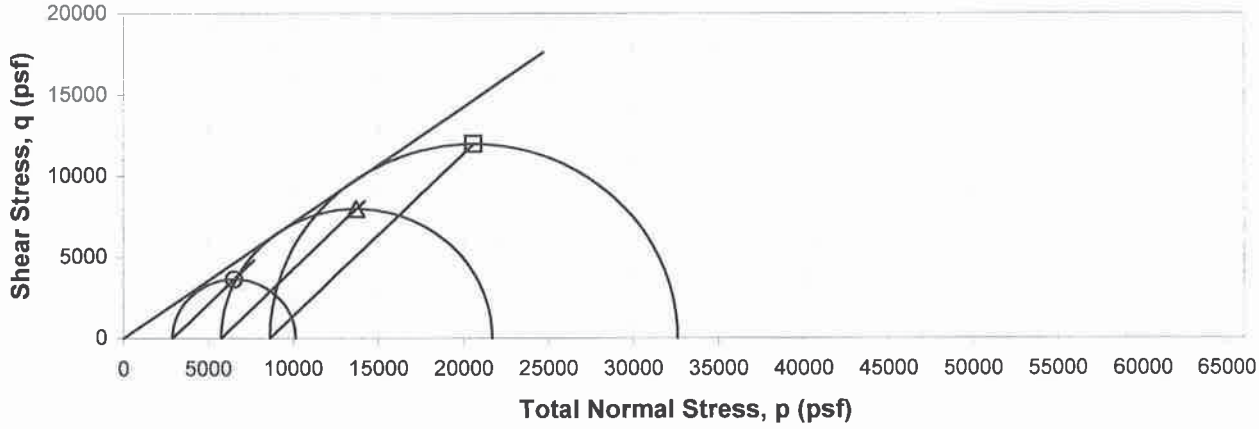
Project	HCH Forebay		
Project No.	200804-007	**Boring No**	FB-TP #26
Location	TP # 26	**Depth / Elev. (ft)**	3-4'
Date	10/31/09	**Sample Type**	Remolded
Tested By	J Boone	**Failure Criteria**	Max obliquity
Sample Description	Lean Clay CL-1: LL = 23, PI = 8		

Summary of Results		σ'_{consol} psf	$\sigma_{d,f}$* psf	ε_f	$\sigma'_{1,f}$* psf	$\sigma'_{3,f}$* psf
Stage 1	○	2884	7266	3.0%	9183	1917
Stage 2	Δ	5758	15937	8.2%	20546	4609
Stage 3	□	8639	23969	12.7%	30825	6856

Effective stress failure envelope **c'** = 156 psf ϕ' = 38.9°



Total stress failure envelope **c** = 0 psf ϕ = 35.4°



See page two for plots of deviator stress and pore water pressure versus strain.

*Values corrected for membrane effects
**A_c calculated according to ASTM D 4767 10.3.2.1 *Method A*

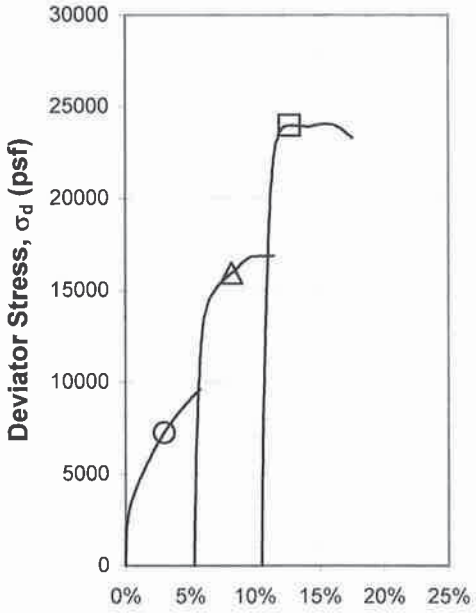
Tested in general accordance with **ASTM D 4767**

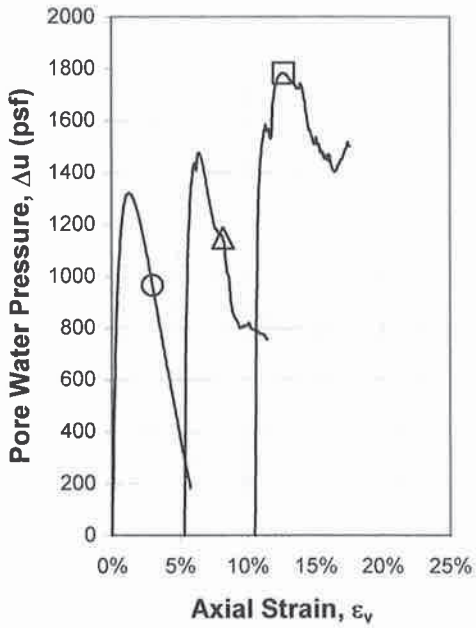
RB&G ENGINEERING, INC.

MULTI-STAGE CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

Project	HCH Forebay		
Project No.	200804-007	**Boring No**	FB-TP #26
Location	TP # 26	**Depth / Elev. (ft)**	3-4'
Date	10/31/09	**Sample Type**	Remolded
Tested By	J Boone	**Failure Criteria**	Max obliquity
Sample Description	Lean Clay CL-1: LL = 23, PI = 8		

Symbol			○	Δ	□	
Stage			1	2	3	
Vertical effective consolidation stress		σ'_c	2884	5758	8639	(psf)
Initial	**Height**	L_o	3.33	3.12	2.94	(in)
	Diameter	D_o	1.42	1.36	1.38	(in)
	Moisture	w_o	14.8%	13.4%	12.0%	
	Dry unit weight	γ_{do}	105.1	123.1	126.5	(pcf)
	Est. specific gravity	G_s	2.68	2.68	2.68	
	Void ratio	e_o	0.59	0.36	0.32	
	Saturation	S_o	67%	100%	100%	
After consolidation	**Moisture**	w	13.4%	12.0%	10.6%	
	Dry unit weight	γ_d	123.1	126.5	130.1	(pcf)
	Void ratio	e	0.359	0.322	0.285	
	Saturation	S	100%	100%	100%	
	Area	A_c	1.36	1.40	1.44	(in^2)
	Time to 50% consolidation	t_{50}	163.05	261.56	270.68	(min)
	B-value	B	0.97	-	-	
	Total back pressure		4898	8991	10651	(psf)
Results at Failure	**Deviator stress**	$\sigma_{d,f}$	7266	15937	23969	(psf)
	Major principal effective stress	σ'_1	9183	20546	30825	(psf)
	Minor principal effective stress	σ'_3	1917	4609	6856	(psf)
	Strain	ε_f	3.0%	8.2%	12.7%	
	Strain rate, /min		0.02%	0.02%	0.02%	
	Sketch at Failure					



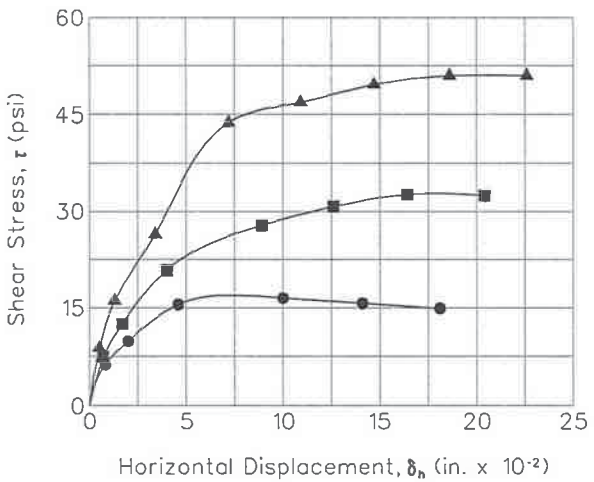


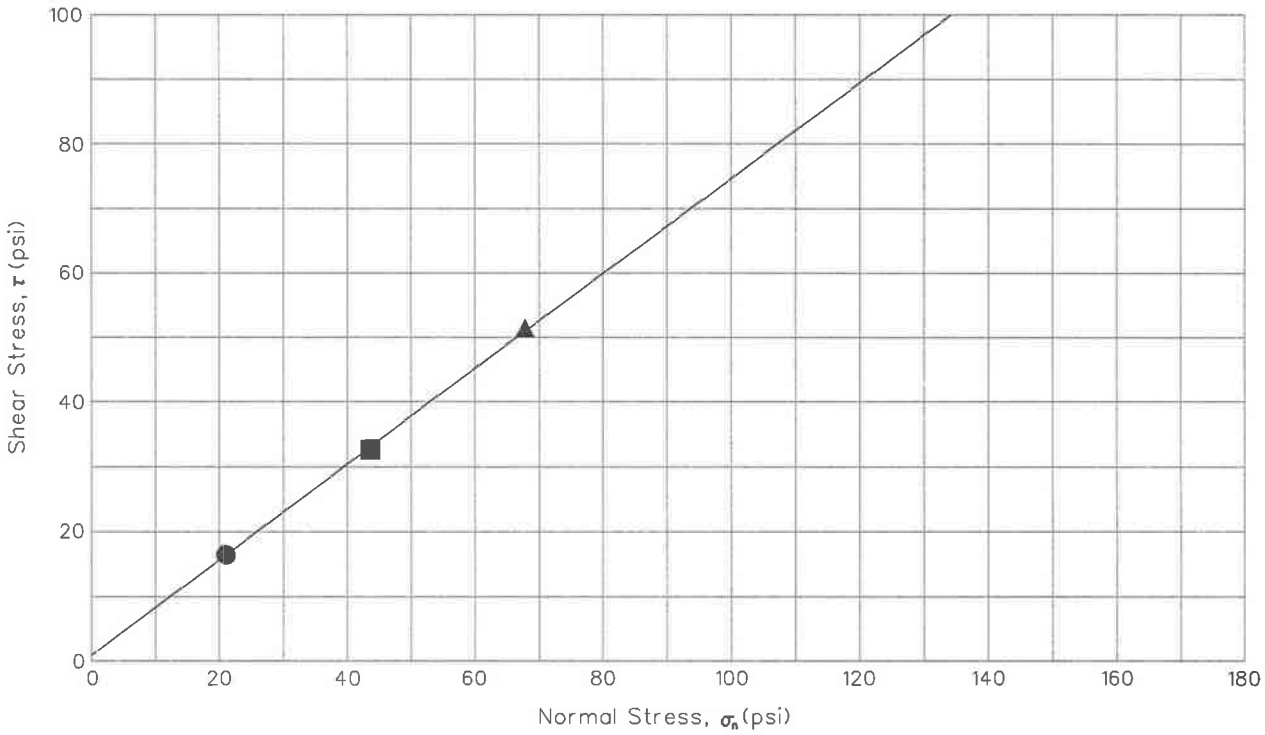
Remarks

*Values corrected for membrane effects

**A_c calculated according to ASTM D 4767 10.3.2.1 *Method A*

Tested in general accordance with **ASTM D 4767**





Test No. or Symbol	Sample Size (inches)	Sample Data		Degree of Saturation (%)	Normal Stress σn (psi)	Maximum Shear Stress τ (psi)	Strain Rate (inches/ minute)	Shear Strength Parameters	
		Dry Density (pcf)	Moisture Content (%)					Friction Angle φ (degrees)	Cohesion (c/psi)
●	2.375	105.6	14.8	~100	21.0	16.5	0.0006	36.4	1
■	2.375	105.8	15.0	~100	43.6	32.7	0.0006		
▲	2.375	105.3	15.0	~100	67.8	51.0	0.0006		

MATERIAL: LEAN CLAY, CL-1 (REMOLDED)

RB&G ENGINEERING, INC.

DIRECT SHEAR TEST

Project: *Hurricane Cliffs Reservoir Sites - Forebay*
Washington County, Utah

HOLE NO.: TP-FB-26

DEPTH: 3'-4'

Figure

DRAFT 09-FB-9 **Permeability Tests**

HCH Dam Site

June, 2009

MNH

Radius (in)	NQ	HQ
	1.49	1.89

3.782 D HQ3
2.938 rockbit

HCH Dam Site Forebay S Dam
Drill Hole 09-FB-9
60 deg dip Trend due west

DEPTH (ft.) on Angle	DEPTH (ft.) vert	Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)	summary>> Depth ft	Permeability ft./yr.	
			Water table			??? >	200.0						
0 - 8	0.0 - 6.9	161.2	0.0	0			0	6.93	3.46	1,939	0.0 - 8.0	1,939	
8 - 13	6.5 - 11.3	153.8	3.3	13			13	4.76	42.18	1,101	7.5 - 13.0	1,101	
13 - 23	11.3 - 19.9	125.2	3.3	13			13	8.66	48.89	2,667	13.0 - 23.0	2,667	
13 - 23	11.3 - 19.9	143.5	3.3	20	11		9	8.66	39.66	5,675	13.0 - 23.0	5,675	
13 - 23	11.3 - 19.9	126.5	3.3	13			13	8.66	48.89	2,804	13.0 - 23.0	2,804	
23 - 33	19.9 - 28.6	133.2	3.3	15	3		12	8.66	55.24	3,109	23.0 - 33.0	3,109	
23 - 33	19.9 - 28.6	129.0	3.3	29	17								
23 - 33	19.9 - 28.6	133.2	3.3	15	3		12	8.66	55.24	3,109	23.0 - 33.0	3,109	
33 - 43	28.6 - 37.2	169.1	3.3	18			18	8.66	77.75	559	33.0 - 43.0	559	
33 - 43	28.6 - 37.2	174.6	3.3	37			37	8.66	121.59	749	33.0 - 43.0	749	
33 - 43	28.6 - 37.2	169.1	3.3	18			18	8.66	77.75	559	33.0 - 43.0	559	
43 - 53	37.2 - 45.9	205.1	3.3	23			23	8.66	97.95	108	43.0 - 53.0	108	
43 - 53	37.2 - 45.9	214.6	3.3	45			45	8.66	148.72	170	43.0 - 53.0	170	
43 - 53	37.2 - 45.9	217.5	3.3	23			23	8.66	97.95	132	43.0 - 53.0	132	
53 - 59	45.9 - 51.1	103.3	3.3	25			25	5.2	109.49	708	53.0 - 59.0	708	
53 - 59	45.9 - 51.1	187.5	3.3	50			50	5.2	167.18	841	53.0 - 59.0	841	
53 - 59	45.9 - 51.1	111.67	3.3	25			25	5.2	109.49	797	53.0 - 59.0	797	opend
53 - 63	45.9 - 54.6	186.6	3.3	27			27	8.66	115.84	384	53.0 - 63.0	384	
53 - 63	45.9 - 54.6	222.0	3.3	55			55	8.66	180.45	631	53.0 - 63.0	631	
53 - 63	45.9 - 54.6	161.3	3.3	20			20	8.66	99.68	586	53.0 - 63.0	586	opend
63 - 73	54.6 - 63.2	170.1	3.3	32			32	8.66	136.04	266	63.0 - 73.0	266	
63 - 73	54.6 - 63.2	211.0	3.3	64			64	8.66	209.88	271	63.0 - 73.0	271	
63 - 73	54.6 - 63.2	177.1	3.3	32			32	8.66	136.04	293	63.0 - 73.0	293	opend
73 - 83	63.2 - 71.9	153.76	3.3	36			36	8.66	153.93	57	73.0 - 83.0	57	
73 - 83	63.2 - 71.9	232.71	3.3	70			70	8.66	232.39	60	73.0 - 83.0	60	
73 - 83	63.2 - 71.9	153.93	3.3	36			36	8.66	153.93	71	73.0 - 83.0	71	opend
83 - 93	71.9 - 80.5	194.3	3.3	40			40	8.66	171.82	102	83.0 - 93.0	102	
83 - 93	71.9 - 80.5	264.0	3.3	80			80	8.66	264.13	118	83.0 - 93.0	118	
83 - 93	71.9 - 80.5	171.82	3.3	40			40	8.66	171.82	135	83.0 - 93.0	135	opend
93 - 103	80.5 - 89.2	212.3	3.3	44			44	8.66	189.71	33	93.0 - 103.0	33	
93 - 103	80.5 - 89.2	280.0	3.3	80			80	8.66	272.79	95	93.0 - 103.0	95	
93 - 103	80.5 - 89.2	189.71	3.3	44			44	8.66	189.71	95	93.0 - 103.0	95	opend
103 - 113	89.2 - 97.9	153.2	3.3	24	20		4	8.66	106.06	2,595	103.0 - 113.0	2,595	
113 - 128	97.9 - 110.9	154.0	3.3	24	20		4	13	116.89	1,755	113.0 - 128.0	1,755	
128 - 138	110.9 - 119.5	151.0	3.3	20	20		0	8.66	118.48	2,227	128.0 - 138.0	2,227	
138 - 148	119.5 - 128.2	142.7	3.3	18	10		8	8.66	145.60	1,517	138.0 - 148.0	1,517	
138 - 148	119.5 - 128.2	150.0	3.3	24	19		5	8.66	138.68	1,865	138.0 - 148.0	1,865	
138 - 148	119.5 - 128.2	142.7	3.3	18	10		8	8.66	145.60	1,517	138.0 - 148.0	1,517	
148 - 158	128.2 - 136.8	0.25	3.3	70			70	8.66	297.34	4	148.0 - 158.0	4	
148 - 158	128.2 - 136.8	0.05	3.3	100			100	8.66	366.57	1	148.0 - 158.0	1	lower at 100psi
148 - 158	128.2 - 136.8	0.1	3.3	70			70	8.66	297.34	2	148.0 - 158.0	2	
148 - 158	128.2 - 136.8	0.0	3.3	30			30	8.66	205.03	0	148.0 - 158.0	0	
158 - 168	136.8 - 145.5	4.8	3.3	30			30	8.66	213.69	116	158.0 - 168.0	116	
158 - 168	136.8 - 145.5	8.2	3.3	70			70	8.66	306.00	139	158.0 - 168.0	139	
158 - 168	136.8 - 145.5	9.5	3.3	100			100	8.66	375.23	131	158.0 - 168.0	131	
158 - 168	136.8 - 145.5	8.1	3.3	70			70	8.66	306.00	137	158.0 - 168.0	137	
158 - 168	136.8 - 145.5	5.9	3.3	30			30	8.66	213.69	143	158.0 - 168.0	143	
168 - 178	145.5 - 154.2	155.3	3.3	52			52	8.66	273.12	294	168.0 - 178.0	294	
168 - 178	145.5 - 154.2	210.0	3.3	100			100	8.66	383.89	283	168.0 - 178.0	283	10 gal back flow
168 - 178	145.5 - 154.2	174.0	3.3	52			52	8.66	273.12	322	168.0 - 178.0	322	opend 3 gal back flow
178 - 188	154.2 - 162.8	0.0	3.3	70			70	8.66	323.32	0	178.0 - 188.0	0	
178 - 188	154.2 - 162.8	0.0	3.3	150			150	8.66	507.94	0	178.0 - 188.0	0	starting to move packer
178 - 188	154.2 - 162.8	0.0	3.3	70			70	8.66	323.32	0	178.0 - 188.0	0	w/ 300psi nitog

09-FB-10

HCH Dam Site

Permeability Tests

June, 2009

	NQ	HQ
Radius (in)	1.5	1.89

3.782 D HQ3
2.938 rockbit

HCH Dam Site Fore Drill Hole	Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)	summary>> Depth ft	Permeability ft./yr.	
09-FB-10		Water table			??? >	118.0						
60 deg dip Trend due west on Angle												
0 - 7	0.4	0.0	0			0	6.06	3.03	868	0.0 - 7.0	868	
7 - 17	2.0	4.0	0			0	8.66	14.39	7,800	7.0 - 17.0	7,800	
17 - 27	24.0	4.0	5			5	8.66	34.59	3,590	17.0 - 27.0	3,590	
27 - 37	9.4	4.0	15			15	8.66	66.33	733	27.0 - 37.0	733	
27 - 37	15.2	4.0	32			32	8.66	105.56	745	27.0 - 37.0	745	
27 - 37	10.6	4.0	15			15	8.66	66.33	827	27.0 - 37.0	827	
37 - 47	11.5	4.0	20			20	8.66	86.53	688	37.0 - 47.0	688	
37 - 47	21.0	4.0	40			40	8.66	132.68	819	37.0 - 47.0	819	opend
37 - 47	16.0	4.0	20			20	8.66	86.53	957	37.0 - 47.0	957	
47 - 57	>50.0	4.0	20	20		0	8.66	49.03	5,276	47.0 - 57.0	5,276	max flow
50 - 57	>50.0	1.0	20	20		0	6.06	47.33	7,112	50.0 - 57.0	7,112	max
57 - 67	0.15	3.7	25			25	8.66	115.09	7	57.0 - 67.0	7	
57 - 67	0.8	3.7	50			50	8.66	172.78	24	57.0 - 67.0	24	
57 - 67	0.15	3.7	25			25	8.66	115.09	7	57.0 - 67.0	7	
67 - 77	>49.5	3.7	24	17		7	8.66	82.21	3,115	67.0 - 77.0	3,115	
77 - 87	>50.0	3.7	20	20		0	8.66	74.71	3,462	77.0 - 87.0	3,462	max
87 - 97	>50.0	3.7	21	20		1	8.66	85.68	3,019	87.0 - 97.0	3,019	max
97 - 107	>51.0	3.7	22	20		2	8.66	96.65	2,730	97.0 - 107.0	2,730	max
107 - 117	0.4	3.7	50			50	8.66	216.08	10	107.0 - 117.0	10	
107 - 117	1.0	3.7	100			100	8.66	331.46	16	107.0 - 117.0	16	
107 - 117	0.4	3.7	50			50	8.66	216.08	10	107.0 - 117.0	10	

DRAFT 09-FB-11 **Permeability Tests**

HCH Dam Site

May, 2009

MNH

	HQ
Radius (in)	1.89

3.782 D HQ3
2.938 rockbit

HCH Dam Site Drill Hole	DEPTH (ft.)		Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)	summary>> Depth ft.	Permeability ft./yr.
09-FB-11				Water table			>	164.2	?				
60 deg dip on Angle													
0 - 7	0.0	- 6.1	0.3	0.0	0			0	6.06	3.03	625	0.0 - 7.0	625
0 - 17	0.0	- 14.7	1.1	0.0	10			10	14.7	30.44	126	0.0 - 17.0	126
0 - 22	0.0	- 19.1	6.1	0.0	12			12	19.1	37.22	463	0.0 - 22.0	463
27 - 37	23.4	- 32.0	20.0	3.4	10			10	8.66	54.19	1,909	27.0 - 37.0	1,909
27 - 37	23.4	- 32.0	30.0	3.4	20			20	8.66	77.27	2,009	27.0 - 37.0	2,009
27 - 37	23.4	- 32.0	20.0	3.4	10			10	8.66	54.19	1,909	27.0 - 37.0	1,909
37 - 47	32.0	- 40.7	2.3	3.4	12			12	8.66	67.47	176	37.0 - 47.0	176
37 - 47	32.0	- 40.7	2.9	3.4	25			25	8.66	97.47	154	37.0 - 47.0	154
37 - 47	32.0	- 40.7	2.5	3.4	12			12	8.66	67.47	192	37.0 - 47.0	192
47 - 57	40.7	- 49.4	0.0	3.4	30			30	8.66	117.66	0	47.0 - 57.0	0
47 - 57	40.7	- 49.4	0.3	3.4	50			50	8.66	163.82	9	47.0 - 57.0	9
47 - 57	40.7	- 49.4	0.0	3.4	30			30	8.66	117.66	0	47.0 - 57.0	0
57 - 67	49.4	- 58.0	0.65	3.4	33			33	8.66	133.25	25	57.0 - 67.0	25
57 - 67	49.4	- 58.0	1.4	3.4	58			58	8.66	190.94	38	57.0 - 67.0	38
57 - 67	49.4	- 58.0	1.0	3.4	33			33	8.66	133.25	39	57.0 - 67.0	39
67 - 77	58.0	- 66.7	3.0	3.4	19			19	8.66	109.60	142	67.0 - 77.0	142
67 - 77	58.0	- 66.7	5.8	3.4	38			38	8.66	153.45	196	67.0 - 77.0	196
67 - 77	58.0	- 66.7	5.0	3.4	19			19	8.66	109.60	236	67.0 - 77.0	236
77 - 87	66.7	- 75.3	> 52.0	3.4	21	20		1	8.66	76.72	3,506	77.0 - 87.0	> 3,506 max flow
87 - 97	75.3	- 84.0	52.5	3.4	23	20		3	8.66	90.00	3,018	87.0 - 97.0	3,018
97 - 107	84.0	- 92.7	51.5	3.4	25	20		5	8.66	103.27	2,580	97.0 - 107.0	2,580
107 - 117	92.7	- 101.3	25.0	3.4	29			29	8.66	167.32	773	107.0 - 117.0	773
107 - 117	92.7	- 101.3	41.0	3.4	53	9		44	8.66	201.93	1,050	107.0 - 117.0	1,050
107 - 117	92.7	- 101.3	47.0	3.4	70	15		55	8.66	227.32	1,070	107.0 - 117.0	1,070
107 - 117	92.7	- 101.3	36.0	3.4	29	5		24	8.66	155.78	1,196	107.0 - 117.0	1,196
117 - 127	101.3	- 110.0	52.0	3.4	25	20		5	8.66	120.59	2,231	117.0 - 127.0	2,231
127 - 137	110.0	- 118.6	1.8	3.4	68			68	8.66	274.64	34	127.0 - 137.0	34
127 - 137	110.0	- 118.6	1.5	3.4	34			34	8.66	196.18	40	127.0 - 137.0	40
137 - 145.7	118.6	- 126.2	52.5	3.4	34	20		14	7.53	158.12	1,906	137.0 - 145.7	1,906
147 - 157	127.3	- 136.0	52.5	3.4	34	20		14	8.66	167.34	1,623	147.0 - 157.0	1,623
157 - 167	136.0	- 144.6	51.0	3.4	34	19		15	8.66	178.31	1,480	157.0 - 167.0	1,480
167 - 177	144.6	- 153.3	51.0	3.4	34	19		15	8.66	186.97	1,411	167.0 - 177.0	1,411
177 - 189.5	153.3	- 164.1	51.5	3.4	34	20		14	10.8	194.41	1,157	177.0 - 189.5	1,157

