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Detecting Geomorphic Change and Stream Channel Evolution on the Sandy River,
Oregon, Using Lidar Following Dam Removal in 2007

by

Lowell Henry Anthony

A thesis submitted in partial fulfillment of the
requirements for the degree of

Master of Science
in
Geography

Thesis Committee:
Martin Lafrenz, Chair
Scott Burns
David Banis

Portland State University
2019

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Abstract

Following the removal of Marmot Dam on the Sandy River, Oregon, several Lidar flights were flown over the area of the former reservoir. The resultant sequential DEMs permitted calculation of reach-scale volumetric erosion and aggradation following dam removal. This allows for change detection across the entire affected reach of the former impoundment rather than just at several cross sections. In the first year there was a net loss of bank sediment in the dewatered reach. Subsequent flights show continued degradation of 145,649 m³ as well as aggradation of 6,232 m³. Sediment transport reached quasi-equilibrium in 2012 with a net change of 65 m³. In addition, this technique allows the extraction of cross-section information which shows that the channel continues to be active migrating in some areas while also being constrained by bedrock features from past volcanism in some reaches. This study further shows the capability of lidar to measure rates of aggradation and degradation for an entire river system instead of reach specific extrapolations and that repeat lidar flights can more than adequately assess the changing nature of entire stream reaches more rapidly and more cost effectively than traditional field techniques. In addition:

- The utility of Lidar to do river management with repeat returns, having successive lidar acquisitions run on the watershed level will help us to gain insight into the correlation to precipitation events and geomorphological change in a given reach.
- Lidar can be used to assess the validity of channel evolution models. Sequential runs of lidar can be used to adjust the overall effectiveness of current CEM's and create new ones that consider reach specific geomorphology.
- Dam removal projects should incorporate initial lidar flights prior to removal and follow acquisitions based on known CEM's for the region and overall region-specific physiography.
- Sequential lidar should be used for hazard mitigation and geohazards analysis with an acquisition timeframe that is appropriate for the region's physiography, geology, geomorphology and the return interval of the hazard being monitored.

Dedication

I wish to express special thanks to all those that have made this endeavor possible and put up with me while I went through it. To my parents Lawrence L. and Mollie P. Anthony, for their unwavering support and encouragement throughout my adventures in higher education, and life. To my children Ariana and Nicholas who added their own adventures on top of this one and yet helped me to learn more about myself in the process. To everyone that believes in themselves and that they can change their life for the better irrespective of past mistakes. And most especially to my wife, Heather, for her unwavering support, love and encouragement while I struggled to finish this endeavor, that patience and understanding came when I needed it the most.

It's never too late to be what you might have been. ~George Elliot

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The influence and patience of Martin Lafrenz both as my advisor and as a field assistant has been pivotal to helping me accomplish this manuscript and for keeping me focused when the task at hand seemed to become more daunting and my confidence in what I was doing was waning; he always challenged me to look at things from varied perspectives.

In addition, special thanks are due to my numerous colleagues at the Oregon Department of Geology for their support and help throughout this process, most especially Clark Niewendorp, Ian Madin, Jed Roberts, Yumei Wang, Bill Burns, and John English. Each of you helped me gain a deeper understanding of the geologic and geomorphic principles at work in the region and through the work done on our many projects over the years, have helped to expand my knowledge and appreciation of what we do. And to Deb Schueller, for helping me be a better writer and understanding the ins and outs of map and manuscript layout and keeping me from losing my mind fighting with Word and Adobe Illustrator, your knowledge and patience with me over the years has been most appreciated.

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Acronyms

CEM	Channel evolution models
CFS	Cubic feet per second
CMS	Cubic meters per second
CMZ	Channel migration zone
DO	Dissolved oxygen
DOGAMI	Department of Geology and Mineral Industries (State of Oregon)
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
GIS	Geographic Information System
GPS	Global Positioning System
HZ	Hyporheic zone
LWD	Large woody debris
NAIP	National Agriculture Imagery Program
NOAA	National Oceanic and Atmospheric Administration
OLC	Oregon Lidar Consortium
RTK	Real-time kinematic
SFM	Structure from Motion
TIN	Triangulated Irregular Network
UAV	Unmanned Aerial Vehicle
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

Definitions

Active Channel – A short-term geomorphic feature formed by prevailing stream discharges, is narrower than the bankfull channel and is defined by a break in bank slope that also typically is the edge of permanent vegetation.

Aggradation – The process by which a stream's gradient steepens due to increased deposition of sediment.

Bathymetry – The study of the "beds" or "floors" of water bodies, including the ocean, rivers, streams, and lakes.

Channel Migration – Channel migration is the natural process by which streams move laterally over time. It is typically a gradual phenomenon that works over many years to effect significant migration. In some cases, usually associated with flood events, significant migration can happen rapidly.

Competence – A stream's ability to transport sediment. The measure of the maximum size of particles a stream can transport.

Degradation – The process by which a stream's gradient becomes less steep, due to the erosion of sediment from the stream bed. Such erosion generally follows a sharp reduction in the amount of sediment entering the stream.

Fluvial geomorphology – Examination of the processes that operate in river systems and the landforms which they create or have created.

Geomorphology – Study of landforms, the processes that created them, and the history of their development.

Headcut – Channel bottom erosion progressing upstream indicating a readjustment of slope, discharge, and sediment.

Incised Channel – Channel that is not hydraulically connected with its floodplain due to erosion.

Knick Point – Location in the thalweg where there is an abrupt change in elevation.

Lahar – A flow of material comprised from a mixture of hot or cold water, pyroclastic material, and rock fragments flowing down the slopes of a volcano typically within a river valley.

Lidar – A remote sensing technology that measures distance by illuminating a target with a laser and analyzing the reflected light. Lidar is popularly used as a technology to make high-resolution maps.

Orthophoto – An aerial photograph that has been geometrically corrected or 'ortho-rectified' such that the scale of the photograph is uniform and utilized in the same manner as a map. An ortho-photograph can be used to measure true distances of features within the photograph.

Pools – Are the deepest locations of the reach. Water surface slope of pools at below bankfull flows is near zero. Pools are often located at the outside of meander bends.

Riffles – The sections of the bed with the steepest slopes and shallowest depths at flows below bankfull. Riffles typically occur at the cross over locations and have poorly defined thalweg.

Riverine – Of or produced by a river. Riverine floodplains have readily identifiable channels.

Susceptibility – Degree of proneness to natural hazards that is determined based on physical characteristics that are present.

Thalweg – Longitudinal outline/trace/survey of a deepest part of riverbed from source to mouth (upstream/downstream). Line of steepest descent along the stream.

Tinning – Areas where lidar returns are sparsely recorded; this decreased point spacing results in a tinning pattern inherent in the extrapolation between points in a triangulated irregular network.

1.0 Introduction

1.1 Study Area - Marmot Dam

In this study I examine the geomorphic change on a small reach of the Sandy River, Oregon after the removal the Marmot Dam in 2007 (Figure 1). Dam removal presents researchers with a remarkable opportunity to gain a better understanding of the complex process of stream morphology channel adjustment. Dam removal is often as contentious a proposition today as the building of the original dams was during the 20th century. Advocates for dam removal focus on the benefits to ecology through the removal of structures and the subsequent reestablishment of the ‘natural’ flow of the stream reach. This restoration of the natural process benefits all facets of the watershed and the various species that reside in the reaches themselves, while providing benefits to several endangered species that were essentially cut off from the watershed and areas upstream of the dam. While many studies of dam removal focus just on the immediate reach where the dam was removed, more comprehensive studies are being made that investigate the effects of dam removal on the watershed and full-scale impacts on the environment from the release of trapped sediments.

Accumulated sediment builds up behind the dam structure, this, however, can be mitigated through dredging of the material, slow draw down of the dam reservoir level, removal of trapped sediments, or with the rapid “blow and go” method that quickly disperses much of the trapped sediments back in to the reach. While studies into the various methods are still in progress, there is evidence that the sediment impact to downstream habitat is minimal. With the advent of Light Detection and Ranging (lidar) technology, we can gain a better understanding of the morphological process intervals (changes in channel

Sandy River, Oregon Marmot Dam Study Area

Plate 1

Figure 1. Plate 1 Marmot Dam study area showing active channel margins mapped from the four separate lidar flights.

position; changes in channel gradient, etc.) over time and how they correlate to the flow of the reach and the current geologic conditions. Having successive lidar acquisitions run on

the watershed level will help us to gain insight into the correlation to precipitation events and geomorphological change in a given reach. The study of river morphology using lidar is just starting to gain traction and as lidar sensors improve the quality of the data gathered continues to improve giving us more insight in the bedform morphology and channel specific dynamics in a given reach. After constructing thousands of dams in the 20th Century, the past several decades have seen the removal of some aging dams. These removals provide the fluvial geomorphologist the opportunity to observe how stream channels respond to these sudden changes in hydrology. Most of these studies have documented these changes by examining stream cross-sections to monitor, for instance, changes in the position of the thalweg. However, this technique necessarily acts as only an estimate of the total amount change in stream plan form as well as the position of all geomorphic features in the channel. In this study I use repeat flights of remotely sensed lidar imagery to map and quantify changes in channel evolution of an entire reach of a river following dam removal over a period of 6 years. This technique allows for an additional account of sediment movement, which allows river managers the opportunity to better predict, monitor, and mitigate the effects of dam removal on both downstream and upstream ecosystems.

Fluvial geomorphology is the study of the development of valley and channel landforms by moving water, such as rivers and streams. It is the form and function of the river system that fluvial geomorphologists study to better understand the processes at work in the fluvial system (Schumm 1977). By studying how moving water shapes the landforms we gain perspective on the active processes at work and how our own actions can affect the system (Endreny, 2003). We can see an example of how our interactions have negatively affected

the system through the decade's long process of channelization and dam building to control stream flow. These engineering techniques were considered the most effective way to control critical flows (floods) and the loss of bank material through the process of erosion. These projects have disrupted the fluvial system's hydrology, altered water temperatures, and seriously disturbed biological and ecological aquatic systems (Babbitt, 2002; Higgs, 2002).

What we have come to realize is that the control of the natural river process (erosion, deposition, and meandering) often does more harm than good; for instance, the accumulation of sediment behind dams decreases the available habitat that is critical to the river's species diversity (Endreny, 2003). Streams are classified as one of three types including straight, meandering, and braided. The form and function of the river system is such that it rarely runs in a straight channel; even at the headwaters in steep mountain channels there is some lateral movement that occurs in the system (Schumm, 1977). As the angle of the slope lessens, the waterway starts to wander laterally across the channel. This lateral movement produces a meandering course on a moderate slope.

Classic meandering streams have many meanders or bends and are a stable system, although they will shift and move across the floodplain through time. Meandering streams contribute to a healthy riverine environment and create diverse habitat types. They also disperse the potential hydraulic energy of the reach through turbulent eddies and the process of scour (Endreny, 2003). Other features of meandering streams that are important to the understanding of the form and function of the system is the pool-riffle complex. The pool-riffle complex makes up the deep and shallow portions of meandering stream beds, with the pools forming near the outer edge of the meander bends, while the riffles form in

short, shallow, wider portions of the stream between the meander bends. The pool-riffle sequence occurs at repeating intervals within the meanders of ~5 to 7 widths of the channel (Charlton, 2008). The pool-riffle sequence provides dissolved oxygen (DO) to the river system as water flows into and out of the hyporheic zone (HZ) (Figure 2), which is the zone of interaction between groundwater and channel water. This movement of water through the HZ occurs through changes in hydraulic pressure at multiple scales. This further contributes to habitat diversity in the system (Winter et al., 1998).

Figure 2. Cross-sectional view of the hyporheic zone in a river catchment. The hyporheic zone (HZ) is a fundamental part of a river ecosystem. It is the zone of interaction between groundwater and channel water (Biddulph, 2015).

Additionally, the pool-riffle sequence provides transport of sediment materials, which are important for salmon spawning habitat; while there is erosion and deposition occurring in both the pools and the riffles, the coarser material in the riffle region is what salmon prefer. It is in this deposition region of the riffle that salmon lay their eggs; it is also the region where the smaller macroinvertebrates reside which provides a nutrient rich region for the young salmon. Fundamentally, the relationship of pools and riffles to bed form structures is a key attribute to understanding functions of riverine ecology (Endreny, 2003).

This initial mobility of trapped sediments is the first factor to consider in the geomorphic response to the removal of a dam, yet there are other factors that need to be explored. It is important to consider the initial channel response and subsequent channel migration/morphology and the reestablishment of key instream habitat structures such as pools and riffles. The effects of dams and reservoirs create an imbalance to the natural system and have been shown to have adverse effects on native fish populations, even when fish ladders have been installed to offset the presence of the dam (Neave et al., 2009). The consideration given to threatened native fish species and the restoration of their natural habitat have been discussed in the dam removal process but have not been the key factor cited for the removal which in many cases have been the initiation of Federal Energy Regulatory Commission (FERC) relicensing and the high expense of implementing changes in line with the Endangered Species Act (ESA) as was the case with the Marmot Dam. The introduction of new technologies has made the study of the geomorphic response to dam removal over large areas more feasible. Lidar is one such breakthrough that allows researchers to view changes over time and apply watershed and geologic reach similarities to disturbance regime models which would prove beneficial in dam removal impact assessments.

The removal of the Marmot provided an opportunity to run repeat lidar acquisitions over a 6-year period. Oregon Lidar Consortium (OLC) and the Oregon Department of Geology and Mineral Industries (DOGAMI) gathered a group of stakeholders to fund the multiple flights and study various geohazards in the region (English, 2008). The Sandy River is highly competent as are many of the streams that come out of the Cascades (Abbe et al., 2015). The competence of the Sandy lends it to the mobilization of boulders and has

resulted in a reverse sorting due to the extreme pulses on the stream (Figure 3); this has led to the formation of well armored terraces and islands which have not seen flow levels sufficient enough to mobilize them. Past avulsion/channel migration paths are visible in the terraces and the fact that the river has shifted laterally and incised vertically in its current path lends to my theory that the current stream position is highly stable given current conditions and has reached the quasi-equilibrium stage of the process.

Figure 3. Reverse sorting of sediment with large cobbles intermixed throughout the gravel bar, approximate location of Transect C. Photo by Lowell Anthony, Oregon Department of Geology, October 13th, 2014 (left) at 294 cfs and July 15th, 2018 at 410 cfs (right).

However, lack of any significant revegetation on the bars would indicate significant flows during the winter months which would continually scour the bars and further readjust their position. Since the removal of the Marmot Dam the channel has gone through various changes but is currently in a condition of quasi-equilibrium and the ‘flashy’ nature of flooding on the Sandy lends to the reverse sorting seen on the bars, during high quick flows there is enough discharge to mobilize the large boulders, which in turn end up falling out much quicker when the flows start to slacken leaving very well armored bars that would need significant flow over a stretch of time to see further mobilization or significant change in the lateral profile of the reach. Well consolidated and resistant bedrock flows also limit the lateral migration potential of the Sandy in this area and is probably one of the driving

factors behind choosing the site for the dam. Flow is diverted around these resistant lahar tufts and an accumulation of large woody debris (LWD) is noticeable atop one of the formations (Figure 4) downstream of the crib structure mid-riffle, which in turn forms a pool before sliding around the bend into another riffle.

The resistant lahar tufts that extend into the river margin currently preclude further migration potential, but also lead to sweeping meander arcs that present the potential for slope failure; channel migration induced landslides can occur when the outside arc of the meander bend cuts into the margin of the bank enough to undermine the angle of repose for the bank. This in turn leads to instances of channel blockage and avulsion potential for the river. Landslides are downhill movements of rock, debris, or soil. While there are many different types of landslides in Oregon.

Figure 4. Large woody debris accumulation atop brecciated lahar dike, approximate location of Transect D. Photo by Lowell Anthony, Oregon Department of Geology, October 13th, 2014 (left) at 294 cfs facing south and July 15th, 2018 at 410 cfs in channel facing north (right).

In the Lower Columbia–Sandy watershed where the Sandy River is located, the most common are debris flows and shallow- and deep-seated landslides. Landslides can occur in many sizes, at different depths, and with varying rates of movement. Given the Sandy Rivers competence and mobility along its course there is a potential for channel migration induced landslides in the area. Many triggers can cause a landslide: intense rainfall,

earthquakes, or human-induced factors like excavation along a landslide toe or loading at the top or channel migration induced action (Figure 5). Landslides can cause severe damage to buildings and infrastructure. Fast-moving landslides may pose life safety risks and can occur throughout Oregon (Burns et al., 2016).

Figure 5. Channel migration induced slope failure. Note the exposed sediment layers which show Troutdale formation overlaying older flood deposition (left) 2018 photo shows the same location from a different angle the exposure is less evident. Photo by Lowell Anthony, Oregon Department of Geology, October 13th, 2014 (left) at 294 cfs and July 15th, 2018 at 410 cfs (right).

1.2 Reach Description

The study area is located at the site of the removed Marmot Dam, a portion of the Sandy River, Oregon, which is a 90-kilometer tributary of the Columbia River originating on the southwest flanks of Mount Hood from the Reid Glacier. The Sandy River then flows through Clackamas and Multnomah County ending at the Columbia River near Troutdale Oregon. Increased interest in the Sandy River's hydraulics and geomorphology has come from the decommissioning of the Marmot Dam in July of 2007 and its final removal completed in October of 2007. The removal of the dam provided a unique opportunity to examine channel morphology characteristics in a sediment-rich environment (Major et al., 2012).

The examination of the old impoundment of the Marmot Dam, a 3.2-kilometer reach, is the area of focus. Using field surveys, known literature of the same region, orthophotos and lidar, I examine whether lidar can be an effective proxy to field work to map geomorphic features and pool-riffle complexes on the river. Previous literature shows that lidar can be effective for extracting water surface features when the angle of incidence for the pulse return is at its nadir and that rougher water surfaces give more return pulses for extraction (English, 2008). The use of lidar for natural resource management and planning has progressed over the past decade and a national U.S. lidar acquisition (<https://nationalmap.gov/3DEP/>) is expected to be a fact by 2020 (Evans et al., 2009). Lidar has been used to illustrate the geometry and slope of mountain channels in the Pacific Northwest giving researchers the capability to have a reliable and repeatable approach for quickly and effectively sampling and analyzing the physical characteristics within the watershed (Faux et al., 2009). New studies using green wavelength lidar allows for high-resolution bathymetric studies of channel depth and bed profiles. My own research is a continuation/addition to the growing use of lidar for resource management and channel morphology studies and allows me to build off previous research methods while still providing a valuable contribution to the field.

The immediate downstream area of the dam has not seen significant changes due to the well armored channel carved out of the river entrenchment downstream of the dam spillway. Figure 6 shows the channel morphology at the spillway looking upstream from the footbridge, notice that there is not significant difference in the channel morphology at this point. The natural constriction formed at this point of the reach would explain the location of the dam. Overall incision rate of the entire Sandy compared to the rivers around

it from the last lahars flow approximately 1781 CE (Old Maid eruptive period) still puts it at an overall higher elevation than other rivers around it suggesting downward incision still needed to reach equilibrium, the area of the Marmot Dam had the downward incision rate halted and the accumulation of additional sediment from upstream erosion.

Figure 6. Location of the old Marmot Dam and beginning of the spillway looking upstream from the footbridge. Photo by Lowell Anthony, Oregon Department of Geology, October 13th, 2014 (left) at 294 cfs and July 15th, 2018 at 410 cfs (right).

This coupled with development in the Villages at Mt. Hood area and subsequent channel modifications by the United States Army Corps of Engineers (USACE) has adjusted the Sandy Rivers capability to mobilize the sediment that was left after the Old Maid eruptive period. We know from previous studies of the Mt. Hood region that the Old Maid eruptions added large volumes of sediment to the upper reaches of the Sandy River, overwhelming the highly competent river system, accelerating the sediment loading to the river during peak flow conditions.

The large sediment loads exceeded the Sandy's transport capacity changing the rivers geomorphology downstream of the event (Pierson et al., 2009). Evidence of this volcanic action is still visible in the stream cuts and bank exposures along the old Marmot Dam impoundment. The current position is well entrenched, but further plucking and high flows continue to pick at the margins.

The initial removal of the dam saw the bulk of accumulated dam sediment quickly mobilized and redistributed with the knickpoint retreat establishing itself at the pre-dam incision point upstream (Major et al., 2012). Local geology constrains the extents of lateral migration with well consolidated dikes of brecciated lahar tufts scattered through the reach and well armored boulder fields that are well defined.

Major et al., (2008) looks at the initial response to the removal of the Marmot Dam which was located approximately 45 kilometers upstream of the Columbia River Confluence. The removal of the dam released approximately 730,000 cubic meters of sediments stored behind the dam. The articles focus was on the initial fluvial response to the removal of the dam in the first 48 hours after the breach of the coffer dam. In that period approximately 100,000 cubic meters of stored sediment was transported downstream by the erosive force of the Sandy River (Major et al., 2008).

The original rock-and-timber-crib structure dam was built in 1913 and was later replaced in 1989 by a 14-meter high and 50-meter wide concrete dam owned and operated by Portland General Electric (PGE) and was used as part of the Bull Run Hydroelectric Project, diverting water from the Sandy River and up to Lake Roslyn, a manmade lake that is no longer in existence after the removal of the dam. Options were evaluated for the decommissioning of the dam, and it was determined that the “blow and go” method would be the most effective given the competency of the river; all that was needed was a sufficient flow (Major et al., 2008).

With this method the dam is removed as quickly as possible with minimal sediment removal taking place before the dam is breached. To facilitate the dam’s removal an earthen cofferdam was built on top of impounded sediment approximately 70 meters upstream of

the 1989 concrete dam, diverting the Sandy River around both the dams and allowing for the pre-removal of close to 20,000 cubic meters of sediment that was located between the two dam structures. While this method is desirable from a low cost and minimal in-stream disturbance perspective, there was still the issue of the 730,000 cubic meters of sediment remaining behind the coffer and dam (Major et al., 2008).

To minimize the impact to seasonal fish runs and any adverse effects to resident and migratory fish, the dam breach schedule was decided in July of 2007 to coincide with the higher flows associated with region which typically begin in mid-October. The Sandy River is an unfettered river with a high-gradient of 0.006 – 0.009 meters per meter and peak flows in the winter months above 20,000 cfs (Major et al., 2008). With a heavy rainfall forecasted for October 19th, 2007 and a predicted flow of 68 cubic meters per second (cms), a dam breach was initiated at 10:00 am PDT, dewatering pumps were removed around 12:00 pm PDT and by 1:30 pm PDT the first signs of water began seeping through the earth dam, triggering a small mass failure of the dam's downstream face. By 5:00 pm PDT the river was flowing near 50 cms and a small notch was carved in the crest of the cofferdam allowing for the release of the flow (Major et al., 2008). By 5:45 pm PDT the flow was exponentially enlarging the breach which resulted in a flash flow peak of 136 cms as the river rapidly reasserted itself to predam profile, by 6:00 pm PDT the river had completely incised through the cofferdam and by 11:30 pm PDT the river had completely removed it (Major et al., 2008).

As the dam washed away, the Sandy River continued to erode the impoundment of sand and gravel through a combination of lateral erosion and headward cutting, and within 12 hours of the breach, it had incised through the sand and gravel fill in the lower 300 meters

of the reservoir reach (Major et al., 2008). As the knickpoint retreated upstream the lateral migration of the river swiftly widened the river and eroded the meters high unconsolidated fill which was exposed as the reservoir drained. Preliminary analysis of the initial results indicated approximately 100,000 cubic meters of sediment was eroded in the first 48 hours of the breach at about 50 cms which is a discharge just 30% greater than the median flow. That sediment load correlates to the approximate mean annual load of the Sandy River at the Marmot Dam (Major et al., 2008). Within 6 months of the breach approximately 300,000 cubic meters of sediment had eroded from the reservoir, and the knickpoint had retreated 1.5 kilometers upstream of the dam to the approximate intersection point of the Sandy River to the upstream influence of the Marmot Dam, the area of reduced discharge where the river transitions from being unfettered to the reservoir (Major et al., 2008).

The removal of the Marmot Dam marked the largest release of a trapped impoundment up to that time and was the first instance in close to 100 years that the Sandy River ran unconstrained from its headwaters to its confluence with the Columbia River (Major et al., 2012). Channel response following the removal of Marmot Dam showed the same geomorphic characteristics described by Doyle et al., (2005); the initial knickpoint progressed rapidly upstream as the high velocity Sandy River eroded the unconsolidated sand-gravel sediment impoundment. This quick incision rate and knickpoint migration upstream caused the channel to widen rapidly and mobilize a large portion of the 15-meter-high sediment banks on either side of the initial breach channel.

The high velocity Sandy River incised to near pre-dam elevations in just 12 hours the upstream geomorphology further adjusted following high velocity stormflows typical of the Sandy River in winter months. Thus, by mid-January close to another 300,000 cubic

meters of impoundment was removed (Major et al., 2012). The knickpoint retreat stabilized at the upper most end of the original impoundment deltaic zone and the river has migrated laterally a few times over the years since the initial removal but seems to have stabilized in the current channel configuration. My observation correlates to the conclusion drawn by Major et al., (2012) and shows the channel has reached the quasi-equilibrium stage of the removal. As degradation and lateral migration continued a wooden ‘crib’ structure (Figure 7) emerged from the sediment and has since formed part of the rapid/riffle structure with the resistant lahar dike forming a breakwater that lends to the pool structure at the end of the riffle run (Figure 8).

Figure 7. ‘Crib’ structure mid-rapid above the old Marmot Dam location. Photo by Lowell Anthony, Oregon Department of Geology, October 13th, 2014 (left) at 294 cfs and July 15th, 2018 at 410 cfs (right).

Upstream of this structure, reverse gradient deposition beds can be seen in the bank margin, this shows the accumulation of sediment in the impoundment overtime (Figure 9). The different sediment accumulations can give us a picture of the flow regimes that influenced the river over time.

Different layer accumulations show sediment differences, these differences would correlate to high flow regimes and the type of sediment mobilization from further upstream. Given the nature of the Sandy River and the geologic history of the region, high

precipitation events dislodge material from further up the reach. This material can be in the form of old lahar deposits, glacial till, and landslide/debris flow material from over saturation and channel migration events. Major et al., (2012) is a comprehensive USGS report on the results of the multi-year study of the dam removal. The report provides a starting point for my own look at this region.

Figure 8. Brecciated lahar dike north of the crib structure at the end of the riffle/run. Photo by Lowell Anthony, Oregon Department of Geology, October 13th, 2014 (left) at 294 cfs and July 15th, 2018 at 410 cfs (right).