DRAFT 09-FB-12 **Permeability Tests**

HCH Dam Site

July, 2009

MNH

Radius (in)	NQ	HQ
	1.49	1.89

3.782 D HQ3
2.938 rockbit

HCH Dam Site Forebay S Dam
Drill Hole 09-FB-12
65 deg dip Trend S 88 W 25 deg from vert

DEPTH (ft.) on Angle	DEPTH (ft.) vert depth	Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (m)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)	summary>> Depth ft	Permeability ft./yr.	
			Water table			??? >	239.0						
8 - 18	7.3 - 16.3	50.0	3.0	20	18		2	9.06	19.40	12,887	8.0 - 18.0	12,887	max flow
28 - 38	25.4 - 34.4	50.0	3.0	20	18		2	9.06	37.52	6,662	28.0 - 38.0	6,662	
37 - 48	33.5 - 43.5	9.0	3.8	20			20	9.97	88.47	473	37.0 - 48.0	473	
37 - 48	33.5 - 43.5	13.2	3.8	40			40	9.97	134.63	456	37.0 - 48.0	456	
37 - 48	33.5 - 43.5	9.0	3.8	20			20	9.97	88.47	473	37.0 - 48.0	473	
48 - 58	43.5 - 52.6	46.0	3.0	20	14		6	9.06	64.88	3,545	48.0 - 58.0	3,545	
48 - 58	43.5 - 52.6	49.0	3.0	38	17		21	9.06	99.50	2,462	48.0 - 58.0	2,462	
48 - 58	43.5 - 52.6	40.0	3.0	20	8		12	9.06	78.73	2,540	48.0 - 58.0	2,540	
58 - 68	52.6 - 61.6	50.5	3.0	20	18		2	9.06	64.71	3,902	58.0 - 68.0 >	3,902	max flow
68 - 78	61.6 - 70.7	50.0	3.0	28	18		10	9.06	92.24	2,710	68.0 - 78.0	2,710	
78 - 88	70.7 - 79.8	0.2	3.0	40			40	9.06	170.53	6	78.0 - 88.0	6	
78 - 88	70.7 - 79.8	0.0	3.0	80			80	9.06	262.84	0	78.0 - 88.0	0	
78 - 88	70.7 - 79.8	0.0	3.0	40			40	9.06	170.53	0	78.0 - 88.0	0	
88 - 98	79.8 - 88.8	0.3	3.0	44			44	9.06	188.83	8	88.0 - 98.0	8	
88 - 98	79.8 - 88.8	0.3	3.0	88			88	9.06	290.36	5	88.0 - 98.0	5	
88 - 98	79.8 - 88.8	0.2	3.0	44			44	9.06	188.83	5	88.0 - 98.0	5	
98 - 108	88.8 - 97.9	0.2	3.0	49			49	9.06	209.43	5	98.0 - 108.0	5	
98 - 108	88.8 - 97.9	0.0	3.0	98			98	9.06	322.50	0	98.0 - 108.0	0	no take
98 - 108	88.8 - 97.9	0.2	3.0	49			49	9.06	209.43	5	98.0 - 108.0	5	
108 - 118	97.9 - 106.9	0.3	3.0	53			53	9.06	227.72	7	108.0 - 118.0	7	
108 - 118	97.9 - 106.9	0.3	3.0	107			107	9.06	352.34	4	108.0 - 118.0	4	
108 - 118	97.9 - 106.9	0.3	3.0	53			53	9.06	227.72	7	108.0 - 118.0	7	
118 - 128	106.9 - 116.0	0.8	3.0	60			60	9.06	252.94	16	118.0 - 128.0	16	
118 - 128	106.9 - 116.0	1.2	3.0	115			115	9.06	379.86	16	118.0 - 128.0	16	
118 - 128	106.9 - 116.0	0.8	3.0	60			60	9.06	252.94	16	118.0 - 128.0	16	
128 - 138	116.0 - 125.1	1.5	3.0	65			65	9.06	273.54	27	128.0 - 138.0	27	
128 - 138	116.0 - 125.1	2.3	3.0	125			125	9.06	412.00	28	128.0 - 138.0	28	
128 - 138	116.0 - 125.1	1.6	3.0	65			65	9.06	273.54	29	128.0 - 138.0	29	
138 - 148	125.1 - 134.1	0.7	3.0	67			67	9.06	287.22	12	138.0 - 148.0	12	
138 - 148	125.1 - 134.1	1.2	3.0	130			130	9.06	432.60	14	138.0 - 148.0	14	
138 - 148	125.1 - 134.1	0.8	3.0	67			67	9.06	287.22	14	138.0 - 148.0	14	
148 - 158	134.1 - 143.2	0.4	3.0	70			70	9.06	303.20	7	148.0 - 158.0	7	
148 - 158	134.1 - 143.2	0.5	3.0	135			135	9.06	453.20	6	148.0 - 158.0	6	
148 - 158	134.1 - 143.2	0.4	3.0	70			70	9.06	303.20	7	148.0 - 158.0	7	
158 - 168	143.2 - 152.3	0.5	3.0	75			75	9.06	323.81	8	158.0 - 168.0	8	
158 - 168	143.2 - 152.3	0.5	3.0	125			125	9.06	439.19	6	158.0 - 168.0	6	
158 - 168	143.2 - 152.3	0.5	3.0	75			75	9.06	323.81	8	158.0 - 168.0	8	
168 - 178	152.3 - 161.3	0.8	3.0	80			80	9.06	344.41	12	168.0 - 178.0	12	
168 - 178	152.3 - 161.3	1.4	3.0	130			130	9.06	459.79	15	168.0 - 178.0	15	
168 - 178	152.3 - 161.3	0.8	3.0	180			180	9.06	575.18	7	168.0 - 178.0	7	
178 - 188	161.3 - 170.4	1.3	3.0	85			85	9.06	365.01	18	178.0 - 188.0	18	
178 - 188	161.3 - 170.4	1.7	3.0	125			125	9.06	457.32	19	178.0 - 188.0	19	
178 - 188	161.3 - 170.4	1.4	3.0	85			85	9.06	365.01	19	178.0 - 188.0	19	
188 - 198	170.4 - 179.4	0.0	3.0	90			90	9.06	385.61	0	188.0 - 198.0	0	
188 - 198	170.4 - 179.4	0.0	3.0	120			120	9.06	454.84	0	188.0 - 198.0	0	
188 - 198	170.4 - 179.4	0.0	3.0	90			90	9.06	385.61	0	188.0 - 198.0	0	
198 - 218	179.4 - 197.6	0.5	3.0	100			100	18.1	422.28	3	198.0 - 218.0	3	
198 - 218	179.4 - 197.6	0.9	3.0	120			120	18.1	468.44	6	198.0 - 218.0	6	
198 - 218	179.4 - 197.6	0.5	3.0	100			100	18.1	422.28	3	198.0 - 218.0	3	
218 - 238	197.6 - 215.7	0.35	3.0	75			75	18.1	382.72	3	218.0 - 238.0	3	
218 - 238	197.6 - 215.7	0.7	3.0	160			160	18.1	578.87	4	218.0 - 238.0	4	
218 - 238	197.6 - 215.7	0.35	3.0	75			75	18.1	382.72	3	218.0 - 238.0	3	

DRAFT 09-FB-15 **Permeability Tests**

HCH Dam Site

July, 2009

MNH

	NQ	HQ
Radius (in)	1.48	1.89

3.782 D HQ3
2.938 rockbit

HCH Dam Site Drill Hole HQ 09-FB-15	DEPTH (ft.)	Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)	summary>> Depth ft.	Permeability ft./yr.
	Water table >						68.0					
60 deg dip on Angle												
0 - 13	0.0 - 11.3	0.5	0.0	0			0	11.3	5.63	354	0.0 - 13.0	354
13 - 23	11.3 - 19.9	16.7	3.0	10			10	8.66	41.67	2,074	13.0 - 23.0	2,074
13 - 23	11.3 - 19.9	25.0	3.0	20			20	8.66	64.74	1,998	13.0 - 23.0	1,998
13 - 23	11.3 - 19.9	18.0	3.0	10			10	8.66	41.67	2,235	13.0 - 23.0	2,235
23 - 33	19.9 - 28.6	2.7	3.0	14			14	8.66	59.56	235	23.0 - 33.0	235
23 - 33	19.9 - 28.6	4.9	3.0	29			29	8.66	94.17	269	23.0 - 33.0	269
23 - 33	19.9 - 28.6	3.5	3.0	14			14	8.66	59.56	304	23.0 - 33.0	304
33 - 43	28.6 - 37.2	45.0	3.0	13	13		0	8.66	35.91	6,483	33.0 - 43.0	6,483
33 - 43	28.6 - 37.2	51.5	3.0	20	20		0	8.66	35.91	7,420	33.0 - 43.0 >	7,420 max flow
33 - 43	28.6 - 37.2	45.0	3.0	13	13		0	8.66	35.91	6,483	33.0 - 43.0	6,483
43 - 50	37.2 - 43.3	12.4	3.0	20			20	6.06	89.42	934	43.0 - 50.0	934
43 - 50	37.2 - 43.3	17.3	3.0	43			43	6.06	142.50	817	43.0 - 50.0	817
43 - 50	37.2 - 43.3	12.5	3.0	20			20	6.06	89.42	941	43.0 - 50.0	941
	0.0 - 0.0											
48 - 58	41.6 - 50.2	0.0	3.0	25			25	8.66	106.59	0	48.0 - 58.0	0
48 - 58	41.6 - 50.2	0.0	3.0	50			50	8.66	164.28	0	48.0 - 58.0	0
48 - 58	41.6 - 50.2	0.0	3.0	60			60	8.66	187.36	0	48.0 - 58.0	0
58 - 68	50.2 - 58.9	50.0	3.0	19	18		1	8.66	59.87	4,321	58.0 - 68.0	4,321
58 - 68	50.2 - 58.9	52.0	3.0	20	20		0	8.66	57.56	4,674	58.0 - 68.0 >	4,674 max flow
68 - 78	58.9 - 67.5	50.0	7.7	18	18		0	8.66	70.92	3,647	68.0 - 78.0	3,647 ~max flow
73 - 78	63.0 - 67.5	49.2	3.0	17	17		0	4.55	68.28	5,959	72.8 - 78.0	5,959 ~max flow
74 - 78	64.1 - 67.5	0.0	2.0	40			40	3.46	160.13	0	74.0 - 78.0	0
74 - 78	64.1 - 67.5	0.2	2.0	60			60	3.46	206.28	10	74.0 - 78.0	10

DRAFT 09-FB-16 **Permeability Tests**

HCH Dam Site

MNH May, 2009

	NQ	HQ
Radius (in)	1.89	1.89

3.782 D HQ3
2.938 rockbit

HCH Dam Site Drill Hole	DEPTH (ft.)	Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)
09-FB-16			Water table			>	89.0			
60 deg dip on Angle										
0 - 7.5	0.0 - 6.5	0.2	0.0	0			0	6.5	3.25	394
8 - 17.5	6.5 - 15.2	9.2	3.4	10			10	8.66	37.30	1,276
18 - 27	15.2 - 23.4	38.0	4.4	12	7		5	8.23	35.21	5,802
18 - 27	15.2 - 23.4	42.0	4.4	23	10		13	8.23	53.67	4,207
18 - 27	15.2 - 23.4	38.0	4.4	12	7		5	8.23	35.21	5,802
27 - 37	23.4 - 32.0	0.0	4.4	32			32	8.66	105.96	0
37 - 47	32.0 - 40.7	0.0	4.4	60			60	8.66	179.23	0
47 - 56.8	40.7 - 49.2	0.8	4.4	25			25	8.49	107.04	39
47 - 56.8	40.7 - 49.2	1.6	4.4	50			50	8.49	164.73	51
47 - 56.8	40.7 - 49.2	1.2	4.4	28			28	8.49	113.96	55
57 - 67	49.4 - 58.0	1.4	4.4	18			18	8.66	99.63	73
57 - 67	49.4 - 58.0	1.9	4.4	33			33	8.66	134.25	73
57 - 67	49.4 - 58.0	2.7	4.4	68			68	8.66	215.02	65
57 - 67	49.4 - 58.0	1.9	4.4	33			33	8.66	134.25	73
67 - 77	58.0 - 66.7	37.0	4.4	20	6		14	8.66	99.06	1,932
67 - 77	58.0 - 66.7	46.5	4.4	30	14		16	8.66	103.68	2,320
67 - 77	58.0 - 66.7	37.5	4.4	20	6		14	8.66	99.06	1,958
	0.0 - 0.0									
77 - 87	66.7 - 75.3	0.0	4.4	20			20	8.66	121.57	0
77 - 87	66.7 - 75.3	0.0	4.4	35			35	8.66	156.18	1
77 - 87	66.7 - 75.3	14.2	4.4	55			55	8.66	202.34	363
77 - 87	66.7 - 75.3	0.4	4.4	35			35	8.66	156.18	12
87 - 97	75.3 - 84.0	49.3	4.4	20	17		3	8.66	91.00	2,803
move										
92 - 97	79.7 - 84.0	0.00	4.4	48			48	4.33	197.01	0
92 - 97	79.7 - 84.0	0.00	4.4	85			85	4.33	282.39	0
92 - 97	79.7 - 84.0	0.00	4.4	115			115	4.33	351.62	0
97 - 102	84.0 - 88.3	0.2	4.4	45			45	4.33	194.42	9
97 - 102	84.0 - 88.3	0.2	4.4	50			50	4.33	205.95	8
97 - 102	84.0 - 88.3	0.2	4.4	90			90	4.33	298.26	6
97 - 102	84.0 - 88.3	0.2	4.4	50			50	4.33	205.95	8

summary>>

Depth ft.	Permeability ft./yr.
0.0 - 7.5	394
7.5 - 17.5	1,276
17.5 - 27.0	5,802
17.5 - 27.0	4,207
17.5 - 27.0	5,802
27.0 - 37.0	0
37.0 - 47.0	0
47.0 - 56.8	39
47.0 - 56.8	51
47.0 - 56.8	55
57.0 - 67.0	73
57.0 - 67.0	73
57.0 - 67.0	65
57.0 - 67.0	73
67.0 - 77.0	1,932
67.0 - 77.0	2,320
67.0 - 77.0	1,958
77.0 - 87.0	0
77.0 - 87.0	1
77.0 - 87.0	363
77.0 - 87.0	12
87.0 - 97.0	2,803
92.0 - 97.0	0
92.0 - 97.0	0
92.0 - 97.0	0
97.0 - 102.0	9
97.0 - 102.0	8
97.0 - 102.0	6
97.0 - 102.0	8

DRAFT 8/5/2009 **Permeability Tests**

HCH Dam Site

Aug, 2009

09-FB-17 MNH

Radius (in)	NQ	HQ
		1.89

3.782 D HQ3
2.938 rockbit

summary>>

HCH Dam Site Drill Hole	DEPTH (ft.)		Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)	Depth ft.		Permeability ft./yr.	
09-FB-17				Water table			>	100.0							
60 deg dip on Angle															
0 - 8	0.0	- 6.9	20.9	0.0	0			0	6.93	3.46	1,587	0.0	- 8.0	1,587	
0 - 18	0.0	- 15.6	24.0	0.0	0			0	15.6	7.79	1,691	0.0	- 18.0	1,691	
18 - 28	15.6	- 24.2	50.0	3.4	20	18		2	8.66	27.93	9,260	18.0	- 28.0	9,260	
28 - 38	24.2	- 32.9	33.3	3.4	16	3		13	8.66	61.98	2,780	28.0	- 38.0	2,780	
28 - 38	24.2	- 32.9	50.0	3.4	26	20		6	8.66	45.82	5,645	28.0	- 38.0	5,645	
28 - 38	24.2	- 32.9	41.0	3.4	16	9		7	8.66	48.13	4,407	28.0	- 38.0	4,407	opend
38 - 48	32.9	- 41.6	350	3.4	19	5		14	8.66	72.95	2,482	38.0	- 48.0	2,482	
38 - 48	32.9	- 41.6	500	3.4	20	18		2	8.66	45.25	5,716	38.0	- 48.0	5,716	
48 - 58	41.6	- 50.2	52.8	3.4	6			6	8.66	63.15	1,786	48.0	- 58.0	1,786	
58 - 68	50.2	- 58.9	11.8	3.4	28			28	8.66	122.57	498	58.0	- 68.0	498	
58 - 68	50.2	- 58.9	19.8	3.4	40			40	8.66	150.27	682	58.0	- 68.0	682	
58 - 68	50.2	- 58.9	17.5	3.4	28			28	8.66	122.57	739	58.0	- 68.0	739	opend
68 - 78	58.9	- 67.5	5.6	3.4	30			30	8.66	135.85	213	68.0	- 78.0	213	
68 - 78	58.9	- 67.5	16.0	3.4	60			60	8.66	205.08	404	68.0	- 78.0	404	
68 - 78	58.9	- 67.5	13.5	3.4	30			30	8.66	135.85	514	68.0	- 78.0	514	opend
78 - 88	67.5	- 76.2	10.5	3.4	36			36	8.66	158.36	343	78.0	- 88.0	343	
78 - 88	67.5	- 76.2	19.7	3.4	68			68	8.66	232.20	439	78.0	- 88.0	439	
78 - 88	67.5	- 76.2	15.7	3.4	36			36	8.66	158.36	513	78.0	- 88.0	513	opend
88 - 98	76.2	- 84.9	11.5	3.4	42			42	8.66	180.86	329	88.0	- 98.0	329	
88 - 98	76.2	- 84.9	43.0	3.4	50	11		39	8.66	173.94	1,279	88.0	- 98.0	1,279	opend at 60 psi dropped to 50
88 - 98	76.2	- 84.9	41.0	3.4	42	9		33	8.66	160.09	1,325	88.0	- 98.0	1,325	opend

DRAFT 8/5/2009 **Permeability Tests**

HCH Dam Site

Aug, 2009

Radius (in)	NQ	HQ
		1.89

3.782 D HQ3
2.938 rockbit

09-FB-17 MNH

HCH Dam Site Drill Hole	DEPTH (ft.)		Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)	summary>> Depth ft.	Permeability ft./yr.	
09-FB-17				Water table			>	100.0						
60 deg dip on Angle														
0 - 8	0.0	- 6.9	[illegible]	0.0	0			0	6.93	3.46	1,587	0.0 - 8.0	1,587	
0 - 18	0.0	- 15.6	[illegible]	0.0	0			0	15.6	7.79	1,691	0.0 - 18.0	1,691	
18 - 28	15.6	- 24.2	[illegible]	3.4	20	18		2	8.66	27.93	9,260	18.0 - 28.0	9,260	
28 - 38	24.2	- 32.9	[illegible]	3.4	16	3		13	8.66	61.98	2,780	28.0 - 38.0	2,780	
28 - 38	24.2	- 32.9	[illegible]	3.4	26	20		6	8.66	45.82	5,645	28.0 - 38.0	5,645	
28 - 38	24.2	- 32.9	[illegible]	3.4	16	9		7	8.66	48.13	4,407	28.0 - 38.0	4,407	opend
38 - 48	32.9	- 41.6	[illegible]	3.4	19	5		14	8.66	72.95	2,482	38.0 - 48.0	2,482	
38 - 48	32.9	- 41.6	[illegible]	3.4	20	18		2	8.66	45.25	5,716	38.0 - 48.0	5,716	
48 - 58	41.6	- 50.2	[illegible]	3.4	6			6	8.66	63.15	1,786	48.0 - 58.0	1,786	
58 - 68	50.2	- 58.9	[illegible]	3.4	28			28	8.66	122.57	498	58.0 - 68.0	498	
58 - 68	50.2	- 58.9	[illegible]	3.4	40			40	8.66	150.27	682	58.0 - 68.0	682	
58 - 68	50.2	- 58.9	[illegible]	3.4	28			28	8.66	122.57	739	58.0 - 68.0	739	opend
68 - 78	58.9	- 67.5	[illegible]	3.4	30			30	8.66	135.85	213	68.0 - 78.0	213	
68 - 78	58.9	- 67.5	[illegible]	3.4	60			60	8.66	205.08	404	68.0 - 78.0	404	
68 - 78	58.9	- 67.5	[illegible]	3.4	30			30	8.66	135.85	514	68.0 - 78.0	514	opend
78 - 88	67.5	- 76.2	[illegible]	3.4	36			36	8.66	158.36	343	78.0 - 88.0	343	
78 - 88	67.5	- 76.2	[illegible]	3.4	68			68	8.66	232.20	439	78.0 - 88.0	439	
78 - 88	67.5	- 76.2	[illegible]	3.4	36			36	8.66	158.36	513	78.0 - 88.0	513	opend
88 - 98	76.2	- 84.9	[illegible]	3.4	42			42	8.66	180.86	329	88.0 - 98.0	329	
88 - 98	76.2	- 84.9	[illegible]	3.4	50	11		39	8.66	173.94	1,279	88.0 - 98.0	1,279	opend at 60 psi dropped to 50
88 - 98	76.2	- 84.9	[illegible]	3.4	42	9		33	8.66	160.09	1,325	88.0 - 98.0	1,325	opend

APPENDIX B – AFTERBAY
Field & Laboratory Testing

Borings

Hurricane Cliffs Hydropower Project

Drill Hole: AB-1 & 1A
Vertical
Elevation 3576.9

Location: Near Maximum Section of Option 1 South Dam

Depth Interval (ft) from - to	Thickness (ft)	Material Encountered	Permeability from - to	Permeability Rate (ft/yr)	Notes	Elevation 3576.9
0 - 25	25	GC-GM,SM	0 - 5	1037	YOUNG ALLUV	3551.9
			5 - 10	173		
			10 - 15	106		
			15 - 20	38		
			20 - 25	30		
25 - 64	39	CL, ML, SC-SM	25 - 30	11	OLD ALLUV	3512.9
			25 - 35	12		
			25 - 40	53		
			38.5 - 45	9		
			38.5 - 50	12		
			38.5 - 55	7		
			38.5 - 60	34		
			58.5 - 65	2947		
64 - 85	21	SCORIA, VESICULAR BASALT	63.5 - 70	6008	SCORIA, VESIC BASALT	3491.9
			68.5 - 75	9330		
			73.5 - 80	8734		
			78.5 - 85	137		
85 - 149	64	BASALT	78.5 - 90	198	Grass Valley Flow BASALT	3427.9
			99 - 109.5	776		
			109 - 119.5	190		
			120 - 134.5	186		
			135 - 144.5	138		
			145 - 154.5	531		
149 - 166	17	SCORIA, VESIC BASALT	155 - 162.0	701	SCORIA, VESIC BASALT	3410.9
166 - 173	7	BASALT			BASALT	3403.9
173 - 179	6	BASALT & MS			interbedded basalt MS & vuggy basalt	3397.9
179 - 187	8	VUGGY BASALT				3389.9
187 - 199	12	SANDSTONE			Navajo Sandstone	3377.9

Hurricane Cliffs Hydropower Project

Drill Hole: AB-2

Vertical **Elevation** 3610

Location: Toward Right (west) abutment of Option 1 South Dam

Depth Interval (ft) from - to	Thickness (ft)	Material Encountered	Permeability from - to	Permeability Rate (ft/yr)	Notes	Elevation 3610
0 - 12	12	Alluvuim W/ Basalt	6 - 10	127		3598
			9 - 15	10,721		
12 - 30	18	Scoria, to vuggy Basalt	15 - 20	26,202	Highly Fractured	3580
			20 - 25	14,817		
			25 - 30	14,306		
30 - 98	68	Basalt	30 - 39	1,635	more compotent	3512
			39 - 49	3,746		
			49 - 59	940		
			59 - 69	1,332		
			69 - 79	750		
			79 - 89	1,162		
98 - 110	12	BASALT GRAVEL, SCORIA				3500
110 - 134	24	SANDSTONE	123 - 134	2	Navajo Sandstone	3476

Hurricane Cliffs Hydropower Project

Drill Hole: AB-3

Vertical **Elevation 3570.5**

Location: Near Maximum Section of Option 1 South Dam

Depth Interval (ft) from - to	Thickness (ft)	Material Encountered	Permeability from - to	Permeability Rate (ft/yr)	Notes	Elevation 3570.5
0 13	13	SM, ML, GM	0 - 5 5 - 10	259 43	YOUNG ALLUV	3557.5
13 18	5	CL	10 - 15	73	OLD ALLUV	3570.5
18 22	4	GP, SCORIA	15 - 20	15	BASALT GRAVEL	3552.5
22 103	81	BASALT	20 - 25	81		3548.5
103 108	5	SCORIA		End Perm		3467.5
108 125	17	BASALT				3462.5
125 128	3	SCORIA, ALLUV, MS BOTTOM			scoria w/ alluvium at bottom	3445.5
128 140	12	Sandstone			Navajo Sandstone	3442.5

Hurricane Cliffs Hydropower Project

Drill Hole: AB-4 Elevation **3609.51**

Vertical

Location: Toward Left (east) abutment of Option 1 South Dam

Depth Interval (ft) from - to	Thickness (ft)	Material Encountered	No Perm tests	Notes	Elevation 3609.5
0 - 62	62	GP-GM, SM		young alluv	3547.5
62 - 176	114	CL-ML, GP-GM, SC-SM		OLD ALLUV	3433.5
176 - 181	5	MIX CL-ML, BASALT		MIXED W/ VOLC.	3428.5
181 - 186	5	SCORIA / BASALT		SCORIA / BASALT	3423.5
186 - 210	24	BASALT		Basalt	3399.5

Hurricane Cliffs Hydropower Project

Drill Hole: AB-5

Vertical

Location: Near Maximum Section of Option 1 North Dam

Depth Interval (ft) from - to	Thickness (ft)	Material Encountered	Permeability from - to	Permeability Rate (ft/yr)	Notes	Elevation 3599.32
0 - 8	8	Calcareous Silt and Clay w/ basalt gravels	0 - 8	570		3591.3
8 - 25	17	Basalt Scoria Gravel	10 - 15 15 - 20 22 - 25	3,936 10,875 6,194		3574.3
25 - 38	13	Vuggy Basalt	24 - 34	2644	100% Water Loss at 32 ft.	3561.3
38 - 73	35	**Basalt**	34 - 44 44 - 54 54 - 64 58 - 64 64 - 74	2923 3470 3516 204 243	Divide Flow from the East	3526.3
73 - 82	9	Scoria and Basalt	74 - 83	447		3517.3
82 - 102	20	Gravel w/ Silt and Sand	84 - 94 94 - 104	65 861	Old Alluvium	3497.3
102 - 126	24	Vuggy Basalt and Scoria	104 - 114 114 - 124	730 1689		3473.3
126 - 182	56	**Basalt**	124 - 134 134 - 144 144 - 154 154 - 164 164 - 174 174 - 184	1708 1489 1639 1179 559 431	Grass Valley Flow from the West	3417.3
182 - 202	20	Vuggy Basalt and Scoria	184 - 194 194 - 204	893 1072		3397.3
202 - 243	41	**Basalt**				3356.3
243 - 245	2	Scoria				3354.3
245 - 248	3	**Navajo Sandstone**				3351.3

Hurricane Cliffs Hydropower Project

Drill Hole: AB-6 Elev. 3582.38 ft.