By the end of the first year after the breach the slope discontinuity caused by the rapid retreat of the knickpoint and subsequent lateral migration of the channel was nearly indistinct and bed coarsening progressed to near normal conditions for a high velocity high competency stream like the Sandy River. Seasonal variability on the Sandy River plays a significant role in shaping the morphology. Flow conditions on the Sandy are tied to the seasonal precipitation inputs. Precipitation in the system comes as both rain and snow, with the amount of snow affecting the seasonal discharge rates in late spring and through the summer months with lowest discharge rates occurring between late August and early October (Major et al., 2012; Abbe et al., 2015).

As pointed out in previous articles channel bedform watershed geology strongly influence the rate of degradation, aggradation and over transport capabilities of the stream

reach (Major et al., 2012). Causal correlation exists between upstream geomorphic responses to disturbance regimes such as dam removals. The relationship between the initial head-cut knickpoint creation with rapid upstream migration and the subsequent migration of the channel both lateral and in the incision, rates correlate to the volume of impoundment removed over a given timeframe (Major et al., 2012).

Figure 9. Reverse gradient foreset deposit (left) and foreset deposits exposed in slope failure (right). Photo by Lowell Anthony, Oregon Department of Geology, October 13th, 2014 (left) at 294 cfs and July 15th, 2018 at 410 cfs (right).

The duration of the fluvial response to dam removal will vary from reach to reach based on the reach boundary conditions and valley form variations. The Sandy River provided the researchers with an opportunity to record geomorphic changes on a high energy stream and put into play various interrelated functions because of dam removal that played out in a relatively short timeframe compared to past studies on the subject (Major et al., 2012).

1.3 Current Geomorphic State

The Sandy River is in the Lower Columbia-Sandy watershed, it is subject to numerous natural hazards that pose a potential to alter the current geomorphic conditions, as it has many times in the past. The Lower Columbia–Sandy watershed, which extends from the High Cascades through the Western Cascades and into the Portland Basin, is subject to

several significant natural hazards, including riverine flooding, earthquake, landslides, volcanic lahars, channel migration, and wildfire (Anthony et al., 2019).

Flooding is a recurring problem for most of the riverine communities along the Sandy River and many buildings within the floodplain are vulnerable to significant damage from flooding and prone to channel migration hazard being located within the mapped channel migration zone (CMZ). While the impact of flooding on residence from a risk prospective is minor this is mainly due to local initiatives that have looked to reduce the risk to infrastructure. The Sandy River is the primary drainage for the watershed, but many secondary tributaries add to the overall mobility of the riverine environment that are prone to flooding (Anthony et al., 2019).

Volcanic activity of Mount Hood has added character to the Sandy River and human activity has further defined its current characteristics, but the Sandy River itself continues to define the region around it due to the yearly flooding that occurs in the upper reaches. This volcanism can be seen in areas of resistant brecciated lahar tufts within the study area, and the large reverse sorted gravel bars with boulder sized rocks sitting on top, and significant areas with large woody debris built up show the power and frequency of the flood events on the Sandy River. Prior to the removal of the dam, orthophotos show large sand bars covering most of the areas now exposed as boulder fields and lahar dikes. Evidence of the past volcanic lahar from Mt. Hood can be seen in the resistant lahar dikes and channel migration induced slope failure (Figure 10) GIS analysis of the longitudinal profile of the stream is in line with previous literature from Leopold and Maddock, (1953), wherein he describes the longitudinal profile of a stream as a product of the overall change in the bed load downstream.

The correlation to stream gradient and bed load is also taken into consideration as stream competency and overall configuration of the stream bed are a result. In the case of the Marmot Dam, past geologic events have shaped the margins of the stream channel and after the Old Maid approximately 1781 C.E. pyroclastic flows and lahars choked the Sandy River with sand and gravel altering the river valley margins and increasing sediment loads out to the Sandy Delta. The unconsolidated lahar tuffs and breccia are visible in the study area. The angularity of many of the exposed cobbles within the lahar complex lends to the ferocity of the eruptive period resistance to the erosive competency of the Sandy River.

Figure 10. Resistant lahar dike, reverse sorted gravel bar, and channel migration induced slope failure. Photo by Lowell Anthony, Oregon Department of Geology, October 13th, 2014 (left) at 294 cfs and July 15th, 2018 at 410 cfs (right).

The area has reached a stage of quasi-equilibrium with the channel well defined and bracketed by large gravel bars and resistant lahar deposits. Some area on the west bank are still prone to slope failure given significant enough flows to overtop the gravel bars and current (2014) channel. Most of the gravel/boulder bars have limited amount of sediment accumulated on them, suggesting that the winter flows off Mt. Hood continue to scour them, but do not provide sufficient flows to mobilize the gravel bars themselves.

The reach has a few discernable pool/riffle sequences. The most prominent riffle is located approximately 10 meters upstream of the crib structure before the constriction point

of the reach and transitions quickly into an approximately 170-meter-long rapid/run before depositing into the first pool at the downstream bend beyond the structure. The resistant lahar tufts that emerge into the channel margin slow the flow of the river at this bend and cause a slackening and deepening of the channel creating a nice pool for salmonids to take advantage of (Charlton, 2008).

1.4 Past Geomorphic History

The geomorphology of the Sandy River has been directly affected by past eruptive periods from Mt. Hood followed by successive high flow events that have mobilized the sediment and moved debris from the eruptions down the riverine system. The most recent significant eruption from Mt. Hood was the Old Maid eruptive period which took place over approximately two decades and added significant amount of source sediment to the Sandy River.

Pierson et al., (2009) describe the two most significant eruptive events to come off Mount Hood in the late Holocene period. The Timberline and Old Maid eruptive periods were both considered dome-building eruptions resulting in numerous dome-collapse pyroclastic flows and lahars. These events moved large volumes of sediment and volcanic clasts both into temporary storage near the headwaters, and throughout portions of the entire reach resulting in the resistant lahar exposures visible throughout the Sandy River (Pierson et al., 2009).

These events introduced sediment loads that exceeded the river's transport capacity, leading to channel aggradation, channel widening, and channel morphology change approximately 80 kilometers downstream of Mount Hood (Pierson et al., 2009). Both

events lead to broad bed-material waves of sediment, creating slurry like conditions that took approximately 2 decades to reach the mouth of the river. The Old Maid event added approximately 23 meters of aggradation from the initial lahar hazard, but the bulk of the aggradation came from transport of sediment and subsequent deposition during normal peak flow conditions on the Sandy River. Over time the supply of sediment in the headwaters diminished enough that the river was able to degrade some areas, incising channels further which are evident today as abandoned terraces with higher avulsion potential and thus exposure to channel migration hazard (Pierson et al., 2009). Since that time the major driver in overall morphology is the variability in seasonal inputs to the system accounting for the high flood hazard for the Upper Sandy River and the overall movement of sediment the Sandy River is capable of (Major et al., 2012; Abbe et al., 2015)

2.0 Seasonal Inputs

Flows on the Sandy are directly correlated to the climate of the region. The typical seasonal outputs for the western Cascades are generally mild, wet winters and relatively cool and drier summers. The annual precipitation average varies from 78 inches down in the lower valley, with 100 inches or more, annually on the slopes of Mount Hood. Most precipitation for the region comes in the form of rain in the valley and transitions to snow in the upper elevations. The elevation variability of the freezing level in the region can account for increased discharges depending on the episodic pulses in the weather pattern (Abbe et al., 2015).

Factors that contribute to the flow regime on the Sandy River vary depending on the level of precipitation, the time of the year, and the level of the snow pack coupled with the time of melt. The streamflow characteristics of the Sandy River are dictated by this variability in precipitation and temperature, leading to low flows in October during the start of the water year, with discharge increasing as the winter storms come in mid-November, continuing to remain high into May. These generally taper off through the summer where they reach minimum flow conditions in August and September (Abbe et al., 2015).

2.1 Gauge Data

The active USGS Marmot stream gage #14137000 has discharge records dating back to 1912 for the Sandy River. The gage is in a confined channel segment near the former Marmot Dam site, comparing daily streamflow stats allows calculation of flood probability and extreme discharge events (Table 1). These data points allow researchers to get a better understanding of the flow regimes on the Sandy River, and for this reach (Abbe et al.,

2015). Seasonal variability on the Sandy is a key factor in the morphological response in my study area, the impact of two key floods provided the most noticeable change in the channel morphology in the lidar comparison and lends credence to having sequential lidar.

Table 1. Top ten peak flow events at Sandy River Marmot gauge (#14137000). Abbe et al., 2015

<u>USGS Gaging Station #1413700</u>	
<u>Date</u>	<u>Peak Flow (CFS)</u>
January 6, 1923	29,200
November 24, 1960	27,500
December 22, 1964	61,400
January 20, 1972	36,200
December 2, 1977	34,500
February 23, 1986	37,800
February 7, 1996	48,100
November 25, 1999	34,400
January 2, 2009	30,000
January 16, 2011	39,000

The largest variability in discharge occurs between November and February with flows that range from ~500 cfs, to extremes as much as ~5,000 cfs, this extreme variability which is also punctuated by episodic pulses during storm events, lend to the dynamic conditions experienced on the Sandy. Snowmelt runoff contributes to the variability during the late spring months with flows that range from 800 cfs to 3,000 cfs (Abbe et al., 2015). “Extreme streamflow values show that the rainfall-driven and rain-on-snow events in winter can be nearly 100% greater than the largest flows during April and May. Summer baseflows typically range between 300 and 500 cfs at Marmot, although late season storm events can increase flow to as much as 1,000 cfs in September.” (Abbe et al., 2015, page 6). These atmospheric river events contribute to the relationship of the channel characteristics and

geomorphic features located throughout the length of the river. Many of the communities above the Marmot Dam have increased risk from various hazards that can occur along the Sandy River and being in close proximity to Mt. Hood. Of those hazards the most potentially devastating and regularly occurring are landslides, floods, and channel migration, all three of which are directly related to the seasonal inputs into the system (Anthony et al., 2019). The reworking of soil lithology by the Sandy River lends to the dramatic vistas along the reach and can mobilize very large boulder sized cobbles. This has had devastating impacts to local infrastructure as happened in the 2011 flood event that reworked a portion of the Sandy River and threatened numerous homes and local access roads located within the channel migration hazard zone (Abbe et al., 2015).

2.2 Flood History

The results of the seasonal inputs, coupled with the geologic composition of the Sandy River, lends to particularly dramatic flood events. Due to the general conditions that exist in the Sandy Watershed, floods are the threat of greatest concern, especially for those in the upper reaches, above the old Marmot Dam location. The implementation of the dam caused the sediment transport profile of the river to be slowed dramatically, which left the towns along the Mt Hood Village Corridor at risk for dramatic effects from the flood pulses, especially in particularly heavy precipitation years, generally following the El Nino/La Nina cycle. The biggest risk associated with the high sediment loads and extreme atmospheric river storms present is that of avulsions. The unconsolidated lahar fill that dominates the surficial geology of the region is highly mobile, with the over saturated soils becoming viscous and prone to failure in the near bank areas. USGS maintains a gaging

station near the old Marmot Dam (#1413700) that provides historical observations of the flood frequency going back to 1987, and both peak streamflow statistics from 1912, and discharge statistics from dating back to 1911 (Abbe et al., 2015).

The robust details available for the region allow flood specialists and hydrologist the ability to create predictive models detailing possible outcomes for the region. Coupled with the advent of high-resolution remote sensing data in the form of lidar, greater detailed hazard mitigation plans, and better planning decisions can be made. The peak flow conditions on the Sandy, generally occur between October and March, with approximately 70% of the flood peaks occurring during the water rich months from November to January. The largest flood events have coincided with heavy atmospheric river conditions and warmer than usual temperatures (Figure 11). The largest flood on record was the 1964 flood which coupled the heavy precipitation with warmer temperatures, and a thick snowpack that was significantly reduced from the combination of precipitation and warm air, reaching a peak flow of 64,000 cfs on the afternoon of December 22, 1964 (Abbe et al., 2015).

The increase in discharge during the wetter months of November through January lend to the flooding in the region and increase geomorphic change of both the lateral, and downstream profiles of the river. Areas of resistant lahar tuff, breccia, and basalt, further complicate the flow potential of the region, and creating areas of dangerous flow regimes with numerous under currents near resistant outcroppings (Abbe et al., 2015). Since the removal of the Marmot Dam, the Sandy River has experienced two flow events greater than 25,000 cubic feet per second (cfs); in 2009 the flow event was recorded at 30,000 cfs and led to significant damage upstream of the Marmot Dam in region of The Villages at

Mt. Hood. Again in 2011 a significant flow of 39,000 cfs occurred, damaging more homes and destroying portions of the local road system (English, 2013), which has also led to further change in the morphology in the study reach. While significant, the two events are what would be considered approximately a 15-year (2009) and 33-year (2011) events based on prior records for the region. This is the probability chance that any precipitation event will be matched or exceeded in proceeding years, for comparison the USGS Marmot Dam Gage has a 100-year peak flow of 49,390 cfs (Abbe et al., 2015).

Figure 11. Daily rainfall accumulation compared to peak flows from October 1, 2009 through December 31, 2014. (Abbe et al., 2015).

3.0 Dam Removal

3.1 Background

While dam removal has been something of a contentious subject in the past the facts behind the impact's dams have on the natural function of a healthy riverine environment have started to have more of an effect on the conversation (American Rivers, 2018). Research has shown measurable impacts dams have on native fish and other aquatic species by blocking their movement and reducing the necessary flow of fresh water necessary to sustain healthy river systems. With as many as 90,000 dams no longer serving their purpose across the United States, dam removal is fast becoming the default response to a healthy watershed and riverine environment (American Rivers, 2018).

The 21st Century has seen the removal of numerous dams with some of the more high-profile removals garnering years long study. While environmental concerns have been cited as a benefit of removal, the driving factor in most dam removals has been the expense of complying with the ESA for fish passage tied to the renewal of the dams FERC operating license as was the case for the Marmot Dam (Major et al., 2012; Cannatelli and Curran, 2012). While the ESA and FERC costs are driving the bulk of removals, there are numerous other factors related to that added expense that impact the decision. Advances in alternative energy sources such as solar and wind power that have a less invasive impact on the natural system and less cost overhead provide a cost-effective alternative to hydroelectric dams (Cannatelli and Curran 2012).

The driving force behind the environmental concerns are primarily linked to the ESA to provide unobstructed access for native fish to upstream spawning habitats. Some examples cited are the Embury Dam on the Rappahannock River, and the Woolen Mills Dam on the

Rivanna River in Virginia to open passage for shad migration; the Chiloquin Dam on the Sprague River in Oregon to restore passage for three species of fish; and the Elwha and Glines Canyon dams in Washington to restore spawning habitat and increase the salmon population on the Elwha River (Cannatelli and Curran 2012).

Between 1912 and 2017 the United States has seen the removal of 1,384 dams, given the large number of dams removed to date and those still slated to be removed in the future this highlights the need to have the necessary tools to provide a better understanding behind the temporal and spatial aspects of the morphological response to dam removal. The Klamath River Dam project is slated to begin in 2020 with the removal and four large head dams encompassing more than 300 miles of river habitat. The plan calls for a slow draw down of the reservoirs over a period of two to three months and a detailed restoration plan which aims to return the lands to native habitat (American Rivers, 2018). While environmental impacts have been stated in all removal proposals the overall driver for removal had been the cost of FERC re-certification and the ESA.

3.2 Channel Evolution Model

The importance of past research into the impact of dam removal on the downstream habitat should not be overlooked (Babbitt 2002). This is especially necessary because in most cases there were no geomorphic studies prior to and after dam construction. A high level of transparency into the impact of dam removal is necessary given the lack of research in the initial building of the dams. As Babbitt points out, not all dams are good candidates for removal, and the larger the dam the larger the impact; this makes research of the disturbance vital to the project (Babbitt, 2002).

The size of the dam should have a direct correlation to the scope of research done on the removal. This includes both upstream and downstream impact and geomorphic assessment of the river. The size of the dam also correlates to the size of the geomorphic response of the removal and thus should correlate to the scope of the assessment. The site's geomorphology is a key factor to understanding the response to the disturbance, thus comparing historical data of the reach pre-dam can help researchers to understand geomorphic changes that can occur post-dam.

Martin Doyle examined the upstream geomorphic response to dam removal in a series of articles published over four years. In Doyle et al., (2002) the authors discuss the need for tools useful toward predicting upstream geomorphic changes from dam removal. The examination came at a time when dam removals were occurring more frequently as numerous dams throughout the country were nearing the end of their FERC license; relicensing would require upgrades and retrofits to comply with safety standards and ESA laws that had been implemented since dam construction. As was discussed by Babbitt (2002) it was essential that more research be done concerning the channel morphology and stream biota changes resulting from the removal of these aging dams; at issue was the lack of well-established tools for predicting erosion and deposition rates following dam removal (Doyle, 2002). Of primary interest was the rate of sediment transport following dam removal. In addition, dam impounded sediments contain potential pollutants that could adversely affect downstream structures and biota. Understanding the rates of erosion after removal was essential to gauging the possible impact of trapped sediment on downstream reaches as well as geomorphic changes in upstream reaches. For instance, following dam removal the rate and pattern of upstream migration of the initial knickpoint and the

subsequent channel migration across the impoundment delta was unknown as the upstream reach seeks to reestablish equilibrium. Thorough understanding of the temporal and spatial scales of dam removal is essential to managing the impacts downstream and understanding the geomorphic changes upstream. Doyle (2002) stated that "understanding the geomorphic processes of channel incision allows prediction of forms and processes, as well as the potential application of documented stabilization techniques already in practice" (Doyle et al., 2002, page 1576). Emphasis needs to be given on pre-removal modeling through scale driven replicas of the impoundment, channel evolution models (CEM), and data collection with equal emphasis given to the post-removal upstream geomorphic changes in the reach (Doyle et al., 2002).

Doyle et al., (2003a) continues the discussion on the importance of good empirical data and the use of CEM's; models used to gain a better understanding of the effects on channel morphology spatially and temporally, developed over time from studies involving channel incision (Doyle et al (2003a). The discussion revolves around predicting the quantity of sediment released from the reservoir impoundment after dam removal. The rates of erosion and deposition are directly correlated to the method of dam removal and the seasonal variations of discharge in the reach (Doyle et al., 2003a). To assist at understanding the rates of change on the impoundment they used a CEM to predict how the channel geometry will respond once the dam is removed. The CEM was adjusted to include bank stability modeling in order to understand changes in the lateral migration of the channel. The rate of knickpoint migration and lateral channel migration will vary from reach to reach dependent upon the geomorphic, geologic, and vegetation characteristics in the impoundment area. For instance, the rate of change closest to the dam is higher as the

impoundment delta is easily mobilized and unconstrained by bedrock or vegetation (Doyle et al., 2003a). As the knickpoint migrates upstream and the channel migrates laterally across the impoundment, the reach approaches base level and starts to encounter the original channel bedform; this limits the lateral migration of the channel and slows the headward cutting of the knickpoint. Once the channel and knickpoint reach the end of the reservoir constraints there is a decrease in lateral migration due to the stabilizing factors of vegetation and the established channel bedform; it is at this point that the channel reaches equilibrium ending knickpoint migration (Doyle et al., 2003a). It can be concluded that once the dam is removed and equilibrium is reached that the remaining sediment in the impoundment will be relatively stable; it can be further stabilized by planting native plants species that increase bank stability in the region (Doyle et al., 2003a).

In Doyle et al., (2003b) the discussion focuses on the removal of two low-head dams in Southern Wisconsin. The differences in the grain sizes and cohesiveness of the two impoundments determined the rate of changes upstream of each reach. As Doyle has previously stated, both erosion and deposition rates of sediment, the effects of unique watershed hydrology, and geomorphology are key factors to understanding the impact to reestablishing natural stream characteristics post-dam removal. Dam removal provides us with a managed disturbance regime on a given reach, thus allowing researchers to gain a better understanding of the geomorphic response to large scale disturbance. At each of the dam sites a cross section survey was performed to mark the existing bank and reach conditions and to help monitor the geomorphic changes occurring upstream of the breach. Following dam removal, the team ran their previously discussed CEM's for each reach, the results of the dewatering and removal of the dams were consistent with the findings of the

CEM data (Doyle et al., 2003b). As the water level lowered, an initial head-cut created a knickpoint with high velocity constrained to a narrow, steep channel. As the channel continued to evolve the knickpoint migrated upstream, until it reached the streams intersection with the reservoir upstream limit. As the channel gets closer to equilibrium it becomes wider and slower meandering across the impoundment delta and both eroding sediment on the cut bank and depositing sediment on the point bar regions of the emerging channel. The group classified the changes of upstream geomorphology into six stages with the variability of stage progression (Figure 12) being marked by the velocity of flow, channel slope, seasonality of the dam removal and stratigraphic composition of the impoundment itself (Doyle et al., 2003b).

Figure 12. Channel Evolution Model stages in profile view. The channel profile view (c) shows each stage as it relates to equilibrium development in the reservoir impoundment. (Doyle et al., 2003b)

Stage A represents existing condition pre-dam removal, Stage B correspond to the conditions right after the initial removal, Stage C is characterized by channel degradation (Figure 13). Stage D represents channel widening, Stage E represents continued widening and migration of the channel with combined degradation and aggradation of the channel margins, and Stage F represents further aggradation and channel equilibrium develops (Figure 14). The composition of the sediment in the impoundment dictates the rate of

upstream channel development and the process of the dam removal itself impacts the rate of change in the reach (Doyle et al., 2003b).

Figure 13. Stage Progression of a channel evolution model showing channel development in a reservoir after the removal of a dam: Stages A to C. Channel degradation begins quickly once the structure is removed. (Doyle et al., 2003b).

In the final Doyle et al., (2005) discussion a series of small dam removals were modeled to understand the effects on upstream channel morphology and downstream effects on key ecosystem attributes. While understanding the upstream effects of dam removal are important to scientific research on the subject, of equal importance is the affect downstream on key stream ecosystems.

The impact downstream on vegetation, fish, macroinvertebrates and nutrient loads should also be considered in the removal of a dam. Understanding the upstream geomorphic response to the removal of a dam can tell us the likely impacts on downstream habitats and allow for mitigation techniques to play a part in the redistribution of trapped

sediment on downstream habitats. Once again, CEM's were used to establish preliminary responses across a range of trophic conditions (Doyle et al., 2005).

Figure 14. Stage Progression of a channel evolution model showing channel development in a reservoir after the removal of a dam: Stages E to D. As degradation continues, the channel widens and begins to aggrade downstream of the knickpoint eventually reaching quasi equilibrium. (Doyle et al., 2003b).

As previously stated by Doyle et al., (2002), the geomorphic response to the removal of a dam constitutes a disturbance regime, albeit one that is controlled by those removing the dam. The rates of change upstream and downstream of the dam are controlled by the amount of sediment trapped in the impoundment and the ability of the river to mobilize the sediment and reestablish its base condition. Thus, higher energy streams will be more efficient at redistributing trapped sediment than lower energy streams which directly correlates to the ability of downstream habitats to adjust to changes in sediment loads.

Again, the six stages of channel morphology following dam removal are discussed (A-F: Pre-removal, lowered water surface, degradation, degradation and widening,

aggradation and widening and quasi-equilibrium) and how each of the stages can have different impacts on downstream ecosystems (Doyle et al., 2005). The main point of this discussion was to demonstrate the magnitude of change brought on both upstream and downstream of a dam removal. While the assumption has been made that through the removal of a dam the stream's ecosystem will return to pre-dam conditions, it is important to note that some aspects, such as macroinvertebrates, will return rather quickly to pre-dam conditions but others, like riparian vegetation will likely take decades to realize. This makes it important for decision makers to weigh the impacts of dam removal while maximizing the rate of recovery both upstream and downstream of the all watershed systems (Doyle et al., 2005).

Chang (2008) researched the proposed removal of the Matilija Dam on the Ventura River in Southern California. The project was approved by congress in 2007, but construction costs became an issue and the removal project is still pending. The research on the removal was conducted using a scale model of the impoundment (FLUVIAL-12) to simulate the upstream changes and re-distribution of the sediment trapped in the reservoir (Chang, 2008). Scale models provide an excellent way to examine the upstream changes and sediment distribution properties of a given reach; by recreating the current conditions and running through various dam removal scenarios the researcher can offer solutions to offset environmental concerns and help to control the rate of change in the upstream reach as well as sediment load introduced downstream. When the dam is breached, the first change noted is the creation of a head cutting knickpoint that quickly moves upstream through the sediment impoundment immediately following the breach. The upstream migration of the knickpoint is most pronounced at the delta and rapidly extends upstream

after the initial breach. The upstream migration of the knickpoint slows after the initial breach as the channel starts reaching a point of pseudo equilibrium and continues to gradually migrate upstream as the channel attempts to reestablish baseline flow. The initial channel width is also rather narrow and steep as the channel reestablishes baseline and only starts to widen and traverse its original flood plain once the original pre-dam bed elevations is reached (Chang, 2008). After the initial burst mobilization of trapped sediment post breach, the impoundment delta slowly undergoes changes, and sediment is slowly redistributed downstream with complete removal of the trapped sediment taking many decades to accomplish. The amount of change in the channel morphology, the rate of knickpoint migration, and the rate of sediment redistribution are affected by the stratigraphy of the reach, the high and low flow rates of the stream and the rate of the initial dam removal. Understanding the rates of erosion and deposition after the removal of a dam are essential to quantifying the upstream geomorphic changes a given reach will undergo (Chang, 2008).

Burroughs et al., (2009) researched the effects on fluvial geomorphic conditions after the removal of the Stronach Dam on the Pine River in Michigan. The study was performed over a 10-year period, both during the slow ("staged") removal of the dam from 1996-2003 and for three years after the dam's removal from 2004-2006. To accomplish this, they established 31 permanent transects in the 10-km study area and monitored the areas for changes in geomorphology. The group's goal was to address questions lacking in the effects on geomorphology through the removal of a dam; the focus was on the scope of the changes and in spatial extent and the length of time the changes would take to happen. The actual response varied slightly from the CEM here in that portions of the upper reach of

the study area had increased slope steepening that was suggested in the previous papers here as being associated more with the margins closest to where the dam was prior to removal, this suggest that local geology will adjust the expected CEM results and should be considered in the long-term implications.