Vertical

Location: Near Maximum Section of Option 2 North Dam

Depth Interval (ft) from - to	Thickness (ft)	Material Encountered	Permeability from - to	Permeability Rate (ft/yr)	Notes	Elevation 3582.4
0 - 27	27	Alluvium	0.0 - 5.0 5.0 - 10.0 10.0 - 15.0 15.0 - 20.0 20.0 - 25.0	491 121 773 159 102	Young Alluvium	3555.4
27 - 40	13	**Gravel & Scoria gravel and sand**	25.0 - 30.0 30.0 - 35.0 35.0 - 40.0	171 41 26	Young Alluvium?? or Old alluvium??	3542.4
40 - 58	18	**Scoria, Scoria sand**	40.0 - 45.0 45.0 - 50.0 50.0 - 55.0 53.5 - 60.0	992 1,744 7,364 967		3524.4
58 - 75	17	**vuggy Basalt**	60.0 65.0 65.0 - 74.0 69.0 - 79.0	no test 1,287 46	Grass Valley	3507.4
75 - 104	29	**Basalt**	79.0 - 89.0 89.0 - 99.0	8 3	Grass Valley	3478.4
104 - 114.5	10.5	**scoria w/ Basalt**	99.0 - 109.0 109.0 - 119.0	no test no test		3467.9
114.5 - 149.5	35	**Basalt**	119.5 - 129.0 129.0 - 139.0 139.0 - 148.8	>1912 >1759 >1671	Grass Valley	3582.4
149.5 - 151	1.5	**scoria**	-	no test		3431.4
151 - 163	12	old alluvium red-brown sandy-clayey gravel, (conglomerate) silty sand		thick bentonite drilling mud	Old Alluvium	3419.4
163 - 174	11	**Navajo Sandstone**			**Navajo Sandstone**	3408.4

Hurricane Cliffs Hydropower Project

Drill Hole: **09-AB-7**

Drilled Vertical **Elevation 3675.66**

Location: **Power House (north side)**

Depth Interval (ft) from - to	Thickness (ft)	Material Encountered Predominately	Permeability from - to	Permeability Rate (ft/yr)	Notes	Elevation 3675.7
0 - 15	15	Fan Alluvium (younger), Lt Brn, interbedded silt, silty-clay, silty gravel, clayey gravel, w/ some silty sand layers	0 - 5 5 - 10 10 - 15	882 95 156	start 5/14/09 Alluvial material above basalt is calcareous	3660.7
15 - 30	15	pink-brn, gravel w/ silty clay, w/ silty clay layer at 25ft	15 - 20 20 - 25 25 - 30	211 35 71		3645.7
30 - 51	21	Interbedded Lt. Brn and Red-Brn,clayey gravel,silty gravel w/ some gravel w/ silt, silty sand, some gypsum lenses, calcite stringers	30 - 35 35 - 40 40 - 45 45 - 50	34 149 79 989		3624.7
51 - 82	31	Interbedded Lt. Brn and Red-Brn, gravel w/ silt, gravel w/ clay, w/ some silty sand, and silty layers, and w/ gypsum lenses and nodules, calcite stringers	50 - 55 55 - 60 55 - 65 55 - 70 55 - 75	790 412 2238 1434 1012		3593.7
82 - 100	18	Interbedded yellow Brn and Red-Brn, silty sand and sandy silty layers, w/ gravel, some calcite encrusted pinholes at 85 ft., and clayey gravel at 100 ft., some calc & gypsum lenses and stringers			Drilling with mud, no K tests after 75 ft	3575.7
100 - 120	20	red-brn, sandy silty clay w/ some silty sand and silt layers, some gravels, lots of gyp(?) lenses at 105ft				3555.7
120 - 135	15	red-brn, sandy silty to silty sand, w/ gravel, some volcanics, scoria and basalt, lots of black cuttings starting at 128ft			lots of black cuttings starting at 128ft, transitioning to basalt between 135-140ft	3540.7
135 - 160	**25**	**Gry Basalt, vuggy and non-vuggy, highly fractured with broken and rubbley layers, some slightly scoriaceous zones**			**started coring Basalt at 140ft Likley from the Divide Flow to the east**	3515.7
160 - 185	25	**Older alluvium**, red-brn, silty gravel with sand(?) to gravel w/ silt & sand			cored **Alluvium** to 175 ft, **very poor recovery**, wiped out HQ core bit, switched back to rotary wash, Reamed HQ w/ rod shoe down to 179 ft where it stopped advancing	3490.7
185 - 271	86	red-brn, silty clay, w/gravel and sand (older alluvium)			**Alluvium** getting denser w/ depth, poor recovery with spoon samples, switch to NQ core at 259-271 ft BOH 6/1/09	3404.7

Hurricane Cliffs Hydropower Project

Drill Hole: AB-8 Elevation **3555.65**

Vertical

Location: Near East Abutment of Option 4 and west toe of Option 3

Depth Interval (ft) from - to			Thickness (ft)	Material Encountered	Permeability from - to	Permeability Rate (ft/yr)	Notes	Elevation 3555.7
0	-	15	15	Lt. brown - pink brown silty sand w/gravel, some clay	0 - 10 10 - 15	2954 1991	Younger Alluvium	3540.7
15	-	30	15	Red-brown Gravel with silty clay, w/calc? and gypsum stringers	15 - 20 20 - 25 25 - 30	266 1955 996	Older Alluvium	3525.7
30	-	64	34	Navajo Sandstone	30 - 35 33.7 - 40 33.7 - 49 48 - 59	2323 1632 1378 536	Navajo Sandstone very highly weatherd, more compotent with depth	3491.7

Hurricane Cliffs Hydropower Project

Drill Hole: AB-9 Elevation **3585.55**

Vertical

Location: Near northwest end of Option 3

Depth Interval (ft) from - to	Thickness (ft)	Material Encountered	Permeability from - to	Permeability Rate (ft/yr)	Notes	Elevation 3585.6
0 - 5	5	Lt. brown - red-brown silt and silty clay	0 - 5	311	Young Alluvium	3580.6
5 - 58	53	Red-brown to brown, gravely silty clay w/ sand to silty sandy gravel w/ silty clay & silty sand layers, and some calc & gypsum stringers	5 - 10 10 - 15 15 - 20 20 - 25 25 - 30 30 - 35 35 - 40 40 - 45 45 - 50 50 - 55	277 664 711 369 453 3191 4425 537 6551 912	Older Alluvium?	3527.6
58 - 60	2	Sandstone	55 - 60	7215	Navajo Sandstone	3525.6

Hurricane Cliffs Hydropower Project

Drill Hole: AB-10 Elevation **3667.08**

Vertical

Location: Near east abutment Option 2

Depth Interval (ft) from - to	Thickness (ft)	Material Encountered	Permeability from - to	Permeability Rate (ft/yr)	Notes	Elevation 3667.1
0 - 15	15	Lt. brown silty gravel w/ sand to gravel w/ silt & sand	0 - 5	4959	young alluvium	3652.1
			5 - 7.5	2149		
			7.5 - 10	1373		
			10 - 15	827		
15 - 50	35	Red-brown, some pink brown, silty clayey gravel, some white stringers, possible cobbles?	15 - 20	708	Possible older alluvium (?), some very weaky cemented	3617.1
			20 - 25	918		
			25 - 30	3006		
			30 - 35	127		
			35 - 40	55		
			40 - 45	2431		
			45 - 50	8700		

Hurricane Cliffs Hydropower Project

Drill Hole: 09-AB-11 **Drilled at 60° dip Trend N75°W** Dec-09

Location: Afterbay Option 4, near left side (east)

Depth Interval (ft) from - to	Thickness (ft)	Material Encountered	Permeability from - to	Permeability Rate (ft/yr)	Notes	Elevation	Corrected for Drill Dip Depth Interval (ft) from - to	Corrected Thickness (ft)
						3527.0		
0 - 9.2	9.2	Alluvium ?	0.0 - 17.0	1,530		3519.0	0.0 - 8.0	8.0
9.2 - 17	7.8	Navajo Sandstone	19.0 - 27.0	770	no recovery VH weathered		8.0 - 14.7	6.8
17 - 102	85	Navajo Sandstone reddish-orange-brown	27.0 - 37.0	5,613			14.7 - 88.3	73.6
			37.0 - 47.0	5,095				
			49 - 57	>5665	max flow			
			57 - 67	4,431				
			67 - 77	3,022				
			77 - 87	>3591	max flow			
			89 - 102	>2474	max flow	3438.7		

Hurricane Cliffs Hydropower Project

Drill Hole: 09-AB-12 **Drilled at 60° dip Trend N50°W** Dec-09

Location: Afterbay Option 4, near middle

Depth Interval (ft) from - to	Thickness (ft)	Material Encountered	Permeability from - to	Permeability Rate (ft/yr)	Notes	Elevation	Corrected for Drill Dip Depth Interval (ft) from - to	Corrected Thickness (ft)
Drilled Vertical 0-15 ft						3469.8	vertical	
0 - 8.5	8.5	Aluvium red brown silty sand with gravel	0 - 5 5 - 10	483 580		3461.3		
8.5 - 15	6.5	Navajo Sandstone	10 - 15	881	very highly weathered	3454.8		
drilled at 60° dip from horizontal							drilled at 60° dip from horizontal	
15 - 103	88	Navajo Sandstone-red-brown	15 - 26.6 26.6 - 36.6 36.6 - 46.6 46.6 - 56.6 56.6 - 66.6 61.6 - 66.6 66.6 - 76.6 76.6 - 86.6 86.6 - 96.6 92.6 - 96.6 96.6 - 106.6 101.6 - 106.6	289 263 1,348 >4669 >4013 1,188 1,461 56 >2900 56 >2183 3,197	Generaly relativley soft rock, some very highly factured zones throughout	3380.6	13.0 - 89.2	76.2
103 - 106.6	3.6	Navajo Sandstone-orange-brown	102.6 - 106.6	2,393		3377.5	89.2 - 92.3	3.1

Hurricane Cliffs Hydropower Project

Drill Hole: 09-AB-13 **Drilled at 60° dip Trend N52°W** Dec-09

Location: Afterbay Option 4, near left side (east)

Depth Interval (ft) from - to	Thickness (ft)	Material Encountered	Permeability from - to	Permeability Rate (ft/yr)	Notes	Elevation	Corrected for Drill Dip Depth Interval (ft) from - to	Corrected Thickness (ft)
						3527.0		
0 - 78	78	Navajo Sandstone Formation	0 - 17	1,529.97				
			19 - 27	770.13				
			27 - 37	5,612.73				
			37 - 47	5,094.77				
			49 - 57	5,665.10			0.0 - 67.5	67.5
			57 - 67	4,430.99				
			67 - 77	3,021.69		3449.0		
78 - 104	26	Navajo Sandstone Formation lower transition zone above Kayenta	77 - 87	3,591.39			67.5 - 90.1	22.5
			89 - 102	2,474.08		3423.0		

Hurricane Cliffs Hydropower Project

Drill Hole: 09-AB-14 **Vertical** Dec-09

Location: Afterbay Option 4, Power House

No Permeability Tests

Depth Interval (ft) from - to	Thickness (ft)	Material Encountered	Notes	Elevation about 3617.0
0 - 10	10	Lt-brn silty sand w/ gravel	all calcareous	
10 - 15	5	Red-brn silty sand w/ gravel	white stringers, trace gypsum	
15 - 50	10	interbedded Lt-brn & Red-brn, gravel w/ silty sand, some clayey layers	cobbles, some layers look like old alluvium	3567.0
50 - 90	40	Red-brn clay to sandy clay, w/ some gravel consisting of yellow & brn mudstone fragments w/ some sandstone and limestone fragments, a few gypsum lenses and noduels. Weakly cemented/underated	old alluvium. Lost water at 55 ft. w/ some coming back. Rotary wash with spoon samples to 90. Could only drive spoon about 4-5"per sample below 65ft	3527.0
90 - 211.2	121.2	same	started NQ core w/ mud at 90ft	3405.8
211.2 - 249	37.8	Navajo Sandstone	some very soft Sandstone	3368.0

DRILL HOLE LOG

BORING NO. 09-AB-01

SHEET 1 OF 5

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, N.Q. CORE, ROTARY WASH
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY TO 162'

PROJECT NUMBER: 200804.007.2
DATE STARTED: 3/3/09
DATE COMPLETED: 3/12/09
GROUND ELEVATION: 3576.9'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3575	0			9	3,2,3,(11)	SM	lt. brown, dry to slightly moist, med. dense — SILTY SAND W/GRAVEL young alluvial fan deposit	1037								
	5			13	12,11,12,(52)	GC-GM	pink-brown, dry, dense — SILTY CLAYEY GRAVEL W/SAND	173		5.9	24	6	36	26	38	SS - 13.0%
3570																
	10			13	25,39,25,(99+)	SM	brown & gray, dry, very dense — SILTY SAND W/GRAVEL	106		3.5		NP	33	49	18	
3565																
	15			6	51/6",(REF)	GP-GM	lt. brown, dry, very dense — GRAVEL W/SILT & SAND cobbles & possible boulders	38								
3560																
	20			10	35,50/5", (REF)	GC-GM,SM	brown, dry, very dense — INTERBEDDED SILTY CLAYEY GRAVEL & SAND LAYERS W/COBBLES alluvial fan deposit strong reaction w/HCL between 5'-20'	30								
3555																
	25			13	23,33,44,(80)	CL-1	brown, slightly moist, hard	11		13.8	30	9	0	3	97	SS - 12.0%
3550																
	30			15	26,48,53,(97)	CL	brown to red-brown, slightly moist, hard — LEAN CLAY W/GYPSUM STRINGERS some gravel (no basalt), many white stringers, weak reaction w/HCL	12								
3545																

200804.007.2 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/6/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — 95,60 ← Rock Quality Designation (% RQD) / Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-01

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, N.Q. CORE, ROTARY WASH
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY TO 162'

PROJECT NUMBER: 200804.007.2
DATE STARTED: 3/3/09
DATE COMPLETED: 3/12/09
GROUND ELEVATION: 3576.9'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
				6	65/6",(REF)	CL	brown to red-brown, slightly moist, hard LEAN CLAY W/GYPSUM STRINGERS some gravel (no basalt), many white stringers, weak reaction w/HCL	53								
3540																
	40			10	30,66/5", (REF)	ML	white, slightly moist, very dense			12.3		NP	13	35	52	SS - 13.4%
3535							CALCAREOUS SANDY SILT possible cobbles	9								
	45			4	60/4",(REF)	ML	brown & lt. brown, slightly moist, very dense									
3530								12								
	50			4	60/4",(REF)	SC-SM	red-brown, slightly moist, very dense SILTY CLAYEY SAND calcareous, possibly lithifying or indurating soil to a mudstone, mudstone-sandstone fragments, trace quartzite pebbles									
3525								7								
	55			12	20,28,36,(46)	SM	red-brown, slightly moist, very dense SILTY SAND calcareous, possibly lithifying, mudstone-sandstone fragments, trace quartzite pebbles			11.6		NP	11	48	41	SS - 4.5%
3520								34								
	60			10	55,60/2", (REF)	SC-SM	red-brown, slightly moist, very dense SILTY CLAYEY SAND calcareous, possibly lithifying, mudstone-sandstone fragments, trace quartzite pebbles	2947								
3515																
	65			12	19,17,18,(23)	-	dk. red-brown, dry, med. dense BASALT CAP ROCK HIGHLY BROKEN VESICULAR BASALT TO SCORIA (VOLCANIC CINDER) on & off water loss between 65'-70'	6008								
3510								9330								

200804.007.2 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/6/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) — Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 — Torvane (tsf)

CORE — CORE 95,60 — Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-01

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
PROJECT NUMBER: 200804.007.2
CLIENT: W.C.W.C.D.
DATE STARTED: 3/3/09
LOCATION: SEE SITE PLAN
DATE COMPLETED: 3/12/09
DRILLING METHOD: 08-CME-55 / N.W. CASING, N.Q. CORE, ROTARY WASH
GROUND ELEVATION: 3576.9'
DRILLER: D. SAMPSON
LOGGED BY: M. HANSEN
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY TO 162'

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				11	14,25,49,(71)	SP-SM	purple-brown, slightly moist, very dense			6.7		NP	46	46	8	
3505								9330								
							100% water loss at 74'									
	75			7	38,60/2",(REF)	SP-SM	red-brown to dk. gray, slightly moist, very dense									
3500								8734								
							HIGHLY BROKEN VESICULAR BASALT TO SCORIA (VOLCANIC CINDER)									
	80			6	63/6",(REF)	SP-SM	brown & red-brown, slightly moist, very dense									
							on & off water loss between 65'-70'									
3495							samples contain volcanics likely crushed by sampler	8209								
	85			3	60/3",(REF)	SP-SM	brown & red-brown, dry, very dense									
3490																
							much harder drilling 85'-90', likely more competent	198								
	90															
									172.6	0.4						UC
3485				54	Core 100,100	-	dk. gray, avg. hard to very hard rock									PL
																0,0,0,1
							BASALT fine grained (aphanitic), w/olivine phenocrysts, very few small vugs	227								
	95															PL
3480				60	Core 100,96	-	dk. gray, avg. hard to very hard rock									0,0,1, 1,1
							100% water loss at 96.75'									
							a few fractures at 98'									
	100															
							fracture, slight stain at 100.5'									
3475				60	Core 100,96	-	dk. gray, avg. hard to very hard rock	776								1,1,0, 0,3
							100% water loss at 103.75', white film stains									
				56		-			177.6	0.6						UC

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

- DISTURBED SAMPLE: 2,3,2,(6) — Blow Count per 6"; $(N_1)_{60}$ Value; 0.45 — Torvane (tsf)
- CORE: CORE 95,60 — Rock Quality Designation (% RQD); Percent Sample Recovery
- UNDISTURBED SAMPLE: PUSHED 0.45 — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-01

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, N.Q. CORE, ROTARY WASH
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY TO 162'

PROJECT NUMBER: 200804.007.2
DATE STARTED: 3/3/09
DATE COMPLETED: 3/12/09
GROUND ELEVATION: 3576.9'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
							1/4" vug									PL
3470				56	Core 100,95	-	dk. gray, avg. hard to very hard rock	776								1,1,1, 1,2
							fracture, white calcareous coating									PL
	110															
3465				64	Core 100,94	-	dk. gray, avg. hard to very hard rock									0,1,0, 1,0
									177.3	0.6						UC PL
	115						near vertical open joint 115.2'-116.2' joint gray-brown stain	190								
3460				60	Core 100,85	-	dk. gray, avg. hard to very hard rock									3,3,0, 2,1 PL
	120															
							fracture, white-brown stain 120.8'-121.2'		174.6	0.9						UC PL
3455				60	Core 100,86	-	dk. gray, avg. hard to very hard rock									1,3,0, 1,2
							BASALT fine grained (aphanitic), w/olivine phenocrysts, very few small vugs 1/4" vug									
	125															PL
3450				60	Core 100,86	-	dk. gray, avg. hard to very hard rock	186								1,0,4, 3,0
							fracture, white calcareous coating & red-brown clayey film									
	130															PL
				26	Core 100,18	-	dk. gray, avg. hard to very hard rock									4,6
3445							fracture, film, brown stain									
				32	Core 98,62	-	dk. gray, avg. hard to very hard rock									3,3,1
									177.2	0.6						UC PL
	135						0.15' vuggy layer									
3440				60	Core 100,62	-	dk. gray, avg. hard to very hard rock	138								3,4,6, 1,1
							brown coating, broken layer									
									178.3	0.8						UC PL
				50		-										

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

- DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)
- CORE — CORE 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery
- UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-01

SHEET 5 OF 5

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, N.Q. CORE, ROTARY WASH
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY TO 162'

PROJECT NUMBER: 200804.007.2
DATE STARTED: 3/3/09
DATE COMPLETED: 3/12/09
GROUND ELEVATION: 3576.9'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
3435				50	Core 84,13	-	dk. gray, avg. hard to very hard rock	138								5,5,3, 6,6
							BASALT fine grained (aphanitic), w/olivine phenocrysts, very few small vugs									PL
	145					-	dk. gray, avg. hard to very hard rock									
3430				54	Core 90,27											4,br,br, br UC PL
						-	dk. gray, avg. hard to very hard rock		162.4	0.2						
							medium broken layers BASALT very highly fractured & broken, more vugs	531								
	150															
3425				60	Core 84,14	-	red-brown, dry, soft rock									br,br, br,5,3
							drills very easy, broken & rubble									
									132.6	0.2						UC PL
	155						mostly broken & rubble, hard & very soft layers									
3420				13	Core 22,7	-	red-brown, dry, soft rock									br,m
							SCORIA (VOLCANIC CINDER) very vuggy, similar to rock at top of flow	701								
							*at 160' air was noted being sucked down into the hole showing likely connection to Grass Valley Basalt to the west									
	160															
				8	Core 28,20	-	red-brown, dry, soft rock									br,m
3415																
	165						POSSIBLE BASALT (driller's observation) drill more homogeneous, hard like basalt									
3410																
	170						Lost hole at 170'									
3405							See Boring 09-AB-1A for deeper information									

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-01A

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / H.Q.3 CORE
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY' 4/9/09

PROJECT NUMBER: 200804.007.2
DATE STARTED: 3/31/09
DATE COMPLETED: 4/1/09
GROUND ELEVATION: 3576.3'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
3435							SEE LOG 09-AB-1 FOR 0'-147.2'								
	145														
3430							dk. gray, dry, very hard rock — BASALT very highly fractured & broken, a few more vugs, haphazard fractures, some rusty-brown, stain 100% water loss at 147.5'								
			Core	22	100,0	-									8,10
	150														
3425			Core	44	74,18	-	reddish-brown, dry, hard rock — VERY HIGHLY VESICULAR BASALT highly fractured, some frothy cinder texture								5,5,7, 1,m
	155														
3420			Core	56	94,28	-	brown, dry, hard to soft rock — BASALT very highly fractured, broken to rubbly, dirty, w/many small vugs to solid, some scoriaceous/cinder texture								4,10,br br,5
	160														
3415			Core	62	104,104	-	brown & gray, dry, very hard rock — VUGGY BASALT transitioning to dk. gray 0.2' vug at 161.5'								0,0,0, 0,0
	165					-	brown & gray, dry, very hard rock	161.6	0.3						UC PL
3410			Core	60	100,100	-	brown & gray, dry, very hard rock — INTERBEDDED SOLID & VUGGY BASALT								0,0,0, 0,0 PL
	170														
3405			Core	60	100,96	-	brown & gray, dry, very hard rock — fracture at 168.5', open, tight, slightly rough, spotty pink coating	165.4	0.5						0,0,0, 1,2 UC PL
						-	purple-brown, dry, very hard rock — MUDDY BASALT transitioning to baked(?) orange-brown silt/clay & basalt/volcanics mix								
			Core	56		-	purple-brown, dry, very								

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — CORE 95,60 ← Rock Quality Designation (% RQD); ← Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-01A

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / H.Q.3 CORE
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY' 4/9/09

PROJECT NUMBER: 200804.007.2
DATE STARTED: 3/31/09
DATE COMPLETED: 4/1/09
GROUND ELEVATION: 3576.3'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
					94,0	CL-1	hard rock								
3400							silt/clay changes to mudstone at 176'	117.1	7.7	30	11				PL
				56	Core 94,0	-	purple-brown, dry, very hard rock								4,3,2, 4,2
							intermixed orange-brown mudstone & volcanics								
	180														
3395				64	Core 106,74	-	dk. gray, dry, very hard rock								2,2,1, 4,3
							VUGGY BASALT w/mudstone infilling 1/4" in joint at 182.7'-184'								
	185					-	dk. gray, dry, very hard rock	167.2	0.8						UC PL
3390				60	Core 100,60	-	~~orange-red-brown~~								4,0,3, br,3
						-	~~dk. red-brown~~ TRANSITION FROM BASALT VOLCANICS & QUARTZ SAND								
						-	~~orange, soft rock~~ VERY SILTY SAND								
						-	orange, dry, very soft rock weakly cemented								
	190						NAVAJO SANDSTONE FORMATION								
3385				25	Core 42,0	-	orange, dry, very soft rock very highly weathered, w/many very soft uncemented zones (sandy), 2.9' core missing	132.8	8.2		NP	8	88	4	br PL
						SP									
	195						VERY SOFT SANDSTONE								
3380				36	Core 60,0	-	orange, dry, very soft rock very highly weathered, many haphazard fractures (may be caused by drilling), some near vertical fractures, many iron stain dots								br
	200														
3375															
	205														
3370															