The scope of the project focused on numerous aspects of fluvial geomorphology, but for my purpose the effects on river morphology attributes have the most import. Documented changes in the slope aspect, thalweg, depth, discharge and riffle-pool composition ("bedform diversity") due to the degree of change in sediment impoundment (Burroughs et al., 2009). The Stronach impoundment was classified by "bedform units of runs, riffles, pools, rapids, or complexes (a designation where more than one category applied)" (Burroughs et al., 2009, page 98). This gave researchers a classification regime that allowed them to document the geomorphic changes occurring in the reach. The impoundment area was classified as a slow-flowing wide run prior to the removal of the dam, while the reach upstream of the impoundment was marked by higher bedform diversity. The upper reach was narrower as is typified of normal stream geomorphology, with faster flow, coarse substrate and "high bedform heterogeneity" (Burroughs et al., 2009). The hypothesized result was that once the dam was removed and the river's geomorphology reached base equilibrium, it would have a classification like the upstream reach with normal variations in the pool-riffle-run-rapid sequence. Burroughs's team used channel evolution models to predict the results and subsequent rate of change in the stream morphology (Burroughs et al., 2009).

The actual changes that took place over the 10-year period showed a significant adjustment to the sediment profile and lateral shift of the stream channel in the

impoundment while the upstream reach maintained "healthy stream" geomorphology (Burroughs et al., 2009). The highest changes in the impoundment occurred closest to the dam itself with the slope and velocity of the river being faster in the region nearest the dam upstream and downstream and higher velocities recorded in the thalweg, all of which are consistent with normal flow of an unrestricted river with similar bed structure and geology. The methodology created by this research allows estimation of sediment mobilization through dam removal; the outcome of mobilization in this removal was 12% of the total sediment impoundment, which was consistent with other research done on the subject. Thus, actual sediment mobilization could be estimated prior to the removal of a dam using the equations provided in this paper. Also, of note was the formation of pool-riffle complexes in the impoundment region, although they were not as diverse as the upstream reach new pool-riffle bedform were created through the dam removal. Burroughs et al., (2009) noted that the lack of any significant high velocity events during the study factored in to the lack of more pool-riffle structures in the impoundment reach.

Pearson et al., (2011) looked at geomorphic responses to the removal of the Merrick Village Dam in New Hampshire. The dam impoundment consisted of sand-sized sediment; the mobilization of the impoundment following the initial dam breach was consistent with other studies on reaches with similar composition and rapid initial mobilization of the impoundment (Pearson et al., 2011). Merrick Village Dam was a low-head 4-meter high structure; the accumulated impoundment was composed of sand sized sediment and considered to be highly mobile under high flow conditions. Like other studies pre-dam research was done to determine possible sediment redistribution rates and upstream geomorphic conditions related to the removal of the dam. Building on work by Doyle et

al., (2003a), Doyle, et al. (2003b), and Major et al., (2008) a modified regional CEM was used to determine rates of incision, degradation and aggradation for the reach (Pearson et al., 2011). The resulting upstream response correlated to that reported in the previous articles. An initial head-cut knickpoint became evident at the breach point and started immediate upstream migration. After the initial deep narrow incision lateral migration of the channel started as the knickpoint reached the upstream end of the reservoir influence and hit the channel bedform structure and thalweg of the river. The differences in the Pearson study reach versus the Doyle Wisconsin reach and the Major et al., (2008) Sandy River study was in the sediment composition itself. While all the research thus far shows similarities in upstream responses to dam removal, the rates at which these responses occur are different. Once again, the driving factors that contribute to the rate of degradation, aggradation, transport and migration are products of bed and valley form structure, sediment composition and regional hydrology (Pearson et al., 2011). In this case the initial geomorphic change was a process-driven exchange because of the removal of the dam itself. This initial change lasted approximately three months and from there event driven exchanges were responsible for driving subsequent mobilization of the impoundment and further lateral and headward migration of the channel (Pearson et al., 2011).

Cannatelli and Curran, (2012) discussed hydrology as a factor of channel evolution post dam removal. The researchers monitored a slow-drained reservoir and used modified CEMs that incorporated local hydrologic conditions to discern the impact on upstream geomorphic condition post dam removal. A survey of cross sections was done at 10 locations within the study area and data over the course of one year. They divided the study area up into three reaches based on the date of drainage (Cannatelli and Curran, 2012).

Reach 1 is furthest upstream of the dam sitting just outside of the reservoir influence and extending from 0 to 14 m, Reach 2 was the first portion of the creek to drain extending from 14 to 104m and Reach 3 was the last portion to drain extending from 104 to 356m (Figure 15) (Cannatelli and Curran, 2012).

Figure 15. Study area map Cannatelli and Curran, (2012).

As stated by previous researchers there are numerous factors to consider in the removal of a dam. The main factors being the size of the dam, how difficult the removal will be, the effects on downstream reaches through sediment mobilization and downstream impacts through the lack of the dam itself (Cannatelli and Curran, 2012). Building on all the previously discussed articles, the intent of the research was to provide reliable conceptual models that include known regional seasonal variabilities into the upstream geomorphic

response to the removal of a dam and is considered a key variable in the expected morphological change.

This was accomplished using a modified CEM for the region. The importance of using modified CEM's is logical given you are using the region's known climatic, geologic and geomorphic conditions (Cannatelli and Curran, 2012). Due to the slow-draining aspect of the reach the researchers were able to see the channel evolution and effects of seasonal variability in hydrologic and vegetative regimes over the course of a year. This provided them with the data variables necessary in creating a regional CEM; the variables can be changed to reflect the differences in reach dynamics by regions (Cannatelli and Curran, 2012). Channel changes progressed through the stages of equilibrium (Figure 16) with changes in the channel morphology included marked headward erosion of the knickpoint with lateral changes in the channel and incorporation of vegetation models to modify erosion potential (Figure 17).

An important result from this study was that the lateral migration of the channel was more pronounced on the right bank of Reach 1, which was not protected by established vegetation. Reach 3 was in the center of the original reservoir impoundment and showed the most lateral movement with equally variable shifts left and right during the study. The lack of any established vegetation did not inhibit the channel migration within Reach 3 (Cannatelli and Curran, 2012).

Reach 2 developed a split channel due to high winter flows during the study period; both channels showed equal characteristics becoming narrower and deeper as the ratio between width and depth decreased.

Figure 16. Modified channel evolution model. Stages A–E illustrate the progression of the reservoir from pre-removal in Stage A through channel evolution in Stages C–E. (Cannatelli and Curran, 2012).

Cannatelli and Curran, propose the active monitoring of cross sections at intervals of less than one year provide more benefit in understanding changes in the geomorphology of the upstream reaches due to seasonal fluctuations (Figure 18). This becomes more evident temporally in the removal of a dam, the types of changes occurring during seasonal variation occur in a much quicker period over a more localized region (2012).

Figure 17. Modified channel evolution model with addition of vegetation modeling. CEM deviates from previous models to incorporate flow and vegetation data; Stage F shows the channel state corresponding to the seasonal flow regime. (Cannatelli and Curran, 2012).

The review of research into the upstream geomorphic responses to dam removal showed six stages of change that were originally classified by Doyle et. al. (2003b). Upon dam removal there is a progressive upstream migration of the knickpoint and the sediment is left as an eroded wedge, which over time may have more removal depending on periodic episodic events driven by variations in the local conditions. It is important to consider the aspects of the removal prior to initiation of a breach. The local conditions are important factors in the mobilization of the sediment impoundment and factors such as underlying bed-form structure, valley-form stratigraphy, sediment stratigraphy and the hydrology and competency of the stream reach itself will all play key roles in the upstream geomorphic changes.

The initial upstream migration of the knickpoint and subsequent channel incision results in a steep narrow channel until the knickpoint reaches the upstream limit of the reservoir thalweg. At this point the knickpoint starts to resolve itself into a low relief riffle complex and we start getting channel widening and continued degradation of the upstream channel. Depending on the sediment composition, bedrock/bedform structure and existing vegetation the next stage progresses to lateral incision rates and further degradation and aggradation cycles of the reach. From here again we start to reach a quasi-equilibrium state

that will also vary in temporal and spatial scale dependent on the localized regional conditions mentioned before.

While the rates vary the structure formations and upstream geomorphic changes that occur from dam removal remain consistent between the various research articles. The initial sediment push and upstream change will also be affected by the type of dam removal that is implemented. With respect to dam removal technique, a blow and go removal appears to progress through the six stages at a much higher rate than those removed through a slow draw down or even pre-dredging of the impoundment before removal.

Figure 18. Degradation and widening and aggradation and narrowing based on seasonal flow variability. Seasonal flow regime shown as the high-flow season (HFS), low-flow season (LFS), and seasonal transitions: γ or δ correspond to channel degradation and widening in Stage F; α or β correspond to channel aggradation and narrowing in Stage F; the channel is in the quasi-equilibrium state in Stage F; (g) channel proceeds from Stage F to a stable channel at Stage G only after vegetation has established and banks are stabilized. (Cannatelli and Curran, 2012).

Regardless of the dam removal method used, the upstream geomorphic changes that occur from dam removal remain consistent in form while varying temporally. What has been lacking in all these studies is an extensive survey of study reaches affected by dam removal given that each effort relied on an on-the-ground approach, transect style approach.

Knowledge of the different geomorphic features present and the river's lateral movement potential will give us a better understanding of the forces at work and the types of geomorphic features present. My study examines whether lidar can accurately measure geomorphic features by examining water surface pulse returns in comparison to existing digital elevation models, orthographic/aerial photos and surveyed stream reaches using Geographic Information System (GIS) mapping technology. The use of lidar to detect changes in channel morphology, water surface slope, and floodplain changes has recently become a more common tool. Using lidar, the active channel characteristics extracted include bank profiles, longitudinal profiles, transverse profiles of gullies under forest canopies and water surface slope (English, 2008). Features that are inherent in healthy stream complexes, such as pool-riffle-run portions of a reach, and that are important to the health of river biota would be prime examples of features to identify in lidar extraction. Pool-riffle complexes form in meandering streams that have coarse grain composition with pools being recognizable as areas of lower topography and finer sediment deposition while riffles are characterized by coarser bed material and higher topography (Sawyer et al., 2009). Fluvial geomorphic research has a rich history which has largely been done with field work. Lidar gives us the ability to inform an analysis of geomorphic change using high-resolution, remotely sensed data which allows researchers access too hard to reach areas and provides a tool for analyzing geomorphic changes over a time with sequential acquisitions.

4.0 Lidar

By understanding the function of the river system, we gain a deeper understanding of the process at work in a watershed. The tools used by fluvial geomorphologists to gain this understanding have changed over time and new ideas have helped further researchers' ability to better document the changes over time. In addition to classic methods like matching aerial photos to topographic maps, and field surveys of riverine characteristics (Endreny, 2003), new technologies have provided detailed methods for mapping channel morphology. One example of a new technology that shows great promise for fluvial geomorphic inquiry is lidar. Lidar stands for Light Detection and Ranging and is a remote sensing technique that uses laser pulses to measure the surface variability of the Earth.

The Pacific Northwest is relatively data rich with lidar with the Oregon Lidar Consortium (OLC) and Watershed Sciences/Quantum Spatial group acting as a primary supplier of lidar data and other airborne remotely sensed data, such as thermal imagery and water quality modeling. Lidar has proven to be a cost-effective way to collect highly accurate and detailed terrain surface data over extensive areas. The data is acquired using a laser range finder mounted to either small fixed wing aircraft or on helicopters. These aircraft are precisely navigated to provide the most detailed coverage of the earth's surface dependent on the accuracy of the sensor package at the time of the lidar flight. Sensor packages continue to improve and the accuracy of the lidar acquired. The laser range finder fires a pulse at the earth's surface and records the return pulses from the beam. The laser pulses collect very dense clouds (points) of X-Y-Z coordinates with each return of the beam bringing detail of the surfaces it encounters until the pulse reaches the ground surface. Lidar density involves both the Pulse Spacing and the Pulse Density (Faux et al., 2009).

Different agencies have suggested different point density needs for accurate mapping of terrain features. The standard recommended by the Oregon Lidar Consortium (OLC) for the best multi-application use in the Pacific Northwest is 8 pulses per square meter with 0.35-meter post spacing. The return pulses enable the datasets to map the features that are on the Earth's surface itself, providing highly detailed representation of the land surface or of the vegetation and buildings on the land. The differences between the first return of the laser pulse (the highest hit) and the last return of the laser pulse (ground cover, or in the case of urban settings impenetrable surfaces such as buildings and roads) provides detail on the amount of vegetation and groundcover in the flight path. Because of its accuracy and detail lidar is fast becoming an important tool for agencies interested in natural resource management and change detection. This tool has become fundamental in helping to map risk assessment scenarios and flood inundation levels for regions along the Oregon Coast. For fluvial geomorphologists this tool has helped to augment current practices used to study channel morphology (Evans et al., 2009).

Lidar has been used to help detect changes in channel morphology by examining the pulse returns from the water surfaces as described in English, (2008), Faux et al., (2009) and English, (2013). Water has a certain refraction point and the pulses will often refract from the surface at angles of incidence that are greater than 53 degrees (English, 2008). Understanding the characteristics of the pulse return aids in the processing of the Log ASCII Standard (LAS) point returns for classification purposes, comparison of hillshade derived Digital Elevation Model (DEM) and current Orthophotos of stream reaches allow a better understanding channel morphology and pool-riffle characteristics (English, 2008). Smooth water surfaces tend to have lower lidar point densities which are indicated by long

lines of interpolation (lower point density) in the lidar surface while areas of rough water surfaces create more surface variability and higher point return, this difference in water surface returns also correlates closely to pool-riffle sequences on a river (English, 2008).