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-02

SHEET 1 OF 4

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE, N.Q. CORE
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY TO 119'

PROJECT NUMBER: 200804.007.2
DATE STARTED: 3/12/09
DATE COMPLETED: 3/18/09
GROUND ELEVATION: 3610.0'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
							PAD CUT FILL									
3605	5		9	13,46/6", (REF)	SM		mottled white-brown, slightly moist, very dense — SILTY SAND trace basalt gravel w/many white stringers, absorbs HCL (can't see reaction), highly gypsiferous soil			10.0		NP	4	50	46	
3600	10		4	60/5",(REF)	GP-GM		gray, slightly moist, very dense — BASALT GRAVEL W/SILT & SAND cobbles & boulders	127								
3595	15		14	22,24,28,(74)	GP-GM		gray, slightly moist, very dense	10,721		9.1		NP	62	31	7	
3590	20		5	62/6",(REF)	GP-GM		black & brown, slightly moist, very dense — BASALT & SCORIA/CINDERS (GRAVEL W/SILT & SAND) weathered basalt w/alluvial seams in joints or alluvium, colluvium w/basalt gravel, cobbles & boulders 100% water loss at 22'	26,202								
3585	25		12	61,34,24,(61)	GP-GM		black & brown, slightly moist, very dense	14,817		4.3		NP	66	26	8	
3580	30		0	60/2",(REF)	-		no recovery	14,306								
			23	Core 95,70	-		gray, dry, very hard rock — BASALT 100% water loss at 32.5' BASALT W/OLIVINE CRYSTALS	1635	177.5	0.3						UC PL 2,1
			60	Core	-		gray, dry, very hard rock — trace vugs									

200901200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) — Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 — Torvane (tsf)
CORE — 95,60 — Rock Quality Designation (% RQD); Percent Sample Recovery
UNDISTURBED SAMPLE — PUSHED; 0.45 — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-02

SHEET 2 OF 4

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE, N.Q. CORE
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY TO 119'

PROJECT NUMBER: 200804.007.2
DATE STARTED: 3/12/09
DATE COMPLETED: 3/18/09
GROUND ELEVATION: 3610.0'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description		Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
					100,90												
				60	Core *100,90*	-	gray, dry, very hard rock	trace vugs	1635								0,1,1, 2,1
3570	40																PL
				48	Core *80,72*	-	gray, dry, very hard rock	water back at 41'		178.5	0.3						UC PL 2,0,0, 1,0
								no fractures at 43' to 47.5'	3746								
3565	45			54	Core *129,129*	-	gray, dry, very hard rock										PL 0,0,0, 2,1
				12	Core *67,47*	-	gray, dry, very hard rock	100% water loss at ~47.6' dry ~1/2" clayey sand infilling, slickensides(?) stuck to one side, other side smooth									
3560	50							fracture, calcareous coating									PL
				53	Core *88,38*	-	gray, dry, very hard rock	fracture, calcareous film fracture, some calcareous film		176.4	0.2						PL 4,3,4, 3,4 UC PL
									940								
3555	55							a few vugs									
				67	Core *100,33*	-	gray, dry, very hard rock										5,5,3, 3,3
3550	60							1/4" vug									
				55	Core *92,62*	-	gray, dry, very hard rock										1,2,5, 5,2 UC PL
								fracture, white-rusty stain	1332	178.0	0.4						
3545	65			58	Core *100,93*	-	gray, dry, very hard rock	BASALT W/OLIVINE PHENOCRYSTS trace vugs									0,1,0, 2,1
																	PL
				60	Core	-	gray, dry, very hard rock		750								

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-02

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE, N.Q. CORE
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY TO 119'

PROJECT NUMBER: 200804.007.2
DATE STARTED: 3/12/09
DATE COMPLETED: 3/18/09
GROUND ELEVATION: 3610.0'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
					100,32		fracture, film to 1/16", some infilling silty sand									
			Core	60	*100,32*	-	gray, dry, very hard rock									3,4,5, 6,3
									175.5	0.4						UC PL
3535	75		Core	58	*100,55*	-	gray, dry, very hard rock	750								3,6,3, 1,2
							conj. joints w/red-brown, sandy silt coating, some cemented, no HCL reaction, broken zone (may be mechanical)									PL
3530	80		Core	62	*100,51*	-	gray, dry, very hard rock		180.0	0.7						UC PL 7,3,2, 1,3
3525	85						BASALT trace vugs	1056								PL
			Core	60	*100,76*	-	gray, dry, very hard rock									2,2,0, 1,3
3520	90						competent, non-jointed core									
			Core	60	*100,100*	-	gray, dry, very hard rock									0,0,1, 0,0
									178.3	0.3						UC PL
3515	95		Core	47	*78,42*	-	gray, dry, very hard rock	No Tests								PL 1,4,6, 5,m
							more small vugs at 97'-97.9'									
3510	100		Core	0	*0,0*	-	no recovery									
							BASALT GRAVEL W/SILTY SAND well rounded quartz grains, alluvium									
				6	77/6",(REF)	GP-GM	red-brown & black, dry,									

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-02

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE, N.Q. CORE
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY TO 119'

PROJECT NUMBER: 200804.007.2
DATE STARTED: 3/12/09
DATE COMPLETED: 3/18/09
GROUND ELEVATION: 3610.0'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
							very dense									
							BASALT GRAVEL W/SILTY SAND well rounded quartz grains, alluvium									
3500	110			7	40,60/3", (REF)	-	white & red-brown, dry									
						-	orange to red-brown, dry, soft rock									
3495	115			2	60/2",(REF)	-	red-orange-brown, dry, soft rock									
							Start drilling NQ Core at 119.3'									
3490	120			0	Core 0,0	-	NAVAJO SANDSTONE FORMATION no recovery very highly weathered, some white cuttings, few thin white sandstone lenses, some bedding, breaks down to sand sitting in core boxes	No Tests								
3485	125			28	Core 46,0	-	orange-brown, dry, ext. soft to very soft rock									
3480	130			18	Core 60,0	SP-SM	orange-brown, dry, ext. soft to very soft rock			11.2		NP	3	92	5	
				13	Core 44,0	-	orange-brown, dry, ext. soft to very soft rock									
3475	135															

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) — Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 — Torvane (tsf)

CORE — CORE 95,60 — Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-03

SHEET 1 OF 4

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE, N.Q. 130'-140'
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY' 4/1/09

PROJECT NUMBER: 200804.007.2
DATE STARTED: 3/19/09
DATE COMPLETED: 3/23/09
GROUND ELEVATION: 3570.5'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3570																
				14	2,3,4,(15)	SM	orange-brown, dry, med. dense — SILTY SAND W/CLAY LAYERS									
	5							259								
3565				16	13,19,25,(99+)	ML	buff-brown, slightly moist, hard — SANDY SILT W/GRAVEL									
								43								
	10															
3560				16	25,43,48,(99+)	GM	brown, slightly moist, very dense — SILTY GRAVEL W/SAND			4.6		NP	46	38	16	SS - 3.3%
								73								
	15															
3555				10	28,60/6", (REF)	CL	lt. brown, slightly moist, hard — SANDY LEAN CLAY w/white stringers, possible cobbles			13.3	33	17	11	35	54	
								15								
	20															
3550				1	60/1",(REF)	GP	gray, dry, very dense — BASALT GRAVEL & COBBLES									
							BASALT W/OLIVINE CRYSTALS	81								
	25			0	50/1",(REF)	-	gray, dry, very hard rock									
3545									170.1	0.5						UC PL
				57	Core 100,100	-	gray, dry, very hard rock — fracture at 27.3'-28', slight open joint, rough w/pink calcareous coating w/sandy texture									0,0,1, 0,0
	30						BASALT very small vugs to 29' then solid									
3540							fracture at 30.8'-31.1', tight rough white calcareous partial infill									
				60	Core 100,98	-	gray, dry, very hard rock									1,1,0, 2,0

200804.007.2 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/6/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) — Blow Count per 6" — $(N_1)_{60}$ Value — 0.45 — Torvane (tsf)

CORE — CORE 95,60 — Rock Quality Designation (% RQD) — Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-03

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE, N.Q. 130'-140'
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY' 4/1/09

PROJECT NUMBER: 200804.007.2
DATE STARTED: 3/19/09
DATE COMPLETED: 3/23/09
GROUND ELEVATION: 3570.5'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
3535							BASALT									PL
				60	Core 100,96	-	gray, dry, very hard rock									0,0,0, 0,2
							fracture at 39'-39.5', part open, moderately rough, white & brown calcareous spotty infilling									
3530	40															
				60	Core 100,88	-	gray, dry, very hard rock									0,2,3, 0,0
							fracture at 42.4'-42.8', part open, slight rough spotty red-brown silty sandy calcareous infilling									
3525	45															
				60	Core 100,100	-	gray, dry, very hard rock		176.7	0.2						UC PL 0,0,0, 0,0
							fracture at 50'-51', part open, rough spotty white & red-brown calcareous infill									
3520	50						fracture at 51'-52.3', undulating tight slight rough-smooth, near vertical spotty calcareous coating, some rusty stain									
				60	Core 100,70	-	gray, dry, very hard rock									7,1,3, 0,1
							fracture 52.9'-53.1', part open, slight rough, spotty calcareous coating									
3515	55															PL
				60	Core 100,90	-	fracture at 56.5' 56.8', part open, rough w/white & red-brown calcareous xls & coating									0,2,0, 0,5
							gray, dry, very hard rock									
							fracture at 60.1', open, med. rough, white brown calcareous coating									
3510	60															
				56	Core 94,86	-	fracture at 62.4'-62.7' & 63.7'-64', open, smooth, rusty-brown calcareous coating some calcite xls at 63'									1,1,3, 2,0
							gray, dry, very hard rock									
3505	65															
				55	Core 107,86	-	fracture, open, rough, calcareous coating fracture at 67', lt. red-brown, open smooth, calcareous coating		174.5	0.2						UC PL 2,1,1, 1,5
							gray, dry, very hard rock									
				68		-	fracture at 67.4', open, smooth to slightly rough,									

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) — Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 — Torvane (tsf)

CORE — CORE 95,60 — Rock Quality Designation (% RQD) / Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-03

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
PROJECT NUMBER: 200804.007.2
CLIENT: W.C.W.C.D.
DATE STARTED: 3/19/09
LOCATION: SEE SITE PLAN
DATE COMPLETED: 3/23/09
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE, N.Q. 130'-140'
GROUND ELEVATION: 3570.5'
DRILLER: D. SAMPSON
LOGGED BY: M. HANSEN
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY' 4/1/09

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
3500							spotty, white calcareous coating									
				68	Core 100,88	-	gray, dry, very hard rock fracture 68.8'-69.4' & 70.7'-71.1', rough, open, spotty white calcareous coating									2,0,2, 0,3
	75						fracture at 72.1'-72.4', open, smooth to slightly rough, spotty, white calcareous coating									
3495							fracture 74'-74.5' & 74.8', open-part open, smooth,									PL
				56	Core 94,82	-	gray, dry, very hard rock spotty white & pink calcareous coating starting to lose water at ~75'									3,0,1, 1,1
	80						fracture at 75.6', open, smooth to slightly rough, spotty, white calcareous coating									
3490							100% water loss at 78'-78.5'									
				62	Core 106,106	-	gray, dry, very hard rock fracture at 78.4', 5° open, pink-brown infilling, 0.01' thick crystal & wavy texture, water precipitate									0,2,0, 0,0
	85						fracture 78.7', open-part open, smooth, spotty white & pink calcareous coating									
3485							fracture at 81.2'-82.4',		177.0	0.3						UC PL
				58	Core 94,94	-	gray, dry, very hard rock open-part open, smooth, w/pink & white spotty calcareous coating									2,0,0, 1,3
	90						fracture at 85'-85.7', open-part open, smooth, w/pink & white liner									
3480							fracture 85.5', 88.7'-89' & 89.5'-89.8'open-part open,									
				64	Core 106,100	-	gray, dry, very hard rock smooth, spotty white & pink calcareous coating									0,3,0, 0,1
	95						fracture at 91' & 91.9', part open, smooth & part rough, w/spotty white & pink calcareous coating									
3475							BASALT									PL
				57	Core 95,84	-	gray, dry, very hard rock fracture at 95.8', healed, smooth to slightly rough, spotty, white calcareous coating									1,1,0, 1,2
	100						fracture at 96.3', open, smooth to slightly rough, spotty, white calcareous coating									
3470						-	gray, dry, very hard rock 1/4" healed breccia at 98'-98.4', smooth slickenside(?), brown & white film calcareous									
				55	Core 92,62		gradually more vugs at 99'-103'									0,1,0, br
						-	red-brown, dry, soft rock joint now open but fits tight									

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) — Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 — Torvane (tsf)

CORE — 95,60 — Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-03

SHEET 4 OF 4

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE, N.Q. 130'-140'
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY' 4/1/09

PROJECT NUMBER: 200804.007.2
DATE STARTED: 3/19/09
DATE COMPLETED: 3/23/09
GROUND ELEVATION: 3570.5'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
3465						-	red-brown, dry, soft rock; clear-white crystals 1/8", very slow HCL reaction, open, rough, brown-green coating w/a sandy texture									
				42	Core 70,20		SCORIA/CINDERS w/some gray very vuggy basalt zones, mostly broken & rubble, some white calcareous very fine calcite									br, 2,2
						-	gray, dry, very hard rock		155.1	0.6						UC PL
3460	110						VUGGY BASALT less vugs w/depth									
				60	Core 100,92	-	gray, dry, very hard rock; fracture at 108.3'-108.8', 109.7'-110', 111.7'-112.4', 113'-113.3'									2,0,0, 1,0 PL
3455	115															
				59	Core 99,80	-	gray, dry, very hard rock; BASALT few small vugs									0,0,0, 0,4
3450	120						fractures at 119', 119.5', 119.7', 120.5' & 124', rough w/spotty white calcareous coating		175.1	0.2						UC PL 2,0,0, 0,3
				61	Core 101,86	-	gray, dry, very hard rock									
	125					-	brown-gray, dry, very hard rock; BASALT W/SCORIA/CINDERS									
3445				11	Core 60,0	-	brown to orange brown, dry, avg. hard rock; SCORIA/CINDERS-BASALT brown to orange-brown mudstone infilling into vugs & on bottom at 125', 125'-125.4' baked(?) mudstone w/basalt gravel sized fragments then purple-brown clay w/some orange-brown mudstone gravel size fragments & sand size fragments									
				6	61/6",(REF)	-	red & orange-brown, dry, stiff									
	130															
3440						SP				0.4		NP	28	68	4	
				31	Core 52,0	-	brown-orange, dry, soft rock; drilled like soft rock to 130' NAVAJO SANDSTONE angled bedding 35°-40°, some gray on bedding, 1/16" white calcite lens on bedding, several 1/4" iron stained dots, very highly fractured, highly weathered									br
	135															
3435				25	Core 42,0	-	brown-orange, dry, soft rock; *noted hole sucking air at 126.5'									br
							BOH 140'									

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) — Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 — Torvane (tsf)

CORE — CORE 95,60 — Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-04

SHEET 1 OF 6

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, N.Q. CORE, DRILLING MUD
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY'

PROJECT NUMBER: 200804.007.2
DATE STARTED: 4/1/09
DATE COMPLETED: 4/3/09
GROUND ELEVATION: 3609.5'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3605	5			12	14,15,22,(79)	SM	SILTY SAND W/GRAVEL brown to red-brown, dry to slightly moist, dense		7.4		NP	39	43	18	
3600	10			7	50,60/4", (REF)	GP-GC	very lt. brown to red-brown, dry to slightly moist, very dense GRAVEL W/SAND, SILT, CLAY, COBBLES samples were predominantly calcareous down to 80'								
3595	15			3	50,50/1", (REF)	GP-GM	very lt. brown, dry to slightly moist, very dense GRAVEL W/SILT & SAND some clay, cobbles								
3590	20			9	56,60/3", (REF)	GP-GM	lt. brown to red-brown, dry to slightly moist, very dense Young Alluvium								
3585	25			14	28,34,60,(98)	SM	pink-brown, dry to slightly moist, very dense SILTY SAND W/GRAVEL cobbles		5.8		NP	38	43	19	
				3	60/4",(REF)	SM	pink-brown, dry to slightly moist, very dense								
3580	30			12	36,61/6", (REF)	SM	No Basalt Fragments Noted 0'-65' red-brown, dry, very dense SILTY SAND many white calcareous lenses & spots								
3575				4	60/5",(REF)	GP-GM	red-brown, slightly moist, very dense GRAVEL W/SILT & SAND cobbles, possible boulders								

200804.007.2 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/6/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-04

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, N.Q. CORE, DRILLING MUD
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY'

PROJECT NUMBER: 200804.007.2
DATE STARTED: 4/1/09
DATE COMPLETED: 4/3/09
GROUND ELEVATION: 3609.5'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
				11	43,61/6", (REF)	GP-GM	red-brown, slightly moist, very dense								
3570	40			4	60/4",(REF)	GP-GM	red-brown, slightly moist, very dense		9.9		NP	61	32	7	
							GRAVEL W/SILT & SAND cobbles, possible boulders								
3565	45			4	60/4",(REF)	GP-GM	white to very lt. brown, slightly moist, very dense								
							Young or Older Alluvium?								
3560	50			1.5	80/5",(REF)	SM/GP-GM	red-brown, slightly moist, very dense								
							SILTY SAND TO SILTY GRAVEL W/SAND, COBBLES								
3555	55			3	70/4",(REF)	SM/GP-GM	red-brown, slightly moist, very dense								
				1	60/2",(REF)	GP-GM	red-brown, slightly moist, very dense								GRAVEL W/SILT & SAND, COBBLES
3550	60			10	47,60/4", (REF)	SM	brown to red-brown, slightly moist, hard		10.3		NP	4	53	43	
							SILTY SAND W/COBBLES white calc. stringers								
							Old Alluvium?								
				15	33,46,50,(68)	CL-ML	brown to red-brown, slightly moist, hard								
3545	65			12	34,60/6", (REF)	CL-ML	brown to red-brown, slightly moist, hard								
							SANDY SILTY CLAY W/SOME GRAVEL & COBBLES trace basalt fragments, some very soft green mudstone fragments								
							Old Alluvium?								
3540															

200804.007.2 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/6/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-04

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, N.Q. CORE, DRILLING MUD
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY'

PROJECT NUMBER: 200804.007.2
DATE STARTED: 4/1/09
DATE COMPLETED: 4/3/09
GROUND ELEVATION: 3609.5'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
				6	80/6",(REF)	CL-ML	red-brown, slightly moist, hard								
3535	75			0	60/2",(REF)	-	no recovery SANDY SILTY CLAY W/SOME GRAVEL & COBBLES trace basalt fragments, some very soft green mudstone fragments Old Alluvium?								
3530	80			9	60,60/3", (REF)	CL-ML	red-brown, slightly moist, hard								
3525	85			0	60/1",(REF)	-	no recovery LIMESTONE BOULDER OR BOULDERS (drill the same, may be one large boulder) white limestone cuttings								
3520	90			0	60/1",(REF)	-	white								
						-	white Started coring through cobbles, boulders & soils								
3515	95			14	Core 34,0	GP	GRAVEL, COBBLES & BOULDERS Old Alluvium								
				18	Core 30,0	-	brown								
3510	100			32	Core 54,0	SC-SM	SILTY CLAYEY SAND W/GRAVEL some limestone & sandstone gravel red-brown, moist		17.6	29	7	17	40	43	
3505															

200804.007.2 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/6/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)
CORE — 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery
UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-04

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, N.Q. CORE, DRILLING MUD
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY'

PROJECT NUMBER: 200804.007.2
DATE STARTED: 4/1/09
DATE COMPLETED: 4/3/09
GROUND ELEVATION: 3609.5'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
			Core	60	*100,0*	SC-SM	red-brown, moist — SILTY CLAYEY SAND W/GRAVEL some limestone & sandstone gravel								
							SAND								
							SANDSTONE								
3500	110						SANDY SILTY CLAY TO CLAYEY SAND								
							SANDSTONE	113.2	14.0	25	7	26	34	40	
						SC-SM	red-brown — SILTY CLAYEY SAND W/GRAVEL many course sand to gravel mudstone & limestone fragments								
			Core	60	*100,0*										
						SC-SM	red-brown, moist — SILTY CLAYEY SAND								
3495	115														
								105.1	16.2		NP	44	26	30	
			Core	56	*94,0*	GM	red-brown, moist — SILTY GRAVEL W/SAND								
3490	120														
							SILTY CLAYEY SAND W/GRAVEL some limestone & sandstone gravel								
			Core	44	*74,0*	SC-SM	red-brown, moist								
3485	125														
							SILTY CLAY TO CLAYEY GRAVEL								
			Core	54	*90,0*	CL-ML/GC	red-brown, moist								
3480	130						some near vertical fractures at 131' & 132'								
							SILTY CLAYEY SAND W/GRAVEL LITHIFYING TO A VERY SOFT CONGLOMERATIC MUDSTONE								
			Core	56	*94,0*	SC-SM	brown	117.5	12.1	25	4	29	46	25	PL
3475	135														
						-									
			Core	56	*94,0*		brown — SANDSTONE BOULDER								
						CL-ML	brown — SILTY CLAY LITHIFYING TO A VERY SOFT MUDSTONE								
3470							SILTY SAND								

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) — Blow Count per 6" / $(N_1)_{60}$ Value; *0.45* — Torvane (tsf)

CORE — CORE *95,60* — Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED *0.45* — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

RB&G ENGINEERING, INC.

DRILL HOLE LOG

BORING NO. 09-AB-04

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, N.Q. CORE, DRILLING MUD
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY'

PROJECT NUMBER: 200804.007.2
DATE STARTED: 4/1/09
DATE COMPLETED: 4/3/09
GROUND ELEVATION: 3609.5'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
3465	145		Core	55	*92,0*	CL-ML	red-brown, moist SILTY CLAY W/SAND & GRAVEL some mudstone clasts								
			Core	48	*80,0*	CL-ML	red-brown, moist								
3460	150							103.0	17.8		NP	0	54	46	
			Core	60	*100,0*	SM	red-brown, very soft SILTY SAND								
3455	155					-	red-brown								
			Core	54	*90,0*	-	red-brown								
3450	160					SC		108.1	15.3	40	16	27	45	28	PL
			Core	60	*100,0*	-	red-brown CLAYEY SAND W/GRAVEL LITHIFYING TO A VERY SOFT CONGLOMERATIC MUDSTONE weakly cemented, sandstone cobbles								
3445	165														
			Core	48	*80,0*	-	red-brown								
3440	170														
			Core	46	*76,0*	-	red-brown								
3435															

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; *0.45* ← Torvane (tsf)

CORE — *95,60* ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; *0.45* ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-04

SHEET 6 OF 6

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
PROJECT NUMBER: 200804.007.2
CLIENT: W.C.W.C.D.
DATE STARTED: 4/1/09
LOCATION: SEE SITE PLAN
DATE COMPLETED: 4/3/09
DRILLING METHOD: 08-CME-55 / N.W. CASING, N.Q. CORE, DRILLING MUD
GROUND ELEVATION: 3609.5'
DRILLER: T. KERN
LOGGED BY: M. HANSEN
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY'

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
						CL-ML	red-brown SILTY CLAY w/many very soft mudstone fragments - sand-gravel size								
						-									
						-	black SANDSTONE COBBLE								
				56	Core 94,0	CL-ML/CL	~~orange to red-brown~~ BASALT								
						-	~~black~~ SILTY CLAY TO CLAY								
						CL-ML	orange to red-brown BASALT								
3430						-	black SILTY CLAY TO CLAY								
	180					CL-ML	~~orange to red-brown~~ BASALT								
							SILTY CLAY TO CLAY								
							BASALT								
							CLAY & BASALT RUBBLE								
				55	Core 92,34	-	black, hard & soft rock								br
							BASALT W/SCORIA/CINDER SAND								
3425															
	185														
							Start losing water								
				18	Core 30,0	-	black, hard & soft rock, very highly fractured								br
3420															
	190							149.2	3.3						UC PL
				55	Core 92,58	-	brown-gray, hard rock, fractured BASALT vuggy								3,3,3, 2,5
3415															
	195														
				59	Core 98,35	-	dk. gray, hard to very hard rock, highly fractured								4,4,4, 3,0 PL
3410															
	200														
				56	Core 93,92	-	dk. gray, very hard rock								0,1,2, 1,3
3405							BASALT less vuggy, w/white speckles	170.0	0.4						UC PL
	205														
				59	Core 99,73	-	dk. gray, very hard rock								5,2,2, 2,2
3400						-	dk. gray, very hard rock BASALT no speckles BOH 210'								

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

RB&G ENGINEERING, INC.

DRILL HOLE LOG

BORING NO. 09-AB-05

SHEET 1 OF 8

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q. CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ 243.5'?

PROJECT NUMBER: 200804.007.2
DATE STARTED: 4/23/09
DATE COMPLETED: 5/4/09
GROUND ELEVATION: 3599.0'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				14	6,5,8,(27)	SM	lt. brown, dry, stiff — SILTY SAND w/basalt gravel, slightly plastic			17.3	18	3	30	41	29	15% -0.005 mm
3595	5			15	15,23,31,(99+)	GM	brown-white, dry, hard — SILTY GRAVEL W/SAND - CALCAREOUS SOIL (CALICHE?) basalt gravels; possible cobbles; plastic			5.9	40	8	62	17	21	1% -0.005 mm
							Volcanics - Alluvium									
3590	10			12	23,37,26,(99+)	GM	red-brown, dry, very dense — SILTY GRAVEL W/SAND basalt gravels; possible cobbles; slightly plastic; some white stringers; some calcareous coating on bottom of basalt; started losing water at ~14'									
3585	15			11	18,28,28,(99+)	GM	Volcanics; black & brown, dry, dense									
3580	20			11	21,28,67,(83)	GM	black & brown, dry, very dense — SILTY GRAVEL W/SAND basalt scoria gravel; possible cobbles; 100% water loss at 16.5'; some water back at 23'			8.5		NP	56	31	13	
3575	25			0	30/0",(REF)	-										
				42	Core 78,9	-	black to dk. gray, dry, avg. hard rock		183.8	0.1							UC PL m,7,7,7
3570	30						VUGGY SCORIACEOUS BASALT very highly fractured; rusty-red-brown stain on many fractures; gradually loosing water									
				36	Core 60,0	-	black to dk. gray, dry, avg. hard rock									br,9
3565				59		-	100% water loss at 32.5'									

Permeability: 568, 574, 3936, 10,875, 6194, 2644

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 Torvane (tsf)

CORE — CORE 95,60 Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-05

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q. CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ 243.5'?

PROJECT NUMBER: 200804.007.2
DATE STARTED: 4/23/09
DATE COMPLETED: 5/4/09
GROUND ELEVATION: 3599.0'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
			Core	59	91,39	-	black to dk. gray, dry, avg. hard rock									5,6,6, 9,1
3560	40		Core	46	83,75	-	gray, dry, avg. hard rock	4621								1,1,0, 1,3
							fracture at 44'-46.2', rough w/spotty white calcareous coating									
3555	45															PL
			Core	64	106,54	-	gray, dry, avg. hard rock									3,0,2, 0,0
							BASALT W/OLIVINE PHENOCRYSTS more competent; trace vugs									
3550	50							>3470	188.1	0.2						UC PL
			Core	62	104,104	-	gray, dry, avg. hard rock									0,0,1, 1,1
							fracture at 52.5'-54.5', open smooth w/orange-brown silty sand coating									
3545	55						fracture at 54.8'-56.6', near vertical, open smooth w/orange-brown silty sand coating									
			Core	54	90,66	-	gray, dry, very hard rock									1,2,2, 2,0
							fracture at 57.2'-58', near vertical, open smooth w/orange-brown silty sand coating									
3540	60						fracture at 58'-58.5', 70°, smooth pink-brown silty film	>3516								
			Core	60	100,100	-	lt. gray, dry, very hard rock	204								0,0,0, 1,0
							fracture at 63.1'-63.55', undulating w/trace spotty white calcareous									
3535	65															
			Core	60	100,100	-	lt. gray, dry, very hard rock	243								0,0,0, 0,3
							fracture at 66.9' & 69.2', undulating, white film									
3530																PL
				44		-	lt. gray, dry, very hard rock									

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) — Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 — Torvane (tsf)

CORE — 95,60 — Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-05

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q. CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ 243.5'?

PROJECT NUMBER: 200804.007.2
DATE STARTED: 4/23/09
DATE COMPLETED: 5/4/09
GROUND ELEVATION: 3599.0'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
								243								
			Core	44	74,26	-	lt. gray, dry, very hard rock — basalt more vuggy white calcite vug at 71.3'									2,3,4, br,m
3525	75						SCORIA & SCORIACEOUS BASALT		143.8	10.5						UC PL
			Core	29	48,8	-	red-brown, dry, soft to very soft rock — missing core; rubble w/red-brown clay; very highly fractured & broken w/rubble; mixed w/brown clay									br,m
3520	80					-	red-brown, dry, soft to very soft rock	447								
			Core	51	100,35	SP-SM	red-brown — SAND W/SILT & GRAVEL									PL
						-	red-brown, dry, soft to very soft rock — CONGLOMERATE TO CONGLOMERATIC YOUNG MUDSTONE W/GRAVEL									
3515			Core	0	0,0	-	red-brown, dry, soft to very soft rock — some red scoriaceous basalt cobbles & gravel; some chert & limestone gravel, indurated alluvium									
	85															
			Core	50	84,0	GP-GM	red-brown, dry, very soft to ext. soft rock									
3510	90						GRAVEL W/SILT & SAND recovered limestone & sandstone gravels/fragments	65								
			Core	20	34,14	GP-GM	red-brown, dry, very soft to ext. soft rock — basalt boulder at 91.8'-92.5'									
3505	95															PL
			Core	0	0,0	GP-GM	red-brown, dry, very soft to ext. soft rock									
			Core	29	96,0	SC-SM	red-brown, dry, very soft to ext. soft rock — CLAYEY SAND W/GRAVEL becoming indurated; limestone & sandstone fragments undulating			15.4	22	4	24	40	36	8% -0.005 mm
3500	100							861								
			Core	41	68,0	SC-SM	red-brown, dry, very soft to ext. soft rock									
						-	gray-red-brown, dry, soft to avg. hard rock — VUGGY BASALT very highly fractured & broken w/rubble									
3495				42		-										

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

LEGEND:

- DISTURBED SAMPLE: 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)
- CORE: 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery
- UNDISTURBED SAMPLE: PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

RB&G ENGINEERING, INC.

DRILL HOLE LOG

BORING NO. 09-AB-05

SHEET 4 OF 8

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q. CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ 243.5'?

PROJECT NUMBER: 200804.007.2
DATE STARTED: 4/23/09
DATE COMPLETED: 5/4/09
GROUND ELEVATION: 3599.0'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
			Core	42	*70,0*	-	brown to purple-brown, dry, soft to avg. hard rock									
3490	110							730								
			Core	31	*52,36*	-	red-brown, dry, soft to avg. hard rock — SCORIA TO SCORIACEOUS BASALT highly broken w/rubble; some white calcite coatings; vuggy basalt		135.7	1.2						UC PL
3485	115															
			Core	12	*20,0*	-	red-brown, dry, soft to avg. hard rock									
3480	120					-	red-brown, dry, very soft rock — SCORIA SAND some gravel sized scoria rubble	>1899								
			Core	55	*92,60*	-	gray, dry, very hard rock — BASALT many small vugs; white powdery layers; very slow HCL reaction									br,1,0, 0,1,br
3475	125					-	dk. gray-brown, dry, hard rock — VUGGY BASALT some calcareous film on fractures									PL
			Core	59	*98,58*	-	gray, dry, very hard rock									2,3,1, 2,1
3470	130							>1708								
			Core	61	*102,92*	-	gray, dry, very hard rock — BASALT W/OLIVINE PHENOCRYSTS	2701	176.0	0.6						UC PL 4,2,1, 2,4
3465	135															
			Core	53	*88,70*	-	gray, dry, very hard rock — fracture at 136.8' & 137.1', undulating, 1/16" white calcareous?	>1489								0,2,1, 5,1
3460				60		-	gray, dry, very hard rock — ~1/2" voids at 139.3'									

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

RB&G ENGINEERING, INC.

DRILL HOLE LOG

BORING NO. 09-AB-05

SHEET 5 OF 8

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q. CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ 243.5'?

PROJECT NUMBER: 200804.007.2
DATE STARTED: 4/23/09
DATE COMPLETED: 5/4/09
GROUND ELEVATION: 3599.0'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
			Core	60	*100,50*	-	gray, dry, very hard rock ~1/2" void at 142.5'	>1489								2,5,6, 8,br,m
3455	145		Core	59	*98,64*	-	gray, dry, very hard rock									PL 1,1,8, 0,6
3450	150		Core	62	*104,71*	-	gray, dry, very hard rock	>1639								3,2,3, 6,0
3445	155		Core	61	*102,72*	-	gray, dry, very hard rock BASALT W/OLIVINE PHENOCRYSTS									2,2,1, 3,3
3440	160		Core	60	*100,36*	-	gray, dry, very hard rock	1124								UC PL 6,2,2, 0,2
3435	165		Core	64	*106,86*	-	gray, dry, very hard rock		175.2	1.0						3,2,3, 2,3
3430	170		Core	60	*100,72*	-	gray, dry, very hard rock	619								1,1,2, 6,2
3425				51		-	gray, dry, very hard rock									

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — CORE 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-05

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q. CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ 243.5'?

PROJECT NUMBER: 200804.007.2
DATE STARTED: 4/23/09
DATE COMPLETED: 5/4/09
GROUND ELEVATION: 3599.0'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
																PL
			Core	51	*85,78*	-	gray, dry, very hard rock									2,3,4, 3,3
3420							BASALT W/OLIVINE PHENOCRYSTS									
	180					-	gray, dry, very hard rock									
							a few more vugs below 181'	431								
			Core	69	*115,90*	-	gray, dry, very hard rock									2,5,7, 5,3
							BROKEN BASALT W/SCORIA very vuggy									
3415																
	185						SCORIA TO SCORIACEOUS BASALT w/basalt layers									
			Core	53	*98,42*	-	red-brown to brown, dry, very hard rock									2,5,br
3410																
	190						VUGGY BASALT W/SCORIA LAYERS some pink-brown layers; some solid layers & highly fractured	893								
			Core	59	*89,36*	-	gray, dry, very hard rock		164.0	0.8						UC PL 3,5,1, 3,br
3405																
	195															
			Core	34	*75,13*	-	red-brown, dry, very hard rock									br
							SCORIA broken to rubble									
3400			Core	0	*0,0*	-	no recovery	>1072								
	200					-	red-brown, dry, very hard rock									
			Core	44	*74,52*											br, 0,0
						-	gray, dry, very hard rock									
3395							BASALT solid; non-vuggy									
	205															
			Core	62	*104,70*	-	gray, dry, very hard rock		171.9	0.6						UC PL 1,br,3, 1,4
							BASALT some very highly fractured zones									
3390																
				61		-	gray, dry, very hard rock									

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-05

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
PROJECT NUMBER: 200804.007.2
CLIENT: W.C.W.C.D.
DATE STARTED: 4/23/09
LOCATION: SEE SITE PLAN
DATE COMPLETED: 5/4/09
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q. CORE
GROUND ELEVATION: 3599.0'
DRILLER: D. SAMPSON
LOGGED BY: M. HANSEN
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ 243.5'?

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				61	Core 102,72	-	gray, dry, very hard rock									8,5,2, 1,3
3385	215								177.1	0.3						UC PL
				56	Core 94,66	-	gray, dry, very hard rock; fractures at 217', smooth w.white calcareous coating, very thin									2,2,4, 1,0
3380	220															
				61	Core 109,109	-	gray, dry, very hard rock									0,0,0, 0,0
3375	225						fractures at 223.3' & 224.3', rough, tight, spotty white calcareous									
				62	Core 104,100	-	BASALT some very highly fractured zones; gray, dry, very hard rock									0,0,0, 0,1
3370	230						fractures at 229.2', 229.6', 231.5', 232.2' & 232.9'; rough, trace white calcareous									PL
				61	Core 96,96	-	gray, dry, very hard rock									1,0,0, 1,0
3365	235						fractures at 235', 236.5', 237.5', 238.5' & 239.5'; rough w/spotty calcareous film to coating									
				61	Core 102,90	-	gray, dry, very hard rock; 1/4" healed breccia at 237.8'									2,1,1, 2,2
3360	240															
				59	Core 98,58	-	gray, dry, very hard rock									3,0,1, 0,br
3355				29		-	red-brown, wet, very hard rock; SCORIA very highly broken									

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — CORE 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

RB&G ENGINEERING, INC.

DRILL HOLE LOG

BORING NO. 09-AB-05

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q. CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ 243.5'?

PROJECT NUMBER: 200804.007.2
DATE STARTED: 4/23/09
DATE COMPLETED: 5/4/09
GROUND ELEVATION: 3599.0'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				29	Core 73,0	SP	orange, wet, soft rock — NAVAJO SANDSTONE (SAND) some cross-bedding, very highly weathered, fractured			7.5		NP	0	97	3	br
3350	250															
3345	255															
3340	260															
3335	265															
3330	270															
3325	275															
3320																

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — CORE 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-05A

SHEET 1 OF 1

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ DRY'

PROJECT NUMBER: 200804.007.2
DATE STARTED: 4/23/09
DATE COMPLETED: 4/23/09
GROUND ELEVATION: 3599.3'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				8	3,2,3,(10)	SM	brown, dry, loose SILTY SAND									
3595	5			0	Pushed	-	no recovery									
				15	30,29,27,(99+)	CL	lt. brown, dry, hard SANDY CLAY W/GRAVEL angular-subrounded limestone clast									
3590	10			14	47,57,84,(99+)	GM	brown, dry, very dense SILTY GRAVEL W/SAND plastic; possible cobbles; basalt gravels; calcite/caliche?									
3585	15			12	35,60/6", (REF)	GM	brown, dry, very dense									
3580																

465
29
369

2009012.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE: 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

UNDISTURBED SAMPLE: PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-06

PROJECT: HURRICANE CLIFFS RES. SITES - AFTERBAY, OPTION 2 NORTH DAM
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 109.4' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 5/5/09
DATE COMPLETED: 5/12/09
GROUND ELEVATION: 3582.4'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3580				18	5,4,5,(19)	SM	lt. brown, dry, med. dense — SILTY SAND	491								
	5						SANDY SILT									
				10	Pushed	ML	few white stringers; trace gravel; pinhole structure — lt. brown, dry		99.7	6.7	21	3	0	25	75	CT
				12	6,3,4,(14)	ML	lt. brown, dry, med. dense									
3575								121								
	10						CLAYEY GRAVEL W/SAND									
				14	37,50,50,(99+)	GC	possible cobbles — lt. brown, dry, very dense									
3570								773								
	15															
				13	26,31,23(80)	SC	lt. brown to red-brown, dry, dense — CLAYEY SAND W/GRAVEL possible cobbles			6.2	28	11	36	36	28	
3565								159								
	20															
				11	40,60/5", (REF)	GM	brown, slightly moist, very dense — SILTY GRAVEL W/SAND possible cobbles									
3560								102								
	25															
				15	19,40,60,(99+)	SM	brown, slightly moist, very dense — SILTY SAND calcareous; some basalt gravel			11.3	29	1	20	42	38	HYD
3555								171								
	30															
				13	60,47,33,(94)	GP-GM	brown, slightly moist, dense — GRAVEL W/SILT & SAND some scoria gravel									
3550								41								
							SILTY SAND W/GRAVEL									

200804.007.2 HCH_09-AB-6.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — CORE 95,60 ← Rock Quality Designation (% RQD); ← Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-06

PROJECT: HURRICANE CLIFFS RES. SITES - AFTERBAY, OPTION 2 NORTH DAM
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 109.4' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 5/5/09
DATE COMPLETED: 5/12/09
GROUND ELEVATION: 3582.4'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
			11	28,60/5",(REF)		SM	brown, slightly moist, very dense			11.6		NP	41	45	14	HYD
3545							SILTY SAND W/GRAVEL	26								
	40		2	4/2",(REF)		GP-GM	lt. pink-brown, slightly moist, very dense									
3540							GRAVEL W/SILT & SAND	992								
	45		12	24,61/6", (REF)		SP-SM	interbedded pink-brown & rusty-brown, slightly moist, very dense									
3535								1744								
	50		11	31,51/6", (REF)		SP-SM	rusty-brown, slightly moist, very dense			15.4		NP	46	48	6	HYD
							SCORIACEOUS VOLCANIC, SAND W/SILT & GRAVEL (crushed & broken scoria)									
3530								7364								
	55		13	14,12,14,(24)		SP-SM	rusty-brown, slightly moist, med. dense									
3525								967								
	60								155.6	0.2						UC PL Slaking
3520			44	Core 93,93		-	gray, very hard rock									0,1,1, 0
							VUGGY BASALT									
	65															
			60	Core 100,84		-	gray, very hard rock									0,1,0, 0,5
3515							100% water loss at 67.5'; fracture at 67.5', open, rough, calcite coating to 1/32" thick	1383								
						-	gray, very hard rock	46								
							water back at 69.5'									

200804.007.2 HCH_09-AB-6.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — CORE 95,60 ← Rock Quality Designation (% RQD); ← Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-06

PROJECT: HURRICANE CLIFFS RES. SITES - AFTERBAY, OPTION 2 NORTH DAM
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 109.4' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 5/5/09
DATE COMPLETED: 5/12/09
GROUND ELEVATION: 3582.4'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description		Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3510																	
			Core	58	96,84	-	gray, very hard rock	VUGGY BASALT fracture at 73.5', smooth, spotty calcareous film	1383								1,2,0, 0,1
	75							100% water loss at 76'; fracture at 76', smooth, calcareous coating	46								
			Core	62	104,80	-	gray, very hard rock	water coming back at 78'		170.6	0.2						3,3,1, 0,2 UC PL
3505																	
	80							fracture at 80.5' & 81', smooth, spotty calcareous coating									
			Core	59	98,86	-	gray, very hard rock		8								PL 0,2,2, 0,1
3500																	
	85																
			Core	64	106,106	-	gray, very hard rock										0,0,0, 0,0
3495																	PL
	90							BASALT W/OLIVINE PHENOCRYSTS very few vugs water still coming back at 90'									
			Core	61	102,88	-	gray, very hard rock	starting at 92' many tight, closed, hairline fractures; fractures are tight w/no infilling									1,1,0, 2,1
3490																	
	95								3								
			Core	59	98,80	-	gray, very hard rock										1,2,2, 2,1
3485																	
	100																
			Core	58	96,76	-	gray, very hard rock										0,2,2, 0,2br UC PL Slaking
3480										175.8	0.3						

200804.007.2 HCH 09-AB-6.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — CORE 95,60 ← Rock Quality Designation (% RQD); ← Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-06

PROJECT: HURRICANE CLIFFS RES. SITES - AFTERBAY, OPTION 2 NORTH DAM
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 109.4' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 5/5/09
DATE COMPLETED: 5/12/09
GROUND ELEVATION: 3582.4'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
							100% water loss at 105'									
3475				64	Core 106,50	-	rusty-brown to red-brown, ext. soft to very soft rock		155.9	0.7						2,br,br, 3,2 UC PL
	110						SCORIA w/some vuggy basalt & basalt layers (all rusty-brown w/white crystals); mostly broken & rubble									
3470				48	Core 80,10	-	rusty-brown to red-brown, ext. soft to very soft rock									3,br,br, br,br
	115															
3465				58	Core 96,86	-	purple-gray, avg. hard to hard rock									3,1,2, 2,2
							fracture at 118.2' & 119', rough, spotty, white calcareous coating									PL
	120						BASALT many white crystals; few vugs									
3460				62	Core 104,72	-	purple-gray, very hard rock		164.3	1.3						3,1,1, 3,1 UC PL
							fracture at 122.2', rough, spotty, white calcareous coating									
	125					-	purple-gray, very hard rock	>1912								
3455				56	Core 94,56	-	gray, very hard rock									1,3,1, 2,1
	130															
3450				64	Core 106,68	-	gray, very hard rock									0,3,0, 4,4
							BASALT calcareous crystals at 133'	>1759								PL
	135															
3445				56	Core 94,91	-	gray, very hard rock									0,1,2, 0,1
						-	gray, very hard rock									

200804.007.2 HCH_09-AB-6.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — CORE 95,60 ← Rock Quality Designation (% RQD); ← Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-06

PROJECT: HURRICANE CLIFFS RES. SITES - AFTERBAY, OPTION 2 NORTH DAM
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 109.4' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 5/5/09
DATE COMPLETED: 5/12/09
GROUND ELEVATION: 3582.4'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3440				62	Core 108,81	-	gray, very hard rock		167.5	0.6						UC PL 2,3,1, 2
							fracture at 143.75'-144.5', smooth w/white-pink coating, partially healed									
	145						BASALT									
				62	Core 104,68	-	gray, very hard rock									6,1,4, 2,5
3435							fracture at 145.5'-145.8', partially open, 25% healed breccia									
							fracture at 148'-149.4', 25% healed breccia									
	150			17	Core 76,0	-	rusty-red-brown SCORIA									4, br,m
				0	Core 0,0	-	yellow-brown CONGLOMERATE baked?									
3430				18	Core 50,0	-	red-brown, soft to hard rock to very stiff soil OLD ALLUVIUM indurated; lithifying conglomeratic mudstone to conglomerate									
	155			60	Core 100,0	SC	red-brown, very soft rock to hard soil CLAYEY SAND W/GRAVEL softer; limestone, sandstone & basalt gravels									
3425						SM	red-brown, very soft rock to hard soil SILTY SAND indurated			23.5	39	20	4	55	41	
	160			59	Core 98,0	SM	red-brown, very soft to ext. soft rock SILTY SAND W/GRAVEL many gravels are very highly weathered & soft									
3420																
	165					SM			117.8	6.6		NP	0	84	16	UC PL 4,7,4, 4,6
				60	Core 100,26	-	red-brown, soft to hard rock									
3415							NAVAJO SANDSTONE cross beding; highly fractured									
	170															
				60	Core 100,38	-	red-orange-brown, soft to hard rock									2,3,5, 4,4
3410																

>1671

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — CORE 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-07

SHEET 1 OF 8

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: PUMPHOUSE, SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ DRY TO 258.0' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 5/14/09
DATE COMPLETED: 5/27/09
GROUND ELEVATION: 3676.6'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3675				14	4,4,5	ML	lt. brown, dry, stiff — SANDY SILT W/GRAVEL limestone; brachiopods	882								
	5			15	24,20,14	GM	lt. brown, dry, med. dense — SILTY GRAVEL W/SAND plastic; possible cobbles			12.0	36	11	48	33	19	2% -0.005 mm
3670								95								
	10			11	7,11,14	SC	brown to lt. red-brown, dry, dense — CLAYEY SAND W/GRAVEL gravel layers; white stringers									
3665								156								
	15			18	16,37,58	SC / GM	brown to lt. red-brown, dry / gray, dry, very dense			10.8	34	19	32	33	35	1% -0.005 mm
3660								211								
	20			5	60/5",(REF)	GM	lt. brown, dry, very dense — SILTY GRAVEL W/SAND plastic; cobbles									
3655								35								
	25			12	22,60/6",(REF)	GM	pink-brown & gray, dry, very dense			9.4	40	12	36	30	34	1% -0.005 mm
3650								71								
	30			4	60/4.5",(REF)	GC-GM	brown to red-brown, dry to slightly moist, very dense — SILTY CLAYEY GRAVEL W/SAND abundant calcite/gypsum(?) powder & crystals									
3645								34								
							SILTY GRAVEL W/SAND plastic; possible cobbles; white stringers									

200804.007.2 HCH_09-AB-7.GPJ US EVAL.GDT 11/6/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6"; $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-07

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: PUMPHOUSE, SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ DRY TO 258.0' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 5/14/09
DATE COMPLETED: 5/27/09
GROUND ELEVATION: 3676.6'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
			4	60/4",(REF)		GM	mottled brown & red-brown, dry to slightly moist, very dense									
3640								149								
	40		4	60/5",(REF)		GM	red-brown, dry to slightly moist, very dense — SILTY GRAVEL W/SAND plastic; possible cobbles; white stringers									
3635								79								
	45		9	60,60/3",(REF)		GM	brown, dry to slightly moist, very dense — SILTY GRAVEL W/SAND & COBBLES calcite lenses			8.1		NP	45	39	16	2% -0.005 mm
3630								989								
	50		6	28,60/5",(REF)		SM	brown, dry to slightly moist, very dense — SILTY SAND W/GRAVEL									
3625								790								
	55		3	60/4",(REF)		GM	lt. brown & red-brown, dry to slightly moist, very dense — SILTY GRAVEL W/SAND & COBBLES gypsum nodules	412								
3620								2238								
	60		5	55,60/2",(REF)		GM	lt. brown & red-brown, dry to slightly moist, very dense									
3615								1434 1012								
	65		2	60/4",(REF)		CL-ML	red-brown, dry to slightly moist, hard — SILTY CLAY W/GRAVEL some white stringers; some green mudstone fragments; possible cobbles; looks like older alluvium									
3610																

200804.007.2 HCH 09-AB-7.GPJ US EVAL.GDT 11/6/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) — Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 — Torvane (tsf)

CORE — CORE 95,60 — Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-07

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: PUMPHOUSE, SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ DRY TO 258.0' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 5/14/09
DATE COMPLETED: 5/27/09
GROUND ELEVATION: 3676.6'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3605				6	68/6",(REF)	GC-GM	lt. brown to red-brown, dry to slightly moist, very dense — SILTY CLAYEY GRAVEL W/SAND; white gypsum nodules; looks like younger alluvium	1012								
	75			11	47,61/6",(REF)	GM	yellow-brown, dry to slightly moist, very dense — SILTY GRAVEL W/SAND; white gypsum or calcite lenses; strong HCL reaction; plastic; possible cobbles			13.4	43	14	34	33	33	2% -0.005 mm
3600																
	80			4	60/4",(REF)	GM	yellow-brown, dry to slightly moist, very dense									
3595																
	85			6	66/6",(REF)	ML	red-brown, dry to slightly moist, very dense — SANDY SILT; some clay; trace pinholes; calcite encrusted; trace gravel									
3590																
	90			4	75/4",(REF)	ML	red-brown, moist, very dense — SANDY SILT; trace clay; strong HCL reaction; white gypsum or calcite lenses; may be older alluvium									
3585																
	95			5	80/6",(REF)	SM	yellow-brown, moist, very dense — SILTY SAND W/GRAVEL; limestone sand & gravel, possible cobbles									
3580																
	100			5	82/6",(REF)	GC	red-brown, moist, very dense — CLAYEY GRAVEL W/SAND									
3575																

200804.007.2 HCH 09-AB-7.GPJ US EVAL.GDT 11/6/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6"; $(N_1)_{60}$ Value
0.45 ← Torvane (tsf)