Beyond what has been done in the Pacific Northwest, lidar is fast becoming a necessary component to fluvial studies and planning efforts. De Rose and Basher, (2011) examined the effectiveness of lidar and aerial orthophotography used in conjunction, for monitoring bank and cliff erosion, and the accuracy of deriving volumetric erosion rates from sequential lidar hillshade DEM's. The discussed the need to be consider resolution differences when using lidar and orthophotography, the resolution differences between sequenced lidar, and the lack of sequential lidar runs in close temporal proximation. The date of acquisition for the orthophotography will play a role in resolution.

The erosion potential measured showed the study reach to be in a state of equilibrium with bank erosion and cliff failure being the contributing factors to sediment fluxes in the system (De Rose and Basher, 2011). Channel migration within the reach drive erosion rates for the reach with 69%-88% of the sediment load being attributed to channel migration induced cliff erosion, but within the study reach itself channel migration potential was low suggesting a fairly stable system and most of the current erosion occurring along the bank margins at the meander bends with minor fluxes in aggradation and degradation noticeable in the sequenced lidar (De Rose and Basher, 2011). With the high positional and vertical accuracies, and the ability to filter out areas of ground clutter, lidar makes it possible to accurately measure the position of the channel and elevation of the banks and water surface to derive volumetric erosion rates on an annual schedule taking into consideration the character of the river and its ability to mobilize sediment (De Rose and Basher, 2011).

Hilldale and Raff, (2008) look at the accuracy of lidar to map river bathymetry in Washington State. Using a combination of lidar and orthophotography the effectiveness of measuring river bathymetry on shallow regions was assessed. The 3-band color of the orthophotos can be used as another proxy for deriving depth, however resolution of the aerial imagery and time of flight have direct impacts on the accuracy. Specifically, the red band is more sensitive to depth, however, it does not penetrate as deeply into the channel, and differences in substrate, vegetation overhang, and shadows at bank margins introduce error (Hilldale and Raff, 2008). Airborne bathymetry lidar has been developing an improved addition to bathymetric modeling using orthophotos, its ability to penetrate deeper into the water column and account for vegetation reduces and eliminates many of the errors associated with using orthophotography by itself. Another benefit of bathymetric or “Green” lidar is that it is not affected by sun glint off the water surface which can be an issue with orthophotos (Hilldale and Raff, 2008).

Traditionally river bathymetry surveys have been conducted using single beam sonar or acoustic Doppler surveys in conjunction with RTK GPS. This method produces both horizontal position and water surface elevations while depth is derived from the acoustic equipment. This method is both time consuming and costly, in terms of data collection and post processing; accuracy is also an issue in this process and interpolation of surfaces over long distance occurs when GPS coverage is poor. Terrain features and riparian vegetation can also interfere with the reception of the GPS equipment causing poor vertical correlation in the survey method (Hilldale and Raff, 2008).

The results of the research showed that currently (2008) the ability of bathymetric lidar to map riverine environments at the microscale is not possible for either geomorphological

or numerical modeling analysis due to poor horizontal resolution. Some mesoscale features such as the pool-riffle-glide sequence were well defined from their outputs, but other mesoscale features considered to be integral parts of the overall hydraulic modelling and responsible for critical flow study of the reach, such as large boulders, and other features normally associated with natural obstructions to flow, were not sufficiently rendered (Hilldale and Raff, 2008).

The availability of sequential lidar for the Marmot Dam gave me an opportunity to look at the effectiveness of the lidar to monitor morphological conditions both temporally and spatially. The capabilities of lidar to map channel morphology and changes over an entire reach versus the traditional method using CEM's to predict changes from a small sample size. In addition, the cost effectiveness of lidar allows researchers to get creative in finding new and efficient solutions to managing the riverine environment.

5.0 Methodology

5.1 Statement

My research focus involves detecting the changes in geomorphic features and channel morphology of a study reach that has an unusually high number of lidar return flights over a relatively short period of time both before and after dam removal. I show how lidar data can be used to accurately map changes in channel morphology characteristics thus contributing to established field research of stream reaches. The high level of detail allows the detection of water surface characteristics and can extract slope and features such as pool-riffle complexes, which are valuable for mapping and understanding changes in channel morphology. The removal of Marmot Dam has provided researchers the opportunity to examine channel morphology changes that normally occur over longer time periods. The rapid changes in channel morphology that occur as the river re-establishes its base level add to the understanding of river dynamics and the features that are indicators of channel change.

Measurements of the height of water surface with lidar can give researchers a safer, expansive, more cost-effective approach to mapping channel morphology characteristics than field surveys. This is especially important in areas that are inaccessible due to terrain constraints and river reaches that would not be safe to survey using traditional field methods. Oregon Lidar Consortium (OLC) requires that the vertical accuracy of all the data collected be less than or equal to 9.25cm accuracy, the vertical accuracy is 3.88cm in Oregon, averaged over 72 lidar collections (https://www.oregongeology.org/lidar/DAS-Quantum_7525Amendment7.pdf). The research will help augment existing techniques for understanding channel morphology and mapping flood plain profiles for use in planning

and resource management. Lidar accuracy continues to improve, and studies continue to push the limits of what can be derived from the data. The uses already implemented at many levels of natural resource research and management has proven its validity as an augmentation to traditional field methods CITE (Faux et al., 2009).

5.2 Research

Using field surveys, known literature of the same region, orthophotos and sequential lidar, I examine channel evolution characteristics on the former Marmot Dam impoundment area. Traditionally, studies of geomorphic features are done at low-flow conditions on small, wadeable streams, which can hinder the examination of channel morphology dynamics during higher flows and on larger stream systems.

Lidar allows for characterizing of different geomorphic changes on larger, faster streams that would preclude traditional stream survey due to the unsafe conditions (Faux et al., 2009). The research is intended to provide evidence supporting the use of lidar to detect geomorphic changes from water surfaces and show the accuracy of lidar as a detection tool comparable to field based approaches and to augment studies for conditions that preclude normal survey techniques and to effectively examine stream reaches over larger scales. Lidar has been used to illustrate the geometry and slope of mountain channels in the Pacific Northwest giving researchers the capability to have a reliable and repeatable approach for quickly and effectively sampling and analyzing the physical characteristics within the watershed. New studies using green wavelength lidar allows for high-resolution bathymetric studies of channel depth and bed profiles (Faux et al., 2009). My own research is a continuation/addition to the growing use of lidar for resource management and channel

morphology studies and allows me to build off previous research methods while still providing a valuable contribution to the field.

Sequential lidar was used for the study area with the initial pre-dam removal flight used at baseline for the study. Comparison of the subsequent year's lidar flights was used to show changes in channel structure and geomorphic features over time. Using sequenced lidar I examined the reach before dam removal, immediately after dam removal and the current conditions. Lidar acquisition from 2008, year 1 after removal, 2011 year 4 after removal and 2012 year 5 after removal were compared to show the changes in the reach over time based on the degradation and aggradation of bars in the reach.

The 2012 lidar acquisition was done using the newer green lidar and has a bathymetric component to the flight that I used to better visualize the current channel dynamics but was not used to compare differences between flight years for feature extraction given that the other flights did not have the bathymetric component. All flights contained elevation values in meters (NAVD88), values in the report have been left in meters but have their feet equivalents shown with them. Lidar accuracy is different between acquisition years as technology improved Table 2 compares pulse density resolution and vertical accuracy with mean daily cfs provided for the time of flight.

Table 2. Lidar accuracy and mean flow for date of acquisition.

Date	Pulse Density Resolution	Vertical Accuracy	Mean Flow (CFS) USGS Marmot Gage
October 22, 2006	≥ 4 points/m ²	5.9 cm	311
October 1, 2008	8.04 points/ m ²	5.1 cm	424
September 3, 2011	8.80 points/ m ²	3.6 cm	418
September 22, 2012	9.57 points/m ²	3.7 cm	360

Using sequenced lidar studies I compared features between acquisitions to show how valuable lidar is for identifying geomorphic features that are key indicators of a dynamic river system. Changes in pool-riffle placement in the reach, channel migration, and changes in channel morphology attributed to the geomorphic structure of the reach can all be identified using lidar and monitored for change over time with sequential runs. This is especially useful for highly competent and mobile river systems such as the Sandy River, which is known for its high flows and potential for avulsions and channel migration in certain portions of the rivers floodplain.

Further examination of the region's orthophotos were used to support the data interpretation of existing conditions in the lidar to ascertain if the channel morphology changes detected in the reach were visible. Orthophotos have not always been flown with lidar; more recent flights have co-acquired orthophotos which allow for better visualization of the features in the lidar, none of the flights for this study had co-acquired orthophotography. I used the best available imagery from the National Agriculture Imagery Program (NAIP) acquired in 2005, 2009, 2011, and 2014. While they do not all match the acquisition years of the lidar, they are still useful for visualizing the current conditions and those prior to the removal of the dam and can be used to look at channel morphology above and below the impoundment. Also, the coarse level of detail in older orthophotos does not allow for clear feature extraction. The 2014 NAIP imagery was also compared to the 2012 lidar flight and found that conditions in the reach are relatively stable given minimal changes in the channel features shown. Based on the photos taken in the field myself in 2014 and 2018 the data shown in the 2012 lidar flight shows that the river reach is in equilibrium.

Examination of sequential years of lidar acquisitions shows changes in the geomorphic features within the study reach allowing for characterization of channel morphology changes as they pertain to the features such as active channel margins, floodplain margins and abandoned terraces. Lidar derived stream centerlines were created for each year of delivery, placing the centerline in the perceived channel using a combination of lidar derived bare earth hillshade and orthophotos. Some limitations are inherent in this process as lidar does not capture the water surface elevation unless the returns strike the water surface at a specific angle of nadir or in rapid complexes where the turbulence of the water allows for more refraction of the lidar returns (English, 2008). Also, given that bare earth digital elevation models (DEMs) must extrapolate for the removal of vegetation and other feature where lidar returns are sparsely recorded; stream channels and areas of large bodies of water result in less pulse returns because they are not refracted by water. This decreased point spacing results in a tinning pattern inherent in the extrapolation between points in a triangulated irregular network (TIN) (English, 2008).

Older versions of lidar did not have the resolution capabilities of today, and the newest lidar has 6-inch orthophotos co-acquired at the time of acquisition which provides a reliable secondary source to verify stream position. Lidar derived stream features are used to show channel adjustments over time; these include lateral migration of the channels, channel patterns, gradient changes over time, and terrace/bar realignment within the active river margin. The 2006 lidar acquisition is used as the baseline for the study. This flight was done prior to the removal of the dam and thus, we can compare the changes to the active channel margins for this reach since that removal date. As this data was acquired before

the removal of the dam, the initial comparison between the remaining year's runs produced a negative elevation change due to the level of the reservoir prior to removal.

This was compared against each successive year to show the overall change in active channel size and shape as well as the geomorphic change that has occurred in the reach during this timeframe. A volumetric comparison was made between the baseline elevation of the reservoir and that of each year's stream profile to compare differences in the lateral and downstream profile of the reach. A second comparison was made between each of the three lidar flights run on the reach since the removal of the dam; and used to compare active changes in the lateral and downstream profiles as well as approximate accumulation and degradation of the deposition regime for the reach.

Further comparisons of the lidar was used to document changes in the geomorphic regime that predate the dam structure itself, looking at the surficial geology and bedrock for the reach to show areas of potential migration, and those that are more resistant material overall. Ground truth field work of the reach was conducted to ascertain current conditions. Current lidar data was compared to the features found from aerial photos, field work photos and GPS points. GPS points were successfully collected on October 13, 2014 using a Trimble GeoXT with sub meter vertical accuracy (Appendix A: Appendix A: Differential Correction File). The GPS point locations are shown in Table 3, each point was selected for ease of access and features that I knew would show up in the lidar.

Point A was collected at the approximate location of the monitoring camera placed above the southern edge of the reservoir. This was accessed by using the trail on the southern side of the foot bridge located on site. Point B was collected at the northwestern corner of the eastern bank gravel bar accessed by a small trail leading from the parking lot

to the southwest. Point C was located on the foreset bed of the gravel bar approximately 90 meters southwest of Point B. Points D – G are all located on the margins of the wooden crib structure (Figure 19) that emerged from the sediment between 2009 and 2011. Point F was collected near the center of the gravel bar on the western bank opposite the channel from the wooden structure and in the approximate location between the existing channel and the abandoned channel from approximately 2008 (this channel sees activity in winter flows). Points G – I are located across the lip of the gravel bar, directly south from the large lahar dike shown in Figure 20.

Table 3. GPS point locations.

GPS Point	ID	GPS Time	Height (meters)	Vertical Precision	Horizontal Precision	Standard Deviation
Camera Spot	A	11:42:39pm	227.414	0.7	0.4	0.725875
Gravel Bar	B	12:15:14pm	217.146	0.9	0.4	0.512149
Foreset Bed	C	12:28:24pm	217.984	0.8	0.5	0.263750
CS – Front South Corner	D	02:11:34pm	221.888	0.7	0.5	0.331413
CS – Rear South Corner	E	02:18:09pm	224.666	0.9	0.6	1.322486
CS – Rear North Corner	F	02:20:29pm	222.772	0.5	0.4	0.442280
CS – Front North Corner	G	02:22:42pm	222.019	0.5	0.4	0.457460
Stump	H	02:38:39pm	222.963	0.7	0.4	0.268551
Left Pool Bank	I	02:44:29pm	226.295	1.0	0.5	0.853633
Mid Pool Bank	J	02:46:19pm	222.166	0.8	0.5	0.153974
Right Pool Bank	K	02:48:24pm	220.560	0.8	0.5	0.237230

A comparison was made against the 2006 base flight to determine rates of morphologic change in the reach. Oregon Department of Geology and Mineral Industries (DOGAMI) and the Oregon Lidar Consortium (OLC) made additional lidar flights of the Sandy in 2008, 2011, and 2012, to track changes in the reach and sediment distribution regimes after dam removal.