CORE — CORE 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-07

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: PUMPHOUSE, SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ DRY TO 258.0' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 5/14/09
DATE COMPLETED: 5/27/09
GROUND ELEVATION: 3676.6'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description		Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3570				6	83/6",(REF)	CL-ML	red-brown, moist, hard	SANDY SILTY CLAY trace gravel; lots of white gypsum/calcite; some green-gray mudstone fragments; older alluvium									
	110			5	80/5",(REF)	CL-ML	red-brown, moist, hard	SANDY SILTY CLAY W/GRAVEL possible cobbles; limestone gravel; trace white gypsum/calcite									
3565																	
	115			3	80/3",(REF)	SM	red-brown, moist	SILTY SAND W/GRAVEL									
					0.33	CL-ML	red-brown, moist, hard										
3560								DRILLED LIKE SANDY SILTY CLAY W/SOME GRAVEL possible cobbles									
	120			0	80/1",(REF)	-	no recovery										
3555																	
	125			4	75/4",(REF)	ML	red-brown, moist, very dense	SANDY SILT W/SOME CLAY some basalt; many white stringers									
3550																	
	130			3	70/3",(REF)	ML	red-brown, moist, very dense										
3545								SANDY SILT W/GRAVEL w/scoria gravels; some limestone gravels; transition to scoria/basalt									
	135																
3540								BASALT W/VUGS									

200804.007.2 HCH 09-AB-7.GPJ US EVAL.GDT 11/6/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) — Blow Count per 6" / $(N_1)_{60}$ Value; *0.45* — Torvane (tsf)

CORE — CORE *95,60* — Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED *0.45* — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-07

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: PUMPHOUSE, SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ DRY TO 258.0' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 5/14/09
DATE COMPLETED: 5/27/09
GROUND ELEVATION: 3676.6'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
				0	60/0",(REF)	-	no recovery									
3535				55	Core 92,68	-	gray, very hard rock — fracture at 142.5, smooth, white, spotty calcareous film									UC 2,0,2, 1,2 PL
	145						100% water loss at 145.5', very highly fractured & broken layers									
3530				56	Core 94,18	-	gray, very hard rock — fracture at 145.5'-147', open, near vertical, rough, rusty-green coating, slightly scoriaceous basalt									br 8,9,7, br,4
	150						BASALT W/VUGS									
3525				55	Core 91,78	-	gray, very hard rock									3,2,0, 1,1
	155															PL
3520				46	Core 76,28	-	gray, very hard rock — 157'-158' very highly broken w/lt. brown silty infilling/coating									2,3,br, br,m
	160			10	Core 160,0	CL-1	orange-red-brown — LEAN CLAY W/SAND & GRAVEL			14.1	21	8	22	26	52	17% -0.005 mm
3515				12	Core 22,0	-	red-brown									
	165					GP-GM				7.3	20	3	69	23	8	4% -0.005 mm
3510				24	Core 50,0	-	red-brown — ALLUVIUM - GRAVEL W/SILT & SAND slightly plastic; cobbles; very old alluvium water lost after sample at 176'									
	170			6	Core 50,0	-	red-brown									
3505				12	Core 20,0	-	red-brown									

200804.007.2 HCH 09-AB-7.GPJ US EVAL.GDT 11/6/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — CORE 95,60 ← Rock Quality Designation (% RQD); 95 ← Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-07

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: PUMPHOUSE, SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ DRY TO 258.0' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 5/14/09
DATE COMPLETED: 5/27/09
GROUND ELEVATION: 3676.6'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
				0	Core	-	no recovery									
				0	0,0 60/1",(REF)	-	no recovery									
3500																
	180		1		70/1.5",(REF)	GM	red-brown, moist, very dense SILTY GRAVEL W/SAND plastic; chert-limestone fragments, possible cobbles									
3495																
	185		3		60/3",(REF)	SC-SM	red-brown, moist, very dense									
3490																
	190						SILTY CLAYEY SAND W/GRAVEL chert-limestone fragments, possible cobbles									
3485																
	195		0		60/2",(REF)	-	no recovery									
3480																
	200		5		80/5.5",(REF)	CL	red-brown, moist to dry, hard									
3475							LEAN CLAY W/SAND some gravels; some white stringers; some gravelly layers; may be young mudstone; indurating									
	205		0.5		75/1",(REF)	CL	red-brown, moist, hard									
3470																

200804.007.2 HCH 09-AB-7.GPJ US EVAL.GDT 11/6/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-07

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: PUMPHOUSE, SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ DRY TO 258.0' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 5/14/09
DATE COMPLETED: 5/27/09
GROUND ELEVATION: 3676.6'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3465																
	215			0.5	80/1",(REF)	CL	red-brown, moist, hard									
3460																
	220															
3455																
	225			2.5	70/3",(REF)	CL	red-brown, moist, hard									
3450							LEAN CLAY W/SAND some gravels; some white stringers; some gravelly layers; may be young mudstone; indurating									
	230															
3445																
	235			0.5	70/1",(REF)	CL	red-brown, moist, hard									
3440																
	240															
3435																

200804.007.2 HCH_09-AB-7.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) — Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 — Torvane (tsf)
CORE — CORE 95 60 — Rock Quality Designation (% RQD); Percent Sample Recovery
UNDISTURBED SAMPLE — PUSHED 0.45 — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-07

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: PUMPHOUSE, SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING, H.Q.3 CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ DRY TO 258.0' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 5/14/09
DATE COMPLETED: 5/27/09
GROUND ELEVATION: 3676.6'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3430				0.5	70/0.5",(REF)	CL	red-brown, moist, hard									
	250						LEAN CLAY W/SAND some gravels; some white stringers; some gravelly layers; may be young mudstone; indurating									
3425																
	255			2.5	70/2.5",(REF)	CL	red-brown, moist, hard									
3420																
	260			25	Core 100,0	GC	red-brown CLAYEY GRAVEL W/SAND indurated to conglomeratic mudstone; red-brown sandstone cobble at 259.5'-260'			5.3	27	8	44	25	31	
3415																
	265			98	Core 82,0	SC-SM	red-brown SILTY CLAYEY SAND W/GRAVEL some mudstone fragments; some red-brown sandstone cobbles; angular limestone, chert & mudstone fragments									
3410																
	270					SC-SM				8.1	26	6	20	40	40	6% -0.005 mm
3405				0	90/0.5",(REF)		red-brown									
	275															
3400																

200804.007.2 HCH_09-AB-7.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) — Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 — Torvane (tsf)

CORE — CORE 95,60 — Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-08

SHEET 1 OF 2

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING & N.Q. CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 8/20/09
DATE COMPLETED: 8/24/09
GROUND ELEVATION: 3555.7'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
3555	0															
				6	3,3,3,(14)	SM	lt. brown, dry, med. dense									
							SILTY SAND W/GRAVEL slightly plastic, sample became hot & hardens when water added									
				9	13,8,7,(34)	SM	lt. brown, moist, dense			11.6	28	1	30	52	18	
	5							2954								
3550				11	7,7,10,(39)	SM	lt. brown, moist, dense									SS - 13.2%
				10	10,14,9,(45)	SM	lt. brown, moist, dense			7.0		NP	32	34	34	SS - 15.1%
							SILTY SAND W/GRAVEL occasional sandy silt layer to 4" thick									
	10							1991								
3545				10	4,8,10,(31)	SM	lt. brown, moist, dense									
	15							266								
3540				11	18,31,25,(80)	SM	red-brown, slightly moist, very dense			5.6	18	3	26	44	30	SS - 11.5%
							SILTY SAND W/GRAVEL plastic, possible cobbles									
	20					CL-ML	SANDY SILTY CLAY gypsum lenses									
							red-brown, moist, firm									
3535				13	11,40,30,(87) 0.35	SM	red-brown, slightly moist, very dense									
							SILTY SAND W/GRAVEL plastic, possible cobbles									
	25							1955								
3530				11	19,22,24,(51)	GM	very lt. red-brown, moist, dense			4.4		NP	32	31	37	
							SILTY GRAVEL W/SAND possible cobbles									
	30					GM	very lt. red-brown, moist	996								
3525				9	12,14,23,(38)	SP-SM	red-brown, moist, dense			9.0		NP	2	87	11	SS - 0.5%
							SAND W/SILT (NAVAJO SANDSTONE)									
								2323								
								1632-1378								

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — CORE 95,60 ← Rock Quality Designation (% RQD); ← Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-08

SHEET 2 OF 2

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING & N.Q. CORE
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 8/20/09
DATE COMPLETED: 8/24/09
GROUND ELEVATION: 3555.7'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
3520				4	50/4",(REF)	SP-SM	red-brown, moist, very dense									
							SAND W/SILT (NAVAJO SANDSTONE)	1632								
	40			0	50/2",(REF)	-	no recovery									
3515				7	Core 16,0	-	red-brown, soft rock	1378								
	45															
3510				12	Core 20,0	-	red-brown, soft rock									
							near vertical fracture at 47', 100% water loss									
	50															
3505				19	Core 32,0	-	red-brown, soft rock									
							NAVAJO SANDSTONE FORMATION highly weathered; drys to orange color	536								
	55															
3500				54	Core 90,0	-	red-brown, soft rock									
						SM				0.1		NP	1	80	19	PL
	60															
3495				34	Core 56,0	-	red-brown, soft rock									
	65															
3490																

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) — Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 — Torvane (tsf)

CORE — CORE 95,60 — Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-09

SHEET 1 OF 2

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 8/25/09
DATE COMPLETED: 8/26/09
GROUND ELEVATION: 3585.6'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
3585				12	4,4,8,(27)	SM	very lt. brown, dry, med. dense — SILTY SAND W/GRAVEL			0.8		NP	28	33	39	
						SM	very lt. brown, slightly moist									
				8	5,12,12,(54)	SM	red-brown, slightly moist									SS - 7.6%
	5						SILTY SAND W/GRAVEL plastic, material becomes hot & stiff when water is added									
3580				9	3,7,13,(45)	SM	red-brown, slightly moist			10.1	39	14	25	38	37	
				12	10,25,29,(99+)	GM	red-brown, slightly moist, very dense									
	10						SILTY GRAVEL W/SAND possible cobbles, calcite stringers, gypsum flakes									
3575				10	6,50/6", (REF)	GM	red-brown, slightly moist, very dense									
				13	10,32,30,(96)	SM	red-brown, slightly moist, very dense — SILTY SAND W/GRAVEL			7.1		NP	28	51	21	
	15					GC	lt. red-brown, slightly moist — CLAYEY GRAVEL W/SAND									
3570				10	12,27,22,(70)	SM	red-brown, slightly moist, very dense									SS - 4.8%
							SILTY SAND W/GRAVEL possible cobbles									
	20															
3565				9	25,50/6", (REF)	SM	brown, slightly moist, very dense			6.6		NP	24	53	23	
	25															
3560				15	32,45,45,(99+) *0.50*	SC	red-brown, slightly moist, very dense			8.7	37	17	28	42	30	
							CLAYEY SAND W/GRAVEL material becomes hot & stiff when water is added									
	30															
3555				15	22,34,42,(78)	SC	lt. brown, slightly moist, dense									SS - 14.0%
							SILTY SAND W/GRAVEL									

Permeability (ft/yr): 311, 277, 664, 711, 369, 453, 3191

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; *0.45* ← Torvane (tsf)

UNDISTURBED SAMPLE — PUSHED; *0.45* ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-09

SHEET 2 OF 2

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 8/25/09
DATE COMPLETED: 8/26/09
GROUND ELEVATION: 3585.6'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
3550				14	15,23,47,(66)	SM	lt. brown, slightly moist, dense — SILTY SAND W/GRAVEL	4425		4.6		NP	18	49	33	
3545	40			13	12,10,13,(20)	SM/SC-SM	lt. brown, slightly moist, med. dense — SILTY SAND TO SILTY CLAYEY SAND	537								
3540	45			12	12,15,12,(23)	SM	red-brown, slightly moist, med. dense — SILTY SAND W/GRAVEL	6551		5.1		NP	19	46	35	SS - 11.0%
3535	50			1	50/3",(REF)	GP-GM	brown, slightly moist, very dense — GRAVEL W/SILT & SAND possible cobbles	912								
3530	55			7	42,50/1",(REF)	CL-ML	red-brown, moist, hard — SANDY SILTY CLAY very weathered mudstone	7215		13.0	23	6	4	39	57	
							NAVAJO SANDSTONE (driller's observation)									
3525	60			0	50/2",(REF)	-	no recovery									
3520	65															

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:
DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-10

SHEET 1 OF 2

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 8/27/09
DATE COMPLETED: 8/28/09
GROUND ELEVATION: 3667.1'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				8	3,2,10,(27)	GM	very lt. brown, dry, med. dense									
3665				14	16,32,21,(99+)	GM	very lt. brown, moist, very dense — SILTY GRAVEL W/SAND gypsum, possible cobbles	4959		8.0		NP	48	27	25	SS - 14.4%
	5			12	9,13,13,(59)	GM	lt. brown, moist, dense	2149								
3660				11	11,12,14,(51)	SM	lt. red-brown, moist, very dense — SILTY SAND W/GRAVEL white stringers, possible cobbles	1373		8.2		NP	23	37	40	SS - 15.0%
	10			12	11,15,16,(53)	GM	red-brown, moist, dense — SILTY GRAVEL W/SAND possible cobbles	827		6.2		NP	49	32	19	SS - 9.4%
3655																
	15			11	19,28,22,(71)	SM	lt. red-brown, moist, very dense	708								
3650																
	20			12	24,42,36,(97)	SM	red-brown, moist, very dense	918		5.7		NP	36	38	26	SS - 6.1%
3645							SILTY SAND W/GRAVEL trace of clay, slightly cemented, few white stringers									
	25			10	9,16,18,(38)	SM	red-brown, moist, dense	3006								
3640																
	30			10	22,62/6", (REF)	SM	brown to red-brown, moist, very dense	127		7.4		NP	34	43	23	SS - 7.8%
3635																

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-10

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 8/27/09
DATE COMPLETED: 8/28/09
GROUND ELEVATION: 3667.1'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				0.5	60/1",(REF)	SM	very lt. red-brown, moist, very dense									
3630								55								
	40			9	39,60/3", (REF)	SM	lt. red-brown, moist, very dense — SILTY SAND W/GRAVEL gypsum lenses, possible cobbles, rock crushed to sand in samples			5.9		NP	28	45	27	
3625								2431								
	45			10	17,54/6", (REF)	GM	red-brown to gray, moist, very dense — SILTY GRAVEL W/SAND possible cobbles, crushed rock in samples, gypsum lenses									SS - 8.6%
3620								8700								
	50			14	24,42,40,(65)	GM	lt. gray, moist, dense									
3615																
	55															
3610																
	60															
3605																
	65															
3600																

200901.200 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 11/3/09

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride

DRILL HOLE LOG

BORING NO. 09-AB-11

SHEET 1 OF 3

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING & H.Q. CORE, DIP 60°, TREND N75°W
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 12/8/09
DATE COMPLETED: 12/19/09
GROUND ELEVATION: ~3527.0'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
							Note: Vertical hole drilled to 8', then angled drill hole. Sandstone at 7' vertically.									
3525							SANDY SILTY CLAY TO SANDY LEAN CLAY									
				12	6,9,12,	CL-ML,CL	lt. red-brown, dry									
						SM	pink-brown									
	5			18	7,17,38,	SM	orange-reddish-brown									
							SILTY SAND may be very highly weathered sandstone									
3520				3	60/3"	SM	orange-reddish-brown									
							SANDSTONE	1,530								
	10			0	Core 0,0	-	orange									
							Start Angle Boring Log at 10'									
3515							SANDY CUTTING									
	15			0	Core 0,0	-	orange									
3510	20			42	Core 70,0	-	orange-reddish-brown, soft rock									
							53° fracture at 19.9'-20.1', gypsum healed (1/32" thick)									
						SP-SM (A-2-4(0))	highly fractured at 17'-27.5', many fractures appear mechanical	770	120.7	5.4		NP	0	88	12	PL
3505	25			48	Core 80,10	-	orange-reddish-brown, soft rock									
							NAVAJO SANDSTONE Eolian Sandstone, relatively fine-medium grained sand, well rounded, well sorted, quartz grains									
	30			59	Core 58,78	-	orange-reddish-brown, soft rock									
						SP-SM (A-2-4(0))	more competent at 27.5'-32'	5,613	125.5	5.8		NP	0	88	12	UC
3500				44	Core 74,0	-	orange-reddish-brown, soft rock									

200804.007.2 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 3/12/10

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — CORE 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-11

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING & H.Q. CORE, DIP 60°, TREND N75°W
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 12/8/09
DATE COMPLETED: 12/19/09
GROUND ELEVATION: ~3527.0'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3495			Core	44	74,0	-	orange-reddish-brown, soft rock	5,613								
	40		Core	30	50,8	-	orange-reddish-brown, soft rock									
						SP-SM (A-2-4(0))		5,095	129.7	4.4		NP	0	88	12	PL
3490							highly fractured at 32'-54'									
	45		Core	29	48,8	-	orange-reddish-brown, soft rock									
3485																
	50		Core	36	60,0	-	red-brown, soft rock									
						SP-SM (A-3(0))			128.9	5.2		NP	0	91	9	UC
							NAVAJO SANDSTONE Eolian Sandstone, relatively fine-medium grained sand, well rounded, well sorted, quartz grains	>5,685								
3480	55		Core	53	88,32	-	red-brown, soft rock									
							joint at 53.3'-53.6', 65°, no stain									
							less fractured at 54'-56'									
							100% water loss at 56.7'									
							joint at 56.6'-56.9', 60°, no stain									
			Core	48	80,26	-	missing core at 58'-59', very highly fractured									
3475	60						red-brown, soft rock									
							100% water loss at 59'									
							cross bedding									
						SP-SM (A-3(0))		4,431	131.7	7.7		NP	0	90	10	PL
							joint at 62.5'-62.8', 75°, no coating/stain									
	65		Core	48	80,15	-	orange-reddish-brown, soft rock									
3470							broken zone at 64'-65.5', cross bedding									
			Core	50	84,13	-	orange-reddish-brown, soft rock	3,022								
							highly fractured at 67'-69'									
							joint at 68.9'-69.1', 60°, no stain									

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — CORE 95,60 ← Rock Quality Designation (% RQD) / Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-11

SHEET 3 OF 3

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING & H.Q. CORE, DIP 60°, TREND N75°W
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 12/8/09
DATE COMPLETED: 12/19/09
GROUND ELEVATION: ~3527.0'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3465			Core	50	84,13	- SP-SM (A-2-4(0))	orange-reddish-brown, soft rock highly fractured on bedding at 70'-71' joint at 71.2'-71.5', 53°, no stain		122.1	5.3		NP	0	81	19	UC
	75		Core	56	94,52	-	orange-reddish-brown, soft rock joint at 73.5'-74', 75° joint at 74'-74.4', 57°, conjugate	>3.022								
3460																
	80		Core	36	60,8	- SP-SM (A-2-4(0))	orange-reddish-brown, soft rock joint at 80'-80.3', 62°, white part. film joint at 81.3'-81.6', 50°		132.3	3.3		NP	0	81	19	PL
3455								>3.591								
	85		Core	38	64,0	-	orange-reddish-brown, soft rock joint at 81'-87', very highly fractured, multiple angles & conjugate joints NAVAJO SANDSTONE Eolian Sandstone, relatively fine-medium grained sand, well rounded, well sorted, quartz grains									
3450																
	90		Core	41	68,8	- SP-SM (A-3(0))	orange-reddish-brown, soft rock very highly fractured at 80'-93' fracture at 90.5'-91', 80°, no stain 92'-93.4' is very soft rock (sandy), may be drill cuttings		117.3	8.0		NP	0	92	8	UC
3445								>2.474								
	95		Core	56	94,38	-	orange-reddish-brown, soft rock fracture at 94.3'-96.7', 70°, no stain joint at 96.3'-96.5', 40°									
	100		Core	54	90,9	- SP-SM (A-3(0))	orange-reddish-brown, soft rock joint at 98.5'-98.7', 55° joint at 99.5'-99.65', 35°, no stain joint at 101'-102', 70°, 1/32" white calc. coating, open		115.0	9.5		NP	0	91	9	PL
3440																

200804.007.2 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 3/12/10

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — CORE 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-12

SHEET 1 OF 3

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING & H.Q. CORE, 60° DIP, TREND N50°W
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▽ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 12/2/09
DATE COMPLETED: 12/8/09
GROUND ELEVATION: 3469.8'
LOGGED BY: J.O., M.H., J.B.

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
				14	12,10,12,	ML	red/white, dry, dense SANDY SILT W/GRAVEL	483								
3465	5			13	14,18,21,	GM GM (A-1-b(0))	red/white, dry, dense SILTY GRAVEL W/SAND			5.4		NP	45	42	13	
							Start Angle Core Log	580								
						SP	red/white SAND W/COBBLES									
3460	10			9	Core 25,0	-	no recovery	881								
	15			0	Core 0,0	-	no recovery LIKELY VERY HIGHLY WEATHERED SANDSTONE									
3455	20			9	Core 15,0	- SM (A-2-4(0))	red-brown, soft rock	289	126.4	5.7		NP	0	86	14	
3450	25			26	Core 43,0	-	red-brown, soft rock vertical fracture at 25'-26', white calc. cemented									PL
3445	30			48	Core 80,36	-	red-brown, soft to ext. soft rock NAVAJO SANDSTONE highly weathered to weathered, highly fractured to few fractures	263								
3440	35			59	Core 98,68	SP-SM (A-2-4(0))	red-brown, soft rock		113.2	8.4		NP	0	88	12	UC PL
				54	Core 90,54	-	red-brown, soft rock	1,348								

200804.007.2 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 3/11/10

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6"; $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — CORE 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-12

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING & H.Q. CORE, 60° DIP, TREND N50°W
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 12/2/09
DATE COMPLETED: 12/8/09
GROUND ELEVATION: 3469.8'
LOGGED BY: J.O., M.H., J.B.

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
				54	Core 90,54	-	red-brown, soft rock									
	45			47	Core 78,13	-	red-brown, soft rock NAVAJO SANDSTONE highly weathered to weathered, highly fractured to few fractures 44'-46.6' many breaks on bedding, mechanical?	1,348								PL
3430				41	Core 68,0	-	red-orange-brown, soft to avg. hard rock 100% water loss at 94'									
	50							4,669								
3425				42	Core 70,30	SM (A-2-4(0)) -	red-orange-brown, soft to avg. hard rock fracture at 55'-56', 80°, healed white halo	7,443	115.7	6.7		NP	0	75	25	UC PL
	55															
3420				55	Core 91,38	-	red-orange-brown, soft to avg. hard rock NAVAJO SANDSTONE highly fractured, most fractures appear to be mechanical on bedding near vertical fracture at 58.5'-61.6', partially open, partially white healed									
	60							4,014								
3415				56	Core 94,60	-	red-orange-brown, soft rock one segement 63.5'-66.6' very highly fractured on bedding at 66.1'-68.5', white healed at 68.3'-68.5'	1,188								PL
	65															
3410				52	Core 86,50	-	red-orange-brown, soft rock									
	70							1,461								
3405				60	Core 100,94	-	red-orange, soft rock NAVAJO SANDSTONE more competent, rock crushes w/hand pressure, some harder layers		120.9	6.0		NP	0	53	47	UC PL
	75					SM (A-4(0))										
				59	Core 98,72	-	red-orange, soft rock	84								

200804.007.2 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 3/11/10

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) — Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 — Torvane (tsf)

CORE — CORE 95,60 — Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-12

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING & H.Q. CORE, 60° DIP, TREND N50°W
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 12/2/09
DATE COMPLETED: 12/8/09
GROUND ELEVATION: 3469.8'
LOGGED BY: J.O., M.H., J.B.

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3400																
				59	Core 98,72	-	red-orange, soft rock									
				60	Core 100,84	-	red-orange, soft rock	84								
	85															PL
3395																
				40	Core 66,31	-	red-orange, soft rock									
	90						NAVAJO SANDSTONE more competent, rock crushes w/hand pressure, some harder layers	2,900								
3390																
				58	Core 96,85	-	red-orange, soft rock	56								
	95					SM (A-2-4(0))			124.0	5.5		NP	2	77	21	UC PL
3385																
				54	Core 90,70	-	red-orange, soft rock									
	100						very highly fractured, broken at 100'-102.5'	2,183								
							take water at 102.5'									
3380				58	Core 96,40	-	orange, soft rock NAVAJO SANDSTONE broken zone, some near vertical, at 102.5'-106.6'	2,393 3,197								
	105					-	red-orange, soft rock NAVAJO SANDSTONE very highly fractured									
3375																
	110															
3370																
	115															

200804.007.2 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 3/11/10

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) — Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 — Torvane (tsf)

CORE — CORE 95,60 — Rock Quality Designation (% RQD) / Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-13

SHEET 1 OF 3

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / HQ CORE, DIP 60°, TREND N52°W, THIN EZMUD POLYMER MIX
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 12/30/09
DATE COMPLETED: 12/31/09
GROUND ELEVATION: ~3497.0'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3495				38	Core 64,50	- SM (A-4(0))	red-brown, soft to avg. hard rock		133.2	5.9		NP	0	61	39	PL
	5			60	Core 100,64	-	orange-red-brown, soft to avg. hard rock; broken, fractures at 5.5'-6', 65°, no coating	269								
3490							broken zone at 8'-9', 35°, no coating									
	10			60	Core 100,66	SM (A-4(0)) -	orange-red-brown, soft to avg. hard rock		129.1	7.1		NP	0	57	43	UC
3485							broken zone at 13'-15', no coating	2,738								
	15			58	Core 96,78	-	NAVAJO SANDSTONE highly weathered, w/some very highly fractured zones between competent layers; orange-red-brown, soft to avg. hard rock									
3480																
	20			32	Core 54,34	-	orange-red-brown, soft to avg. hard rock; at 19'-24' missing 2.3' of core, very highly fractured, washing away(?), near location of east side of projected fault zone; fracture at 22.4'-22.6', 45°, no coating; fracture at 24'-24.8', 75°, no coating	2,022	121.5	10.7		NP	0	77	23	PL
3475	25			60	Core 100,38	SM (A-2-4(0)) -	orange-red-brown, soft to avg. hard rock; highly fractured at 25'-28', 40°-60°, no coating; 27' near vertical lt. brown lense, 80°									
	30															UC
3470				26	Core 44,0	-	orange-red-brown, ext. soft to soft rock; at 29'-34' missing 2.8' of core, extremely soft, washing away(?), fractured, may be on western side of projected fault zone	14								
						SM	at 34' start drilling w/thin ezmud polymer mix		111.2	20.5		NP	0	79	21	

200804.007.2 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 3/11/10

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) — Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 — Torvane (tsf)

CORE — 95,60 — Rock Quality Designation (% RQD) / Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 — Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-13

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / HQ CORE, DIP 60°, TREND N52°W, THIN EZMUD POLYMER MIX
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 12/30/09
DATE COMPLETED: 12/31/09
GROUND ELEVATION: ~3497.0'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
						(A-2-4(0))										
3465				58	Core 96,40	-	orange-red-brown, ext. soft to soft rock — NAVAJO SANDSTONE w/some very highly fractured zones between competent layers, crumbles when handled	14								
	40			60	Core 100,0	SM (A-2-4(0)) -	orange-red-brown, ext. soft rock		117.7	14.0		NP	0	79	21	PL
3460								492								
	45			60	Core 100,0	-	orange-red-brown, ext. soft rock — VERY HIGHLY WEATHERED SANDSTONE TO SILTSTONE looks like a tight silty sand, some bedding, RQD values not recorded or recovered, samples appear more like sand than sandstone, readily crumbles when handled, some harder layers									
3455																
	50			60	Core 100,0	-	orange-red-brown, ext. soft rock									
3450						ML (A-4(0))		722	135.0	8.2		NP	0	46	54	UC
	55			60	Core 100,0	-	orange-red-brown, ext. soft rock									
3445	60			60	Core 100,0	-	orange-red-brown, ext. soft rock		125.2	9.7		NP	0	86	14	PL
						SM (A-2-4(0))	SANDSTONE weathered, highly fractured	900								
	65					-	orange-red-brown, soft rock — vertical fracture at 64'-65', no coating									
3440				60	Core 100,18	-	red-brown, avg. hard rock — fracture at 67', 40°, white halo; fracture at 67.6'-68.5', 70°, no coating									
						-	red-brn, avg. hard rock — SILTSTONE/SILTY VERY FINE SANDSTONE									

200804.007.2 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 3/11/10

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)
CORE — 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery
UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-13

SHEET 3 OF 3

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / HQ CORE, DIP 60°, TREND N52°W, THIN EZMUD POLYMER MIX
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 12/30/09
DATE COMPLETED: 12/31/09
GROUND ELEVATION: ~3497.0'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3435			Core	56	94,0	- SM (A-2-4(0))	orange-red-brown, ext. soft rock — SANDSTONE very highly weathered to sand in recovered sample		112.6	17.7		NP	0	82	18	UC
	75		Core	60	100,30	-	orange-red-brown, ext. soft to soft rock w/some avg. hard rock — SANDSTONE									
3430						-	red-brown, soft to avg. hard rock	1.574								
	80		Core	60	100,92	SM (A-4(0)) -	red-brown, soft to avg. hard rock		126.1	10.4		NP	0	62	38	PL
3425							fracture at 82.6'-83.4', 65°, no coating									
	85		Core	59	98,64	-	red-brown, soft to avg. hard rock — FINE SANDY SILTSTONE/SANDSTONE - MAY BE BASAL NAVAJO TRANSITION ZONE ABOVE KAYENTA FORMATION wavy bedding fracture at 86'-97', no coating, w/conjugated fractures (mechanical?)	598								
3420																
	90		Core	58	96,86	SM (A-4(0)) -	fracture at 90.8'-91.3' red-brown, soft to avg. hard rock		130.7	7.8		NP	0	51	49	UC
						-	white, very soft rock — SANDSTONE									
3415	95		Core	60	100,100	-	red-brown, avg. hard rock — fracture at 97'-97.5', 60° FINE SANDY SILTSTONE - MAY BE BASAL NAVAJO TRANSITION ZONE ABOVE KAYENTA FORMATION	76								
3410	100		Core	60	100,82	ML (A-4(0)) -	red-brown, avg. hard rock — 102'-103' highly fractured, ext. soft, sandy		126.9	8.7		NP	0	47	53	PL

200804 007.2 HURRICANECLIFFSAFTERBAY.GPJ US EVAL.GDT 3/11/10

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — CORE 95,60 ← Rock Quality Designation (% RQD); ← Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-14

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING & N.Q. CORE
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 12/20/09
DATE COMPLETED: 12/23/09
GROUND ELEVATION: ~3617.0'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3615	0			12	2,4,5,(19)	SM	lt. brown, slightly moist, med. dense								
							SILTY SAND W/GRAVEL white stringers, calcareous								
	5			14	12,13,11,(51)	SM	lt. brown, moist, very dense		12.5		NP	33	44	23	
3610															
	10			15	14,26,32,(93)	SC	red-brown, slightly moist, very dense								
3605							CLAYEY SAND W/GRAVEL white stringers, calcareous								
	15			16	30,40,37,(99+)	GM	red-brown to lt. brown, moist, very dense		5.2	21	2	50	33	17	
3600							SILTY GRAVEL W/SAND possible cobbles, slightly plastic								
	20			15	22,26,30,(65)	SC	red-brown, moist, very dense								
3595							CLAYEY SAND W/GRAVEL many white spots & stringers								
	25			6	60/6"	GC-GM	red-brown, moist, very dense								
3590							SILTY CLAYEY GRAVEL W/SAND possible cobbles, white spots & stringers, calcareous								
	30			3	60/3"	GM	lt. brown, moist, very dense								
3585							SILTY GRAVEL W/SAND possible cobbles, white spots & stringers, calcareous								
							SILTY CLAYEY GRAVEL W/SAND possible cobbles								

200804.007.2 BACKUP 3-12-10.GPJ US EVAL.GDT 3/12/10

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — 95,60 ← Rock Quality Designation (% RQD) / Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-14

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING & N.Q. CORE
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 12/20/09
DATE COMPLETED: 12/23/09
GROUND ELEVATION: ~3617.0'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
				3	60/3"	GC-GM	red-brown, moist, very dense SILTY CLAYEY GRAVEL W/SAND possible cobbles								
3580															
	40			7	60/7"	CL	red-brown, moist, hard SANDY LEAN CLAY W/GRAVEL								
						GM	red-brown, moist, very dense Old Alluvium								
3575															
	45			4	60/4"	GM	lt. brown & red-brown, moist, very dense SILTY GRAVEL W/SAND possible cobbles, possible gypsum								
3570															
	50			15	41,51,65,(87)	SC-SM	red-brown, moist, very dense		6.9	24	5	31	35	34	
3565							SILTY CLAYEY SAND W/GRAVEL possible cobbles, possible gypsum								
	55			14	51,51,51,(73)	SC-SM	red-brown, moist, dense								
3560															
	60			9	52,60/3"	CL	red-brown, slightly moist, hard								
3555							SANDY LEAN CLAY weakly cemented, mudstone fragments, calcareous								
	65			6	70/6"	CL	red-brown, slightly moist, hard								
3550															

200804.007.2 BACKUP 3-12-10.GPJ US EVAL.GDT 3/12/10

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE: 2,3,2,(6) ← Blow Count per 6"; $(N_1)_{60}$ Value
0.45 ← Torvane (tsf)

CORE: CORE 95 60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE: PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-14

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING & N.Q. CORE
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 12/20/09
DATE COMPLETED: 12/23/09
GROUND ELEVATION: ~3617.0'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
				3	70/5"	CL	red-brown, slightly moist, hard								
3545															
	75			5	60/5"	CL	red-brown, slightly moist, hard								
							SANDY LEAN CLAY weakly cemented, mudstone fragments, calcareous								
3540															
	80			5	60/5"	CL	red-brown, slightly moist, hard								
3535															
	85			4	60/4"	SC	red-brown, slightly moist, very dense								
							CLAYEY SAND many gypsum flakes								
3530															
	90			4	74/6"	SC	red-brown, slightly moist, very dense								
							Old Alluvium								
3525				12	Core 29,0	- SC	red-brown, hard soil to ext. soft rock	113.8	13.2	30	13	6	51	43	UC
							GRAVELLY CLAY TO CLAYEY GRAVEL TO BRECCIA TO CONGLOMERATIC MUDSTONE (CLAYEY SAND TO SANDY SILT (plastic)) older alluvium, inderated weakly cemented soil, very young rock, angular sand to gravel clasts, consists of green to brown mudstone, brown speckled sandstone & some gray limestone fragments, some areas less gravel, some dark brown sandstone cobbles & boulders, possible limestone cobbles & boulders to 211'								
	95														
3520				42	Core 70,0	-	red-brown, ext. soft rock								
	100														
3515				40	Core 66,15	ML -	red-brown w/mottled green, ext. soft rock	114.4	12.3	44	12	8	32	60	PL
							Note: From 91'-211', when water is added, material gets hot & becomes hard. After material is further worked if becomes soft and plasticity increases.								
						-	red-brown w/mottled								
							Note: RQD values shown to 211' are								

200804.007.2 BACKUP_3-12-10.GPJ US EVAL GDT 3/12/10

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — 95,60 ← Rock Quality Designation (% RQD) / Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-14

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING & N.Q. CORE
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 12/20/09
DATE COMPLETED: 12/23/09
GROUND ELEVATION: ~3617.0'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
							green, ext. soft rock								
3510				29	Core 48,30	-	for predominantly non-handled core. Core readily crumbles when handled. Material described as ext. soft rock or hard soil. red-brown w/mottled green, ext. soft rock								
	110					SC		108.1	18.1	38	15	12	41	47	
3505				48	Core 80,44	-	red-brown w/mottled green, ext. soft rock								
	115						GRAVELLY CLAY TO CLAYEY GRAVEL TO BRECCIA TO CONGLOMERATIC MUDSTONE (CLAYEY SAND TO SANDY SILT (plastic)) older alluvium, inderated weakly cemented soil, very young rock, angular sand to gravel clasts, consists of green to brown mudstone, brown speckled sandstone & some gray limestone fragments, some areas less gravel, some dark brown sandstone cobbles & boulders, possible limestone cobbles & boulders to 211'								UC
3500				44	Core 74,32	-	red-brown w/mottled green, ext. soft rock								
	120					-	red-brown w/mottled green, ext. soft rock								
3495				60	Core 100,100?	ML -	red-brown, ext. soft rock	111.7	18.3	43	14	1	28	71	PL
						-	red-brown, hard soil to ext. soft rock								
	125						Note: From 91'-211', when water is added, material gets hot & becomes hard. After material is further worked if becomes soft and plasticity increases. MUDDY BRECCIA TO SILTY CLAYEY GRAVEL (SILT W/SAND) more gravelly from 121'-123'								
3490				60	Core 100,100?	-	red-brown, hard soil to ext. soft rock								
	130														
3485				60	Core 100,100?	- CL-2	red-brown, hard soil to ext. soft rock	MUDSTONE TO SANDY LEAN CLAY sandy w/some gravelly zones	105.3	18.9	34	16	0	38	62	UC UU
	135														
3480				60	Core 100,100?	-	red-brown, hard soil to ext. soft rock								
						-	red-brown, ext. soft rock								

200804.007.2 BACKUP_3-12-10.GPJ US EVAL.GDT 3/12/10

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-14

SHEET 5 OF 8

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING & N.Q. CORE
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 12/20/09
DATE COMPLETED: 12/23/09
GROUND ELEVATION: ~3617.0'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
						-	red-brown, ext. soft rock								
3475			Core	60	100,100?	CL-2	red-brown, ext. soft rock	109.8	19.8	40	15	1	35	64	PL
	145					-	red-brown, ext. soft rock BRECCIA MUDSTONE TO GRAVELLY SANDY LEAN CLAY								
3470			Core	60	100,100?	-	red-brown, ext. soft rock								
						-	red-brown, ext. soft rock								
	150					CL-2		112.7	16.3	38	19	5	37	58	UC
3465			Core	60	100,100?	-	red-brown, ext. soft rock MUDSTONE TO SANDY LEAN CLAY sandy w/some gravelly zones								
							interbedded layers sandy to gravelly, core readily breaks when handled								
	155														
3460			Core	60	100,100?	-	red-brown, ext. soft rock								
						-	red-brown, ext. soft rock								
	160						red-brown, ext. soft rock GRAVELLY CLAY TO BRECCIA MUDSTONE (SILTY SAND) plastic								
3455			Core	60	100,100?	- SM		117.6	11.4	37	11	12	62	26	PL
						-	red-brown, ext. soft rock								
	165						red-brown, ext. soft rock SANDY LEAN CLAY TO MUDSTONE								
3450			Core	60	100,100?	-	red-brown, ext. soft rock								
	170						red-brown, ext. soft rock GRAVELLY CLAY TO BRECCIA MUDSTONE (CLAYEY SAND)								
3445			Core	60	100,100?	SC -		122.7	12.0	33	13	19	57	24	UC
						-	red-brown, ext. soft rock SANDY LEAN CLAY TO MUDSTONE								

200804.007.2 BACKUP_3-12-10.GPJ US EVAL.GDT 3/12/10

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)
CORE — CORE 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery
UNDISTURBED SAMPLE — PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-14

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING & N.Q. CORE
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 12/20/09
DATE COMPLETED: 12/23/09
GROUND ELEVATION: ~3617.0'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3440															
			Core	60	Core 100,100	-	red-brown, ext. soft rock								
	180														
3435			Core	60	Core 100,100	CL-2 -	red-brown, ext. soft rock SANDY LEAN CLAY TO MUDSTONE	115.0	15.5	41	17	0	48	52	PL
	185														
3430			Core	60	Core 100,100	-	red-brown, ext. soft rock								
							brown-black volcanic sand at 188.5'-188.7'								
	190														
3425			Core	60	Core 100,100	SC -	red-brown, ext. soft rock	124.9	12.3	48	21	11	43	46	UC
	195														
3420			Core	59	Core 98,100	-	red-brown, ext. soft rock fracture at 195.9'-196.2', mechanical?								
							less gravel between 197'-199'								
	200						BRECCIA MUDSTONE TO GRAVELLY SILTY CLAY W/SAND (CLAYEY SAND)								
3415			Core	59	Core 98,100	- SC	red-brown, ext. soft rock	126.6	10.4	53	28	19	44	37	PL
	205														
3410			Core	60	Core 100,100	-	red-brown, ext. soft rock								
							vertical clast at 207.6'-208'								
						-	red-brown, ext. soft rock sandstone cobble at 209'-209.5'								

200804.007.2 BACKUP_3-12-10.GPJ US EVAL.GDT 3/12/10

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-14

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING & N.Q. CORE
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 12/20/09
DATE COMPLETED: 12/23/09
GROUND ELEVATION: ~3617.0'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
					-		red-brown, ext. soft rock								
3405				42	Core 70,0	SP-SM		119.7	14.1		NP	1	89	10	
					-		white-pink, ext. soft rock								
							100% water loss at 214'								
	215														
3400				22	Core 36,0	-	white-pink, ext. soft rock								
	220														
3395				17	Core 28,0	- SP-SM	white-pink, ext. soft rock	118.3	9.3		NP	3	90	7	
	225														
3390				36	Core 60,7	-	white-pink, soft rock NAVAJO SANDSTONE very highly weathered, washing away, few iron nodules, less weathered below 219' to 229', more competent, lt. pink w/rust bands								
	230														
3385				0	Core 0,0	-	white-pink, ext. soft rock								
	235														
3380				0	Core 0,0	-	white-pink, ext. soft rock								
	240														
3375				1	Core 1,0	-	white-pink, ext. soft rock								
						-	pink, ext. soft rock								

200804.007.2 BACKUP 3-12-10.GPJ US EVAL.GDT 3/12/10

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

CORE — 95,60 ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

DRILL HOLE LOG

BORING NO. 09-AB-14

PROJECT: HURRICANE CLIFFS RESERVOIR SITES - AFTERBAY
CLIENT: W.C.W.C.D.
LOCATION: SEE SITE PLAN
DRILLING METHOD: 08-CME-55 / N.W. CASING & N.Q. CORE
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200804.007.2
DATE STARTED: 12/20/09
DATE COMPLETED: 12/23/09
GROUND ELEVATION: ~3617.0'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests / Fractures/Ft.
3370			Core	12	*20,0*	-	pink, ext. soft rock	NAVAJO SANDSTONE very highly weathered, washing away, few iron nodules, less weathered below 219' to 229', more competent, lt. pink w/rust bands							
	250														
3365															
	255														
3360															
	260														
3355															
	265														
3350															
	270														
3345															
	275														
3340															

200804.007.2 BACKUP 3-12-10.GPJ US EVAL.GDT 3/12/10

RB&G ENGINEERING, INC.

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; *0.45* ← Torvane (tsf)

CORE — CORE *95,60* ← Rock Quality Designation (% RQD); Percent Sample Recovery

UNDISTURBED SAMPLE — PUSHED *0.45* ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay
PL = Point Load

09-AB-1

HCH Dam Site

MNH

Permeability Tests

March, 2009

Size of Hole	NW	NQ	HQ
Radius (in)	1.47	1.49	1.89
Diam	2.938	2.98	3.782

HCH Dam Site Drill Hole		DEPTH (ft.)		Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)
Vertical	09-AB-1				Water table	-	>		135.0			
	NW	0.0	- 5.0	0.3					0	5	2.50	1,037
		5.0	- 10.0	0.2					0	5	7.50	173
		10.0	- 15.0	0.2	1.5				0	5	14.00	106
		15.0	- 20.0	0.1	1.5				0	5	19.00	38
		20.0	- 25.0	0.1	1.5				0	5	24.00	30
		25.0	- 30.0	0.04	1.5				0	5	29.00	11
		25.0	- 35.0	0.1	1.5				0	10	31.50	12
		25.0	- 40.0	0.5	1.5				0	15	34.00	53
		38.5	- 45.0	38.0	1.5				0	6.5	43.25	6,004
		38.5	- 50.0	0.1	1.5				0	11.5	45.75	12
		38.5	- 55.0	0.1	1.5				0	16.5	48.25	7
		38.5	- 60.0	0.6	1.5				0	21.5	50.75	34
		58.5	- 65.0	27.3	1.5				0	6.5	63.25	2,947
		63.5	- 70.0	60.0	1.5				0	6.5	68.25	6,008
		68.5	- 75.0	> 100.0	1.5				0	6.5	73.25	9,330
		73.5	- 80.0	> 100.0	1.5				0	6.5	78.25	8,734
		78.5	- 85.0	> 100.0	1.5				0	6.5	83.25	8,209
		78.5	- 90.0	3.8	1.5				0	11.5	85.75	198
	NQ	90.0	- 99.5	4.3	1.5	0			0	9.5	96.25	227
		99.0	- 109.5	18.0	5.4	0			0	10.5	109.65	776
		99.0	- 109.5	29.0	5.4	59	1		58	10.5	243.50	563
		109.0	- 119.5	7.6	5.4	30			30	10.5	188.88	190
		109.0	- 119.5	8.1	5.4	60			60	10.5	258.11	148
		109.0	- 119.5	14.6	5.4	120			120	10.5	396.57	174
		109.0	- 119.5	9.9	5.4	60			60	10.5	258.11	181

summary

Depth ft.			Permeability ft./yr.
0.0	- 5.0		1,037
5.0	- 10.0		173
10.0	- 15.0		106
15.0	- 20.0		38
20.0	- 25.0		30
25.0	- 30.0		11
25.0	- 35.0		12
25.0	- 40.0		53
38.5	- 45.0		6,004
38.5	- 50.0		12
38.5	- 55.0		7
38.5	- 60.0		34
58.5	- 65.0		2,947
63.5	- 70.0		6,008
68.5	- 75.0		9,330
73.5	- 80.0		8,734
78.5	- 85.0		8,209
78.5	- 90.0		198
90.0	- 99.5		227
99.0	- 109.5		776
99.0	- 109.5		563
109.0	- 119.5		190
109.0	- 119.5		148
109.0	- 119.5		174
109.0	- 119.5		181

09-AB-2 **Permeability Tests**

HCH Dam Site

March, 2009

MNH

Size of Hole	NW	NQ	HQ
Radius (in)	1.47	1.49	1.89
Diam	2.938	2.98	3.782

HCH Dam Site

Drill Hole		DEPTH (ft.)	Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)
Vertical	09-AB-2			Water table	-	>	135.0				
	NW	6.0 - 10.0	0.1	0.5				0	4	8.50	127
		9.0 - 15.0	21.4	2.5				0	6	14.50	10,721
		15.0 - 20.0	60.0	1.5				0	5	19.00	26,202
		20.0 - 25.0	42.9	1.5				0	5	24.00	14,817
		25.0 - 30.0	50.0	1.5				0	5	29.00	14,306
		30.0 - 39.0	10.7	0.5				0	9	35.00	1,635
	HQ	39.0 - 49.0	39.0	2.7	10	8		2	10	51.32	3,527
		39.0 - 49.0	47.0	2.7	20	15		5	10	58.24	3,746
		39.0 - 49.0	39.0	2.7	10	8		2	10	51.32	3,527
		49.0 - 59.0	25.5	2.7	30			30	10	125.93	940
		49.0 - 59.0	34.0	2.7	60	4		56	10	185.93	849
		49.0 - 59.0	25.5	2.7	30			30	10	125.93	940
		59.0 - 69.0	13.00	2.7	35			35	10	147.47	409
		59.0 - 69.0	47.00	2.7	70	15		55	10	193.62	1,127
		59.0 - 69.0	37.70	2.7	35	7		28	10	131.32	1,332
		69.0 - 79.0	27.3	2.7	40			40	10	169.01	750
		69.0 - 79.0	21.0	2.7	80			80	10	261.32	373
		69.0 - 79.0	12.9	2.7	40			40	10	169.01	354
		79.0 - 89.0	36.5	2.7	45	5		40	10	179.01	946
		79.0 - 89.0	56.5	2.7	90	20		70	10	248.24	1,056
		79.0 - 89.0	42.5	2.7	45	9		36	10	169.78	1,162
	NQ	122.5 - 134.0	0.1	2.7	50			50	11.5	246.33	2
		122.5 - 134.0	0.1	2.7	75			75	11.5	304.03	1
		122.5 - 134.0	0.1	2.7	90			90	11.5	338.64	1

summary>>

Depth ft.	Permeability ft./yr.	
6.0 - 10.0	127	
9.0 - 15.0	10,721	
15.0 - 20.0	26,202	
20.0 - 25.0	14,817	
25.0 - 30.0	14,306	
30.0 - 39.0	1,635	
39.0 - 49.0	3,527	
39.0 - 49.0	3,746	
39.0 - 49.0	3,527	
49.0 - 59.0	940	
49.0 - 59.0	849	
49.0 - 59.0	940	
59.0 - 69.0	409	
59.0 - 69.0	1,127	
59.0 - 69.0	1,332	opend up
69.0 - 79.0	750	
69.0 - 79.0	373	closing
69.0 - 79.0	354	
79.0 - 89.0	946	
79.0 - 89.0	1,056	
79.0 - 89.0	1,162	
122.5 - 134.0	2	
122.5 - 134.0	1	
122.5 - 134.0	1	

09-AB-3 **Permeability Tests**

HCH Dam Site

March, 2009

MNH Afterbay

Size of Hole	NW	NQ	HQ
Radius (in)	1.47	1.49	1.89
Diam	2.938	2.98	3.782

HCH Dam Site
Drill Hole 09-AB-3
Vertical
NW

DEPTH (ft.)	Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)
		Water table	-		>	127.0			
0.0 - 5.0	0.1					0	5	2.50	259
5.0 - 10.0	0.04					0	5	7.50	43
10.0 - 15.0	0.1					0	5	12.50	73
15.0 - 20.0	0.03					0	5	17.50	15
20.0 - 25.0	0.2					0	5	22.50	81

summary

Depth ft.	Permeability ft./yr.
0.0 - 5.0	259
5.0 - 10.0	43
10.0 - 15.0	73
15.0 - 20.0	15
20.0 - 25.0	81