The method of change detection shown in Oregon Department of Geology Open File Report O-13-01 (English, 2013) was used to compare the rates of aggradation and

degradation in the stream reach. To look at overall channel morphologic changes the runs of the reach done after the removal of the Marmot Dam were compared against each other. This was accomplished using raster math, subtracting the bare earth DEM return of one year's run from that of a prior year and comparing the overall change difference between them. Due to noise in the lidar which can come from low vertical accuracy relative to horizontal sample distance and various atmospheric and biotic variables, values between -2.5 feet and 2.5 feet are considered unreliable and so a threshold of values greater than ± 2.5 feet were used for comparison (English, 2013).

Figure 19. Crib structure used in GPS survey. Photo by Lowell Anthony, Oregon Department of Geology, October 13th, 2014 (left) at 294 cfs and July 15th, 2018 at 410 cfs (right).

I created polygons for the impoundment based on the 2006 lidar and active channel polygons for each of the four lidar flights. I used the same ± 2.5 feet threshold to account for noise in the lidar. Polygons were digitized at a 1:1000 scale to obtain the most accurate bankfull margins for the reach relative to the resolution of the original data. Elevation values were queried from the DEM and the mean change in elevation for each polygon was calculated. Total impoundment differences were calculated between years and active channel change between years, with attention paid to areas of aggradation and degradation.

Figure 20. Head of gravel bar location of GPS points G, H, and I. Photo on the left is looking upstream photo on the right is also upstream but from the north flank of the gravel bar just past the end of the long run. Photo by Lowell Anthony, Oregon Department of Geology, October 13th, 2014 (left) at 294 cfs and July 15th, 2018 at 410 cfs (right).

Using the polygons for each return year I clipped out the difference between active channels to show areas of change in the reach discarding polygons with an area $\leq 20 \text{ m}^2$. Using the polygons clipped DEM was created for each lidar flight. Using raster math, a depth variation was created by subtracting the area of each return from that of the subsequent year to show areas of change across the reach. Channel migration pattern within the reach was compared using bankfull polygons of each lidar year. Polygons were digitized to represent the approximate bankfull extent of the reach for a given lidar acquisition. Features were interpreted by colorizing a stack of DEM raster. A colorized DEM was used as the base layer using a terrain shade color ramp and setting the output to generate based on the current elevation extent. A slope shade with a 60% transparency was stacked on top of the colorized terrain DEM with a hillshade derived DEM as the final layer using a 70% transparency. Inferences were made in areas of thinning to maintain cohesive bank margins based on knowledge of the ground conditions and familiarity with extrapolating stream features using lidar. Rates of change were compared by measuring the difference between each polygon. Each year's polygon is overlaid on another, the newer lidar acquisition was subtracted from the old acquisition and the remaining areas of the

polygon were calculated for area. This allows a quick visualization of channel morphology change over time by showing areas of aggradation and degradation within the reach.

Comparison of channel profile gradient for each lidar year was also quantified. A digitized centerline was used for each lidar acquisition; using the *Stack Profile* tool in ArcMap each of the centerlines were given elevation attributes spaced every meter for their given DEM's providing me with a gradient profile for the stream in each year. In addition to the stream centerline, cross-sectional profiles were taken along the reach at specific areas in the study area to compare rates of change laterally along the reach. Also using a one-meter interval all transects were given elevation attributes. Using the *Stack Profile* tool on each transect, comparison of all years' lidar runs were made to show overall change in channel morphology at each cross section.

The combination of change detection, longitudinal profile, and latitudinal profile methods allows us to get a more detailed look at the morphological adjustments taking place in the reach and inferences can be made from the data involving changes to bedform based on changes in water surface elevations. Understanding the rates of change in correlation to the geology and discharge of the river, can allow inferences to be made along the river and be a welcome addition to planning development along a given reach giving credence to geotechnical realities within a given run; this process emulates the traditional field survey techniques done in previous studies.

Observing changes in downstream gradient and comparing that to the geology of the region allows the inference of rates of change in bedform and sediment changes in the reach, showing areas of both aggradation and degradation across subsequent years of lidar to monitor stream health and morphology over time. Cross section comparison allows us

to look at the migratory progress within a reach, again showing areas of aggradation and degradation in the floodplain and allows for monitoring of areas prone to avulsion. This also shows areas within the reach of resistant geology that would provide a natural barrier to channel migration.

This process can also elucidate areas of reverse migration from one year to the next. Once full channel migration equilibrium is reached in either lateral direction, more force will be exerted in down cutting within the gradient, given local geologic constraints. Understanding of the active channel properties within a given area allows for proper planning and active mitigation within a watershed environment.

6.0 Results

6.1 Lidar Comparison

All data were created and compared using ESRI® ArcMap 10 with the 3D-Analyst Extension. Active channel polygons were compared against each year of lidar acquisition for overall change in the channel features, lateral migration, and channel incision over time. The active channel was clipped from the previous year's active channel to get total areas of change along and area was calculated; areas less than or equal to 20 m² were excluded from the output polygons. Each polygon was given a unique identifier using a letter of the alphabet; note that if all the letters were used the identifier would start over putting a Z before the letters and cycling back through from the beginning of the alphabet.

To get the difference in change for each polygon it was necessary to extract values from the rasters being compared to each other. The polygons were then used to extract elevation values just within the areas of change for each year's lidar. Each year's subsequent change raster was then subtracted from the previous year's change raster and a difference raster was created. I compared the total amount of positive change and negative change in the reach to come up with the total difference in active channel margin change over the five-year period. Table 4 shows the outputs of this process with a total aggradation amounts for each acquisition year. Overall change in active channel margins from Transect A through Transect H, from 2006 to 2012 showed a net change of -139,417 m³. The majority of channel change happens over year one, with approximately half that same rate of change occurring over the next four years; the final year of the study shows the first net gain.

Table 4. Total lidar derived active channel margin change from 2006 - 2012. Note: Areas of degradation and aggradation are only for changes in the active channel margins. Note that in the 2011 to 2012 returns the data shows the reach to be in quasi-equilibrium.

Lidar Year	Area of (+) Change (m ²)	Area of (-) Change (m ²)	Surface Change (m) (+)	Surface Change (m) (-)	Sum Degradation (m ³)	Sum Aggradation (m ³)	Net Change (m ³)
06 to 08	4,070	33,301	9.7	-21.9	-89,338	11,433	-77,905
08 to 11	8,135	28,820	2.2	-33.6	-34,546	767	-33,779
11 to 12	2,538	3,907	7.2	-2.0	-874	939	65
06 to 12	3,106	36,895	2.5	-46.1	-145,649	6,232	-139,417

To look at the overall change in net area and morphology for the reservoir impoundment I created a series of polygons based on the elevation at the dam head shown in the 2006 lidar. This polygon encompassed the entirety of the canyon for the study reach using the margins of channel transects created for the lateral profile comparisons. The bare earth DEM for each lidar year was clipped by that shape and the rasters were subtracted from each other to show overall change in the reach between 2006 and 2012. The same process was used to extract the values of change for each year and a comparison of the total change across all returns.

To find the average change over the reach, the mean was extracted for each lidar acquisition year change raster and the area of difference was found by taking the area of the change raster and subtracting that from the area of the polygon demarcating the floodplain/impoundment extent. This area of difference was then multiplied by the mean of the depth change giving the average net change of the study reach over the five-year period. Again, the most significant year of net change occurs in year one; Table 5 shows the details for each year's comparison. Of note again is the overall adjustment shown between 2006 and 2012. The difference in channel depth and changes in the terraces and

gravel bars from the initial reservoir level to the 2012 lidar flight shows how quickly the reach was able to establish quasi-equilibrium.

To further show how effective lidar is for examining channel evolution morphology a longitudinal profile was created to examine the effects from the knickpoint of the impoundment to just downstream of the spillway location. To accomplish this a stream centerline was digitized for each year of lidar at a 1:1,000 scale to ensure the best accuracy of the reach conditions. Each centerline then had the values extracted from their corresponding lidar acquisition DEM resulting in a channel water surface elevation longitudinal profile line.

Table 5. Total impoundment area change 2006-2012. Note: Average overall net change of the study area over the course of six years.

Lidar Year	Area of Change (m ²)	Area of Reservoir (m ²)	Area Difference (m ²)	Surface Change (m)	Net Change (m ³)
06 to 08	3,720,115	3,729,626	9,511	-1.1	-10,462
08 to 11	3,719,308	3,729,626	10,318	-0.8	-8,254
11 to 12	3,713,011	3,729,626	16,615	-0.1	-997
06 to 12	3,714,625	3,729,626	15,001	-1.9	-28,502

Transect points were marked on the profile to correlate what was being seen longitudinally with the areas that were chosen for the lateral profile examination of the lidar acquisitions. Comparison of the longitudinal profiles correlates to the findings shown in the earlier discussion on extracting the difference between rasters. The gradient profile graph shown in Figure 21 shows the feature changes in bedform and areas of aggradation and degradation that are consistent with the data discussed from previous studies on dam removal.

Rates of change along the stream profile are variable. Transects A-H, are used to highlight changes from below the dam site (A) to the upstream extent of the former

reservoir influence and knickpoint migration (H). All transects are drawn from the leftward bank to the rightward bank downstream. Flux between 2006 and 2008; 2011 and 2012 being minimal and would suggest equilibrium at the knickpoint. Point F and G mark the margins of the wooden crib structure to the north and the south; almost five meters of change can be seen between 2006 and 2008 at this point.

Figure 21. Water surface elevation longitudinal profile gradient. While bedform is not something that can be mapped at this point using lidar, inferences in bedform activity can be made by comparing the downstream difference between profile years. The highpoint shown in the 2006 line just downstream from Transect B is the Marmot Dam prior to removal.

Note that the channels are not running in the same course through the part of the reach and thus the lateral position of each channel is not identical and will be explored further in the lateral profile discussion. Change between 2008 and 2011 at this point is approximately one meter, and the change between 2011 and 2012 show the bed aggrading slightly and advancing the head of the rapid downstream close to 50 meters.

Transect D marks the end of the rapid at the gravel bar and Transect E cross cuts the lahar dike that impedes the progress of the Sandy River and creates the pool conditions found at the end of the lahar dike before the second rapid/riffle. Figure 8 and Figure 20 show photos of the current conditions compared with the field collection photos from 2014; while the changes are not large there have been continued adjustments to the channel profile and depositional features on the reach.

Transect C bisects the gravel bar between GPS Point B and GPS Point C. At this cross section there is close to an 8-meter difference between the 2006 lidar acquisition and the 2008 flight. Close to 1 meter of continued degradation occurred between 2008 and 2011 with nearly no change noted between 2011 and 2012 at this point on the reach. Transect B marks the approximate location of the dam head and has 10 meters of change between the 2006 flight reservoir height and the first year of channel incision with some minor degradation occurring between 2008 and 2011, and again between 2011 and 2012.

There is a steady stair step down the profile gradient suggesting the aggradation adjustments moving downstream as discussed in the earlier portions of this paper. Transect A marks the approximate location of the spillway for the original dam, the area is well scoured and armored, so the channel continues to stay connected to this portion of the reach, there is noticeable aggradation between 2006 and 2008 of approximately three meters, with continued degradation occurring between 2008 and 2011, and slowing between 2011 and 2012. Appendix C: Appendix C: Stream Gradient Profiles shows the elevation point tables used from each year's lidar flight to create the stream gradient profile. Appendix B: Appendix B: Transect Tables shows the detailed elevation points applied to each profile using the *Stack Profile* tool. Each of these transect profiles is discussed in

detail in the following section. I will begin at the upstream point which correlates to the visible knickpoint in all four lidar returns. Figure 22 shows the changes over the course of five years to the reservoirs knickpoint. This point is visible in the lidar and corresponds to the calculations given by Major and others, 2012 for the knickpoint retreat.

Figure 22. Transect H is located at the uppermost limit of the reservoirs influence.

Transect H trends south to north in the downstream direction. Terraces are visible in the profile, one to the south with approximately a 1-meter offset between 2006 and 2012, and a lesser terrace to the north that has some channel characteristics and would most likely be engaged in peak winter flow conditions. The overall change to the channel has approximately 1 meter of degradation and close to one meter of channel migration to the south by the 2012 lidar acquisition; note, this could be attributed to the increased accuracy between the original flight and the 2012 flight. The profile again shows that at this location on the river the channel has reached equilibrium and continues to adjust the margins of the

channel laterally and the downstream gradient consistent with what was shown by Doyle et al., (2003b).

Transect G bisects the floodplain at the southernmost margin of the wooden crib structure (Figure 23) and trends northwest to southeast. Channel characteristics and the overall change are noticeable in this profile. Transect G is located 40-meters downstream of the riffle/rapid head.

Figure 23. Transect G follows the southern edge of the crib structure. 2011 is the first indication of it on the lidar profile.