09-AB-5 **Permeability Tests**

HCH Dam Site

May, 2009

MNH

	HQ
Radius (in)	1.89

3.782 D HQ3
2.938 rockbit

summary>>

HCH Dam Site Drill Hole		DEPTH (ft.)			Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)	Depth ft.			Permeability ft./yr.	
Vertical	09-AB-5	HQ				Water table	=		>	230.0								
	NW	0.0	-	5.0	0.2	0.0	0			0	5	2.50	568	0.0	-	5.0	568	
		5.0	-	10.0	0.6	1.5	0			0	5	9.00	574	5.0	-	10.0	574	
		10.0	-	15.0	6.7	1.5	0			0	5	14.00	3,936	10.0	-	15.0	3,936	
		15.0	-	20.0	25.0	1.5	0			0	5	19.00	10,875	15.0	-	20.0	10,875	
		22.0	-	25.0	13.0	1.5	0			0	3	25.00	6,194	22.0	-	25.0	6,194	
		24.0	-	34.5	20.0	6.5	0			0	10.5	35.75	2,644	24.0	-	34.5	2,644	
	HQ	34.5	-	44.5	43.5	6.5	10	11		-1	10	43.69	4,621	34.5	-	44.5	4,621	
		44.5	-	54.5	> 50.5	6.5	25	20		5	10	67.54	3,470	44.5	-	54.5	> 3,470	> max flow
		54.5	-	64.5	> 50.0	6.5	20	20		0	10	66.00	3,516	54.5	-	64.5	> 3,516	> max flow
		58.4	-	64.5	0.15	2.5	25			25	6.1	121.64	8	58.4	-	64.5	8	
		58.4	-	64.5	5.8	2.5	55			55	6.1	190.87	204	58.4	-	64.5	204	
		58.4	-	64.5	0.20	2.5	25			25	6.1	121.64	11	58.4	-	64.5	11	
		64.5	-	74.5	4.5	6.4	25			25	10	133.59	156	64.5	-	74.5	156	
		64.5	-	74.5	10.0	6.4	50			50	10	191.28	243	64.5	-	74.5	243	
		64.5	-	74.5	5.0	6.4	25			25	10	133.59	174	64.5	-	74.5	174	
		74.5	-	83.3	10.0	6.4	30			30	8.75	154.51	332	74.5	-	83.3	332	
		74.5	-	83.3	19.5	6.4	60			60	8.75	223.74	447	74.5	-	83.3	447	
		74.5	-	83.3	5.0	6.4	30			30	8.75	154.51	166	74.5	-	83.3	166	
		84.5	-	94.5	1.8	6.4	40			40	10	188.21	44	84.5	-	94.5	44	
		84.5	-	94.5	3.3	6.4	60			60	10	234.36	65	84.5	-	94.5	65	Alluvium
		84.5	-	94.5	2.1	6.4	40			40	10	188.21	52	84.5	-	94.5	52	
		94.5	-	104.5	26.0	6.4	20			20	10	152.05	794	94.5	-	104.5	794	
		94.5	-	104.5	32.5	6.4	30			30	10	175.13	861	94.5	-	104.5	861	
		94.5	-	104.5	26.0	6.4	20			20	10	152.05	794	94.5	-	104.5	794	
		104.5	-	114.5	14.5	6.4	30			30	10	185.13	364	104.5	-	114.5	364	
		104.5	-	114.5	40.0	6.4	60			60	10	254.36	730	104.5	-	114.5	730	opened up
		104.5	-	114.5	28.5	6.4	30			30	10	185.13	714	104.5	-	114.5	714	
		114.5	-	124.5	> 51.5	6.4	20	20		0	10	125.90	1,899	114.5	-	124.5	> 1,899	max flow
		124.5	-	134.5	> 50.0	6.4	20	20		0	10	135.90	1,708	124.5	-	134.5	> 1,708	max flow
		129.0	-	134.5	> 50.5	3.3	20	20		0	5.5	135.05	2,701	129.0	-	134.5	> 2,701	max flow
		134.5	-	145.5	> 50.5	6.4	20	20		0	11	146.40	1,489	134.5	-	145.5	> 1,489	max flow
		145.5	-	154.5	> 51.0	6.4	20	20		0	9	156.40	1,639	145.5	-	154.5	> 1,639	max flow
		154.5	-	164.5	48.0	6.4	30	16		14	10	198.21	1,124	154.5	-	164.5	1,124	
		164.5	-	174.5	22.0	6.4	50			50	10	291.28	351	164.5	-	174.5	351	
		164.5	-	174.5	49.0	6.4	100	17		83	10	367.44	619	164.5	-	174.5	619	
		164.5	-	174.5	22.2	6.4	50			50	10	291.28	354	164.5	-	174.5	354	
		174.5	-	184.5	28.0	6.4	50			50	10	301.28	431	174.5	-	184.5	431	
		174.5	-	184.5	29.2	6.4	100	1		99	10	414.36	327	174.5	-	184.5	327	
		174.5	-	184.5	21.5	6.4	50			50	10	301.28	331	174.5	-	184.5	331	back pressure
		184.5	-	194.5	51.0	6.4	50	20		30	10	265.13	893	184.5	-	194.5	893	
		193.5	-	204.5	> 51.0	6.4	20	20		0	11	205.40	1,072	193.5	-	204.5	> 1,072	max flow

09-AB-5A **Permeability Tests**

HCH Dam Site

April, 2009

MNH

	NQ	HQ
Radius (in)	1.48	1.89

3.782 D HQ3
2.938 rockbit

HCH Dam Site Drill Hole		DEPTH (ft.)	Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)
Vertical	09-AB-5A	HQ		Water table	=	>	20.0				
	NW	0.0 - 5.0	0.1	0.0	0			0	5	2.50	465
		5.0 - 10.0	0.03	1.5	0			0	5	9.00	29
		10.0 - 15.0	0.6	1.5	0			0	5	14.00	369

summary>>

Depth ft	Permeability ft./yr.
0.0 - 5.0	465
5.0 - 10.0	29
10.0 - 15.0	369

09-AB-6 Option 2 north dam **Permeability Tests**

HCH Dam Site

May, 2009

MNH

Radius (in)	NQ	HQ
		1.89

3.782 D hq3
2.938 rockbit

HCH Dam Site Drill Hole		DEPTH (ft.)			Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)	summary>> Depth ft.	Permeability ft./yr.	
Vertical	09-AB-6	HQ				Water table	-		>	175.0						
	NW	0.0	-	5.0	0.1	0.0	0			0	5	2.50	491	0.0 - 5.0	491	
		5.0	-	10.0	0.1	0.0	0			0	5	7.50	121	5.0 - 10.0	121	
		10.0	-	15.0	1.3	0.0	0			0	5	12.50	773	10.0 - 15.0	773	
		15.0	-	20.0	0.4	0.0	0			0	5	17.50	159	15.0 - 20.0	159	
		20.0	-	25.0	0.3	0.0	0			0	5	22.50	102	20.0 - 25.0	102	
		25.0	-	30.0	0.6	0.0	0			0	5	27.50	171	25.0 - 30.0	171	
		30.0	-	35.0	0.2	0.0	0			0	5	32.50	41	30.0 - 35.0	41	
		35.0	-	40.0	0.1	0.0	0			0	5	37.50	26	35.0 - 40.0	26	
		40.0	-	45.0	5.5	0.0	0			0	5	42.50	992	40.0 - 45.0	992	
		45.0	-	50.0	10.7	0.0	0			0	5	47.50	1,744	45.0 - 50.0	1,744	
		50.0	-	55.0	50.0	0.0	0			0	5	52.50	7,364	50.0 - 55.0	7,364	
	NW	53.5	-	60.0	8.6	0.0	0			0	6.5	56.75	967	53.5 - 60.0	967	
		60.0		65.0										60.0 - 65.0	no test	
	HQ	65.5	-	74.0	17.0	5.6	18			18	8.5	116.89	763	65.5 - 74.0	763	
		65.0	-	74.0	34.0	5.6	25	4		21	9	123.56	1,383	65.0 - 74.0	1,383	
		65.0	-	74.0	18.0	5.6	18			18	9	116.64	776	65.0 - 74.0	776	
		69.0	-	79.0	1.1	1.9	26			26	10	135.90	38	69.0 - 79.0	38	
		69.0	-	79.0	1.8	1.9	46			46	10	182.05	46	69.0 - 79.0	46	
		69.0	-	79.0	1.1	1.9	26			26	10	135.90	38	69.0 - 79.0	38	
		79.0	-	89.0	0.0	1.9	50			50	10	201.28	0	79.0 - 89.0	0	
		79.0	-	89.0	0.5	1.9	88			88	10	288.98	8	79.0 - 89.0	8	
		79.0	-	89.0	0.0	1.9	50			50	10	201.28	0	79.0 - 89.0	0	
		89.0	-	99.0	0.1	1.9	64			64	10	243.59	2	89.0 - 99.0	2	
		89.0	-	99.0	0.2	1.9	95			95	10	315.13	3	89.0 - 99.0	3	
		89.0	-	99.0	0.1	1.9	64			64	10	243.59	2	89.0 - 99.0	2	
		99.0	-	109.0										99.0 - 109.0		scoria no test
		109.0	-	119.0										109.0 - 119.0		scoria no test
		119.5	-	129.0	> 50.0	1.9	20	20		0	9.5	126.15	1,912	119.5 - 129.0 >	1,912	max flow
		129.0	-	139.0	> 51.5	1.9	20	20		0	10	135.90	1,759	129.0 - 139.0 >	1,759	max flow
		139.0	-	148.8	> 51.5	1.9	20	20		0	9.75	145.78	1,671	139.0 - 148.8 >	1,671	max flow

09-PH-7 Power House **Permeability Tests**

HCH Power House

May, 2009

MNH

	NW	HQ
Radius (in)	1.47	1.89

3.782 D HQ3

2.938 rockbit 2.938 2.98 NQ

HCH Power House Drill Hole		DEPTH (ft.)	Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)
Vertical	09-PH-7			Water table	=		>	275.0	?		
	NW	0.0 - 5.0	0.3	0.0	0			0	5	2.50	882
		5.0 - 10.0	0.1	0.0	0			0	5	7.50	95
		10.0 - 15.0	0.2	0.0	0			0	5	12.50	156
		15.0 - 20.0	0.4	0.0	0			0	5	17.50	211
		20.0 - 25.0	0.1	0.0	0			0	5	22.50	35
		25.0 - 30.0	0.2	0.0	0			0	5	27.50	71
		30.0 - 35.0	0.1	0.0	0			0	5	32.50	34
		35.0 - 40.0	0.7	0.0	0			0	5	37.50	149
		40.0 - 45.0	0.4	0.0	0			0	5	42.50	79
		45.0 - 50.0	5.7	0.0	0			0	5	47.50	989
		50.0 - 55.0	5.0	0.0	0			0	5	52.50	790
		55.0 - 60.0	2.9	0.0	0			0	5	57.50	412
		55.0 - 65.0	27.3	0.0	0			0	10	60.00	2,238
		55.0 - 70.0	25.0	0.0	0			0	15	62.50	1,434
		55.0 - 75.0	23.1	0.0	0			0	20	65.00	1,012

End K tests use drilling Mud

summary>>

Depth ft.	Permeability ft./yr.
0.0 - 5.0	882
5.0 - 10.0	95
10.0 - 15.0	156
15.0 - 20.0	211
20.0 - 25.0	35
25.0 - 30.0	71
30.0 - 35.0	34
35.0 - 40.0	149
40.0 - 45.0	79
45.0 - 50.0	989
50.0 - 55.0	790
55.0 - 60.0	412
55.0 - 65.0	2,238
55.0 - 70.0	1,434
55.0 - 75.0	1,012

09-AB-8

HCH Options 3 & 4

MNH

Permeability Tests

Aug, 2009

	NW	NQ	HQ
Radius (in)	1.47	1.49	1.89
Diam	2.938	2.98	3.782

NW= rockbit 2 15/16"

HCH Afterbay near options 3 & 4

Drill Hole		DEPTH (ft.)		Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)	summary>> Depth ft.		Permeability ft./yr.	
Vertical	09-AB-8				Water table	=		>	60							
	Size of Hole															
	NW	0.0	- 10.0	3.0	0.0	0			0	10	5.00	2,954	0.0	- 10.0	2,954	
		10.0	- 15.0	3.0	0.0	0			0	5	12.50	1,991	10.0	- 15.0	1,991	
		15.0	- 20.0	0.6	0.0	0			0	5	17.50	266	15.0	- 20.0	266	
		20.0	- 25.0	5.3	0.0	0			0	5	22.50	1,955	20.0	- 25.0	1,955	
		25.0	- 30.0	3.3	0.0	0			0	5	27.50	996	25.0	- 30.0	996	
		30.0	- 35.0	9.1	0.0	0			0	5	32.50	2,323	30.0	- 35.0	2,323	sandstone @ 30'
		33.7	- 40.0	8.9	1.3	0			0	6.3	38.15	1,632	33.7	- 40.0	1,632	
	NQ	33.7	- 49.0	16.7	1.3	0			0	15.3	42.65	1,378	33.7	- 49.0	1,378	
		48.0	- 59.0	11.5	2.8	18			18	11	97.84	536	48.0	- 59.0	536	
		48.0	- 59.0	12.5	2.8	24			24	11	111.68	510	48.0	- 59.0	510	leaking around packer
		48.0	- 59.0	11.5	2.8	18			18	11	97.84	536	48.0	- 59.0	536	lost bit

09-AB-9 **Permeability Tests**

HCH Option 3

Aug, 2009

MNH

	NW	NQ	HQ
Radius (in)	1.47	1.49	1.89
Diam	2.938	2.98	3.782

NW= rockbit 2 15/16"

HCH Afterbay option 3 NW corner

Drill Hole		DEPTH (ft.)	Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)	summary>> Depth ft.	Permeability ft./yr.	
Vertical	09-AB-9			Water table	=	>	60							
Size of Hole		0.0 - 5.0	0.1	0.0				0	5	2.50	311	0.0 - 5.0	311	
NW		5.0 - 10.0	0.3	0.0				0	5	7.50	277	5.0 - 10.0	277	
		10.0 - 15.0	1.0	0.0				0	5	12.50	664	10.0 - 15.0	664	
		15.0 - 20.0	1.5	0.0				0	5	17.50	711	15.0 - 20.0	711	
		20.0 - 25.0	1.0	0.0				0	5	22.50	369	20.0 - 25.0	369	
		25.0 - 30.0	1.5	0.0				0	5	27.50	453	25.0 - 30.0	453	
		30.0 - 35.0	12.5	0.0				0	5	32.50	3,191	30.0 - 35.0	3,191	
		35.0 - 40.0	20.0	0.0				0	5	37.50	4,425	35.0 - 40.0	4,425	
		40.0 - 45.0	2.8	0.0				0	5	42.50	537	40.0 - 45.0	537	
		45.0 - 50.0	37.5	0.0				0	5	47.50	6,551	45.0 - 50.0	6,551	
		50.0 - 55.0	5.8	0.0				0	5	52.50	912	50.0 - 55.0	912	sandstone @ 56'
		55.0 - 60.0	50.0	0.0				0	5	57.50	7,215	55.0 - 60.0	7,215	casing stuck

09-AB-10 **Permeability Tests**

HCH Option 2

Aug, 2009

MNH

Size of Hole	NW	NQ	HQ
Radius (in)	1.47	1.49	1.89
Diam	2.938	2.98	3.782

NW= rockbit 2 15/16"

HCH Afterbay option 2 NE abutment

Drill Hole	DEPTH (ft.)	Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)
Vertical 09-AB-10			Water table	-	>	50				
Size of Hole	0.0 - 5.0	1.5	0.0				0	5	2.50	4,959
NW	5.0 - 7.5	1.0	0.0				0	2.5	6.25	2,149
	7.5 - 10.0	1.15	2.5				0	2.5	11.25	1,373
	10.0 - 15.0	1.25	0.0				0	5	12.50	827
	15.0 - 20.0	1.5	0.0				0	5	17.50	708
	20.0 - 25.0	2.5	0.0				0	5	22.50	918
	25.0 - 30.0	10.0	0.0				0	5	27.50	3,006
	30.0 - 35.0	0.5	0.0				0	5	32.50	127
	35.0 - 40.0	0.3	0.0				0	5	37.50	55
	40.0 - 45.0	12.5	0.0				0	5	42.50	2,431
	45.0 - 50.0	50.0	0.0				0	5	47.50	8,700

summary>>

Depth ft.	Permeability ft./yr.
0.0 - 5.0	4,959
5.0 - 7.5	2,149
7.5 - 10.0	1,373
10.0 - 15.0	827
15.0 - 20.0	708
20.0 - 25.0	918
25.0 - 30.0	3,006
30.0 - 35.0	127
35.0 - 40.0	55
40.0 - 45.0	2,431
45.0 - 50.0	8,700

Permeability Tests

HCH Afterbay Option 4

MNH **09-AB-11**

Dec-09

Size of Hole	NW	NQ	HQ
Radius (in)	1.47	1.49	1.89
Diam	2.938	2.98	3.782

NW= rockbit 2 15/16"

HCH Afterbay option 4 Drill Hole 09-AB-11 HQ 60 deg drill dip	DEPTH (ft.)	Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)
			Water table	=	>	100				
0 - 17	0.0 - 14.7		0.0	0			0	14.72	7.36	1,530
19 - 27	16.5 - 23.4		4.5	12			12	6.93	52.11	703
19 - 27	16.5 - 23.4		4.5	20			20	6.93	70.57	770
19 - 27	16.5 - 23.4		4.5	12			12	6.93	52.11	703
27 - 37	23.4 - 32.0		3.6	12	5		7	8.66	47.47	4,000
27 - 37	23.4 - 32.0		3.6	28	20		8	8.66	49.77	5,613
27 - 37	23.4 - 32.0		3.6	12	5		7	8.66	47.47	4,109
37 - 47	32.0 - 40.7		3.6	20	15		5	8.66	51.51	4,720
37 - 47	32.0 - 40.7		3.6	26	20		6	8.66	53.82	5,095
37 - 47	32.0 - 40.7		3.6	20	15		5	8.66	51.51	4,720
49 - 57	42.4 - 49.4		5.0	22	20		2	6.93	55.51	5,665
57 - 67	49.4 - 58.0		3.6	23	20		3	8.66	64.22	4,431
67 - 77	58.0 - 66.7		3.6	30	20		10	8.66	89.03	3,022
77 - 87	66.7 - 75.3		3.6	22	20		2	8.66	79.23	3,591
89 - 102	77.1 - 88.3		1.8	22	20		2	11.26	89.12	2,474

summary>>

Depth ft.	Permeability ft./yr.	
0 - 17	1,530	
19 - 27	703	
19 - 27	770	
19 - 27	703	
27 - 37	4,000	
27 - 37	5,613	
27 - 37	4,109	
37 - 47	4,720	
37 - 47	5,095	
37 - 47	4,720	
49 - 57	> 5,665	max flow
57 - 67	4,431	
67 - 77	3,022	
77 - 87	> 3,591	max flow
89 - 102	> 2,474	max flow

DRAFT 12/11/2009 **Permeability Tests**

HCH Afterbay Option 4

Dec, 2009

MNH **09-AB-12**

dip angle 60

	HQ
Radius (in)	1.89

3.782 D HQ3
2.938 rockbit

HCH Dam Site
Drill Hole

	DEPTH (ft.)		Gage Ht Stickup (ft.) Water table	Applied Pressure (psi)	Friction Loss (psi)	Friction Pressure (%)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)	summary>> Depth ft.	Permeability ft./yr.
						>	100.0					
NW vert												
-	0.0	- 5.0					0	5	2.50	483	0.0 - 5.0	483
-	5.0	- 10.0					0	5	7.50	580	5.0 - 10.0	580
-	10.0	- 15.0					0	5	12.50	881	10.0 - 15.0	881
HQ 60 deg dip											HQ 60 deg dip	
15 - 26.6	13.0	- 23.0		3.7	10		10	10	44.79	289	15.0 - 26.6	289
15 - 26.6	13.0	- 23.0		3.7	20		20	10	67.87	191	15.0 - 26.6	191
15 - 26.6	13.0	- 23.0		3.7	10		10	10	44.79	289	15.0 - 26.6	289
26.6 - 36.6	23.0	- 31.7		3.7	15		15	8.66	65.68	244	26.6 - 36.6	244
26.6 - 36.6	23.0	- 31.7		3.7	30		30	8.66	100.30	263	26.6 - 36.6	263
26.6 - 36.6	23.0	- 31.7		3.7	15		15	8.66	65.68	221	26.6 - 36.6	221
36.6 - 46.6	31.7	- 40.4		3.7	24		24	8.66	95.11	887	36.6 - 46.6	887
36.6 - 46.6	31.7	- 40.4		3.7	39	3	36	8.66	122.80	1,348	36.6 - 46.6	1,348
36.6 - 46.6	31.7	- 40.4		3.7	22		22	8.66	90.50	972	36.6 - 46.6	972
46.6 - 56.6	40.4	- 49.0		3.7	24	20	4	8.66	57.62	4,669	46.6 - 56.6	4,669
51.6 - 56.6	44.7	- 49.0		3.7	24	20	4	4.33	59.78	7,443	51.6 - 56.6	7,443
56.6 - 66.6	49.0	- 57.7		3.7	26	20	6	8.66	70.89	4,014	56.6 - 66.6	4,014
61.6 - 66.6	53.3	- 57.7		3.7	12.1		12	4.33	87.14	1,188	61.6 - 66.6	1,188
											pressure started at 32psi dropped to 28, opening up	
66.6 - 76.6	57.7	- 66.3		3.7	28	4	24	8.66	121.09	1,461	66.6 - 76.6	1,461
76.6 - 86.6	66.3	- 75.0		3.7	37		37	8.66	159.75	84	76.6 - 86.6	84
76.6 - 86.6	66.3	- 75.0		3.7	75		75	8.66	247.44	56	76.6 - 86.6	56
76.6 - 86.6	66.3	- 75.0		3.7	37		37	8.66	159.75	55	76.6 - 86.6	55
86.6 - 96.6	75.0	- 83.7		3.7	25	20	5	8.66	94.57	2,900	86.6 - 96.6	2,900
92.6 - 96.6	80.2	- 83.7		2.8	42		42	3.46	181.65	55	92.6 - 96.6	55
92.6 - 96.6	80.2	- 83.7		2.8	86		86	3.46	283.19	56	92.6 - 96.6	56
92.6 - 96.6	80.2	- 83.7		2.8	42		42	3.46	181.65	44	92.6 - 96.6	44
											pressure started at 40 dropped to 35, opening up	
96.6 - 106.6	83.7	- 92.3		3.7	35	20	15	8.66	126.30	2,183	96.6 - 106.6	2,183
101.6 - 106.6	88.0	- 92.3		3.7	30	15	15	4.33	128.47	3,197	101.6 - 106.6	3,197
102.6 - 106.6	88.9	- 92.3	28.3	2.8	45	1	44	3.46	194.92	1,448	102.6 - 106.6	1,448
102.6 - 106.6	88.9	- 92.3	50.0	3.7	68	18	50	3.46	209.67	2,379	102.6 - 106.6	2,379 71 psi drop to 68psi
102.6 - 106.6	88.9	- 92.3	42.0	3.7	45	10	35	3.46	175.06	2,393	102.6 - 106.6	2,393

DRAFT

HCH Afterbay Option 4

Permeability Tests

Dec 2009

MNH **09-AB-13**

Size of Hole	NW	NQ	HQ
Radius (in)	1.47	1.49	**1.89**
Diam	2.938	2.98	3.782

NW= rockbit 2 15/16"

HCH Afterbay option 4 Drill Hole 09-AB-13 HQ 60 deg drill dip	DEPTH (ft.)	Q gpm	Gage Ht Stickup (ft.)	Applied Pressure (psi)	Friction Loss (psi)	Artesian Pressure (ft)	Effective Pressure (psi)	L (ft.)	H (ft)	Perm. K (ft/yr)	summary>> Depth ft.	Permeability ft./yr.
		Water table =				>	104					
										Drilled with a thin Ezmud polymer mix actual K values may be higher		
0 - 9	0.0 - 7.8	[illegible]	0.0	0			0	7.7942	3.90	269	0.0 - 9.0	269
9 - 19	7.8 - 16.5	[illegible]	2.7	12			12	8.6603	42.52	2,738	9.0 - 19.0	2,738
19 - 29	16.5 - 25.1	[illegible]	2.7	12			12	8.6603	51.18	1,213	19.0 - 29.0	1,213
19 - 29	16.5 - 25.1	[illegible]	2.7	28	1		27	8.6603	85.79	1,688	19.0 - 29.0	1,688
19 - 29	16.5 - 25.1	[illegible]	2.7	12			12	8.6603	51.18	2,022	19.0 - 29.0	2,022
29 - 39	25.1 - 33.8	[illegible]	2.7	16			16	8.6603	69.07	7	29.0 - 39.0	7
29 - 39	25.1 - 33.8	[illegible]	2.7	33			33	8.6603	108.30	14	29.0 - 39.0	14
39 - 49	33.8 - 42.4	1.2	2.7	21			21	8.6603	89.27	70	39.0 - 49.0	70
39 - 49	33.8 - 42.4	13.1	2.7	42			42	8.6603	137.73	492	39.0 - 49.0	492
39 - 49	33.8 - 42.4	5.5	2.7	21			21	8.6603	89.27	319	39.0 - 49.0	319
49 - 59	42.4 - 51.1	[illegible]	2.7	25			25	8.6603	107.16	391	49.0 - 59.0	391
49 - 59	42.4 - 51.1	[illegible]	2.7	50			50	8.6603	164.85	722	49.0 - 59.0	722
49 - 59	42.4 - 51.1	[illegible]	2.7	25			25	8.6603	107.16	435	49.0 - 59.0	435
59 - 69	51.1 - 59.8	13.0	2.7	30			30	8.6603	127.36	528	59.0 - 69.0	528
59 - 69	51.1 - 59.8	33.0	2.7	60	3		57	8.6603	189.66	900	59.0 - 69.0	900
59 - 69	51.1 - 59.8	22.0	2.7	30			30	8.6603	127.36	894	59.0 - 69.0	894
69 - 79	59.8 - 68.4	[illegible]	2.7	34			34	8.6603	145.25	641	69.0 - 79.0	641
69 - 79	59.8 - 68.4	[illegible]	2.7	44	11		33	8.6603	142.94	1,574	69.0 - 79.0	1,574
69 - 79	59.8 - 68.4	[illegible]	2.7	34	5		29	8.6603	133.71	1,412	69.0 - 79.0	1,412
79 - 89	68.4 - 77.1	[illegible]	2.7	39			39	8.6603	165.45	84	79.0 - 89.0	84
79 - 89	68.4 - 77.1	[illegible]	2.7	46			46	8.6603	181.60	598	79.0 - 89.0	598
79 - 89	68.4 - 77.1	[illegible]	2.7	34			34	8.6603	153.91	289	79.0 - 89.0	289
89 - 104	77.1 - 90.1	[illegible]	2.7	45			45	12.99	190.12	12	89.0 - 104.0	12
89 - 104	77.1 - 90.1	[illegible]	2.7	38			38	12.99	173.96	76	89.0 - 104.0	76