The 2006 water surface elevation and channel position show an ~40-meter channel to the west and an ~12-meter wide relict channel on the east bank separated by a ~30-meter wide by ~1-meter high terrace. 2008 shows a decrease of ~5-meters in water surface elevation there is a ~12-meter wide by ~1-meter high terrace to the west. The channel is still migrating east and a thick sediment wedge ~35-meters wide by ~5-meters high is still being mobilized by the river in 2008. The relict channel on the east side of the sediment

wedge is just beginning the downward cutting of the sediment wedge. The river continues to change significantly between 2008 and 2011; the 30,000 cfs flood event in 2009 would have had an impact on the mobilization between year 1 and year 4 after the dam removal. The 2011 channel is ~30-meters wide and has engaged the western edge of the wooden crib structure.

The boulder/cobble terrace to the west has aggraded eastward from 2008 and is ~30-meters wide from the western bank to the streambank. In 2012 the profile of the gravel bar is dipping east, and the active channel has narrowed significantly between 2011 and 2012. The streambank on the eastern slope is well established between the two years; again the 39,000 cfs 2011 flood event is evident in the 2012 profile in the realignment of the cobble bar and channel position, with aggradation and degradation occurring in the channel and on the bar.

Transect F is similar to Transect G, as it bisects the floodplain at the northernmost margin of the wooden crib structure (Figure 24) and trends northwest to southeast. We see almost identical channel characteristics in this profile to those of Transect G. Transect F is located 47-meters downstream of the riffle/rapid head, the 2006 water surface elevation and channel position show an ~40-meter channel to the west and an ~15-meter wide relict channel on the east bank separated by a ~30-meter wide by ~1-meter high terrace. 2008 shows a decrease of ~5-meters in water surface elevation, and there is a ~12-meter wide by ~1-meter high terrace to the west that then slopes up at ~45° angle. Again, we see the channel is still migrating east and a thick sediment wedge is still being mobilized by the river in 2008. The relict channel on the east side of the sediment wedge is a bit more

pronounced in the downward cutting of the sediment wedge, and we see a slight dip to the west towards the active channel.

Figure 24. Transect F follows the northern edge of the crib structure. 2011 is the first indication of it on the lidar profile.

The 2009 flood event continues to change the profile significantly between 2008 and 2011 and would have had an impact on the mobilization between year 1 and year 4 after the dam removal. The 2011 channel is ~30-meters wide and has engaged the western edge of the wooden crib structure. The boulder/cobble terrace to the west has aggraded eastward from 2008 and is ~30-meters wide from the western bank to the streambank. We see the same eastward dip to the bar and narrowing of the active channel between 2011 and 2012. The streambank on the eastern slope is well established between the two years, and we see here again the 2011 flood event evidence in the 2012 profile in the realignment of the cobble bar and channel position with aggradation and degradation occurring in the channel and on the bar.

Transect E trends west to east and was drawn to cover the end of the gravel bar to the west of the active channel in 2014. Figure 25 compares the lidar returns and allows us to see the overall change in the channel at this prominent point. The gravel bar is to the west of the wooden crib structure and marks the southern edge of the pool and riffle that have formed as of 2018. The bar extends ~170-meters from the head of the rapids to the north-westerly bend the river takes when it reaches the lahar dike at the end of the run. The 2006 profile line shows a prominent terrace on the west bank ~30-meters wide which slopes down to the east ~1.5-meters before entering the main channel.

Figure 25. Transect E crosses the end of the active channel in 2011/2012 and traverses the northern portion of the gravel terrace head.

We can see the channel is ~45-meters wide at this point and slopes up to the east ~2.5-meters to another prominent terrace ~20-meters wide, this dips sharply eastward into the ~15-meter wide side channel before hitting the near shear bank on the eastern side of the

bar. The immediate difference in this portion of the reach from 2006 to 2008 is striking and further shows the amount of sediment that was removed from the former impoundment.

We notice the terrace has retreated to the west ~5-meters and dropped ~5-meters to create another terrace ~20-meters wide. The bank dips again towards the east two more times forming smaller terraces that indicate the current floodplain margins at the time of acquisition. The active channel at this point of the river is ~15-meters wide and slopes up to the east to form another ~15-meter wide terrace on the eastern bank of the channel. We can still see a portion of the side channel and part of the sediment wedge that is a continuation from the previous two transects immediately upstream from this point.

The 2011 and 2012 lidar profiles are nearly identical at this point of the river and correspond to what was shown in the photos from 2014 and 2018. We see that the terrace created in 2008 is a remnant of itself and the bank dips to the east ~80° before entering the new overflow channel that dips east ~45° before rising to the east ~2.5-meters to the head of the gravel bar. This well armored boulder/cobble terrace is ~30-meters wide and dips slightly towards the active channel. The terrace then dips down ~2-meters to the active channel which is ~30-meters wide at the end of the run before entering the pool/riffle portion of the reach.

Transect D is a west to east trending line that marks the end of the rapid/run and creates conditions that lead to the ~60-meter pool/riffle complex in the northwest bend of the river. An interesting feature in this profile is how it shows the exposure of the resistant lahar dike and the change in channel morphology that came from that exposure. Figure 26 compares the lidar returns and shows the geologic feature emerging from the reservoir sediment. As we can see in the image, the 2006 profile shows a broad pool with a couple of small terraces

flanking east and west. The channel width is ~45-meters at this point with a sand and gravel terrace to the west and a portion of the lahar head at the edge of the channel to the east. The eastern bank is shear and well-formed based on the lidar returns.

Figure 26. Transect D traverses the exposed lahar dike that influences the current stream pattern in the reach.

The most immediate effect we see in the 2008 profile is the ~8-meter drop in water surface for the channel creating ~20-meter wide terrace on the western bank with ~45-meter wide channel that abuts the lahar dike, which rises sharply out of the channel to the east. Some scour can be seen atop the lahar dike in 2008 and would correspond to the end of the sediment wedge that was most likely the effect of presence of the lahar dike under the reservoir surface, acting as a dam. This sediment wedge appears as a beach in the 2005 NAIP imagery and has since been washed downstream.

The only real change we see from 2008 to 2012 is the further erosion and downcutting of the western terrace by another ~4-meters. Also, note the angled gradient of the channel

that is running north at this point of the river as it rounds the lahar dike and heads into another short rapid set before hitting the smaller lahar dike ~225-meters downstream. Between that point there are two more pool/riffle complexes that are well established. Further erosion can be seen on top of the lahar dike exposing a knickpoint in the top of the structure that currently accumulates significant amounts of LWD.

Transect C is a southwest to northeast trending line that bisects the center of the gravel bar between GPS Point B and GPS Point C (Table 3). The western bank is a shear slope that is well constrained given that the lidar profile return shows insignificant change (within noise tolerances discussed in Faux et al., 2009). The main channel is shown as a broad gently sloping pool that then rises at a gentle angle when reaching the eastern bank in the 2006 profile (Figure 27).

The main channel is ~55-meters wide at this point and ~10-meters deep based on the lidar profile. Again, 2008 shows immediate change to the channel profile with ~8-meter drop in the water surface elevation and shifting to a ~20-meter wide channel with increase velocity based on the constraining ~25-meter wide terrace to the west and the steep slope of the bank to the east. The change between 2011 and 2012 is relatively minor, some aggradation of the gravel bar on the eastern bank with some slope degradation on the eastern bank forming what appears to be a low-relief slump. The main channel has migrated laterally west ~15-meters incising ~1.5-meters into the 2008 terrace and forming the ~20-meter wide channel shown in the profile.

Figure 27. Transect C traverses the gravel bar and sandy beach terrace that has formed downstream of one of the lahar dikes.

From 2012 to 2018 this section has continued to aggrade with the gravel bar showing ~1-meter offset from the current bank full conditions in the October 2014 photos to a well aggraded sandy beach in the July 2018 photos. This suggests that the river continues to redistribute sediment from the Upper Sandy River and given the quasi-equilibrium state of the river currently, the gravel bars will continue to aggrade and form stable beach fronts. This spot will continue to see aggradation of the beach until the lahar dikes erode enough for the rivers energy to adjust the channel features; the current meandering course the river takes in the ~300-meters from the end of the first rapid run to this bar is an ideal setting for the continued aggradation of this bar.

Transect B is a south to north trending line that bisects the approximate location of the Marmot Dam spillway head. Figure 28 shows the profile comparison with the most notable feature being the initial drop in the water surface elevation. Between the 2006 and 2008 lidar flights there is ~10-meter drop in the water surface elevation of the main channel

which is ~75-meters wide pool at point of the river. In 2008 we see the channel is ~25-meters wide and slopes sharply up on the north bank; given the lidar profile for the 2008 to 2012 shows a sharp angle of repose but since this is the old outer wall of the dam the slope is stable.

Figure 28. Transect B is located just above the location for the head of the Marmot Dam.

In both the 2011 and 2012 profile lines we see that the main channel is now ~30-meters wide and slopes gently to the south forming ~25-meter bar gently dipping to the north ~10°. The channel profile for this point of the study area shows a stable river system in equilibrium for the reach characteristics. The channel is highly constrained at this point, which is why there is little lateral movement. This is also why it made for an effective dam location.

The approximate foot of the spillway was chosen for the location of Transect A (Figure 29). The transect is a south to north trending line bisecting the width of the spillway chute and the portion of the diversion channel that was used to divert water to Roslyn Lake ~5-

meters west of the footbridge at the site location. When the dam was decommissioned there was no longer a need for the diversion channel, so it was closed, and Roslyn Lake ceased to exist. Return profiles show what has been consistent in the literature reviewed for this report.

Figure 29. Transect A is just downstream of the location of the Marmot Dam spillway.

Removal of the dam saw an immediate downstream aggradation followed by continued degradation until the channel reached quasi-equilibrium. The 2006 profile line shows ~25-meter wide channel and ~12-meter wide side channel ~1-meter higher than the main channel to the north. The old diversion canal channel is shown and is ~7-meters wide.

The first thing to note is the initial aggradation from the removal of the Marmot Dam in 2006 to the profile line in 2008. As noted earlier in this paper, immediately following the removal of a dam the downstream region from the dam shows immediate aggradation, which based on the 2008 profile is ~2.5-meters in both the channel area and the gravel bar terrace that aggraded on the north bank of the river at this transect. Given that there were

two significant flood events that occurred between the 2008 and 2012 lidar flights, we can infer what those events did to this portion of the reach.

The spillway was devoid of any significant sediment for the life of the Marmot Dam and was thus a well armored chute traveling west downstream of the dam before trending to the southwest ~730-meters downstream of Transect A. The aggradation accumulation from the 2008 profile was dispersed across the width of the transect canyon with less than a meter of degradation in the channel and ~1-meter of degradation to the gravel bar from 2008, creating ~55-meter wide channel with a slight dip up to the north. The 2012 profile line comes in the immediate aftermath of the 2011 flood event that devastated parts of the Upper Sandy River in the Village at Mt. Hood segment of the river. We can see some continued degradation of the channel of ~1-meter but no real change to the profile of the gravel bar to the north; hence, we can assume by this profile line that the remaining sediment that had aggraded in the channel from the 2009 flood event was further pulsed out of the channel giving us the 2012 channel profile shown.

The cross-section profiles are another valuable tool for showing the usefulness of lidar for monitoring and identifying geomorphic features. With this study I have compared three different aspect of mapping with lidar that allows for the identification of in stream features and correlation to existing literature on the expectations involved in the removal of a dam and the amount of time needed for the system to reach stability.

6.2 Discussion

My continued research into channel morphology characteristics with lidar to supplement existing field techniques will add to the list of available resource management tools at our

disposal. This study does have its limits given the accuracy of detecting the different geomorphic changes. Lidar accuracy itself will vary depending on the stream reach profile, angle of incidence and overall ground cover for the reach as well as the time of year the study was flown will also affect the data (English, 2008). Being able to use and test methods from other researchers will help me further refine my own methods. Evaluating the overall geomorphic change will provide a potential understanding of the reach dynamics. It is important to factor in flow, channel morphology and ground clutter when using lidar to detect water surface changes. At the time of the lidar acquisition field survey of the region was done to determine accuracy of the data for the flight tied to known ground control points. Comparison of sequential lidar provides a valuable tool for looking at channel morphology and should be considered as a necessary step in monitoring river channel change and morphology. It should also be used to make planning decisions in areas of active migration potential and to inform the public of the potential hazards associated with a given region. The technique has shown that the removal of the Marmot Dam the Sandy River has reached equilibrium with little potential for significant lateral migration in the reach due to geologic constraints.

Channel morphology present in the 2006 lidar (Figure 30) shows a long sandy bar dominating the upper reach in the same relative position as the lahar dike and crib structure and another sand bar to the northwest near another lahar intrusion (GPS points D, G, H, J, and K). This is corroborated by the 2005 NAIP imagery of the reservoir with a visible side channel to the east of the reservoir. The active channel has a low sinuosity and is noticeably wider than the channel in subsequent years. Prominent features visible in the transect profiles show the bar and terrace configuration of the reach. Figure 31 shows the rapid

2006 Channel Characteristics Pre-removal

Plate 2

Figure 30. Geomorphic features present in the 2006 lidar acquisition. Note the long bar of sediment in line with the lahar intrusions visible now.

2008 Channel Characteristics Year 1 after removal

Plate 3

Figure 31. Geomorphic features present in the 2008 lidar acquisition. Note the lahar intrusions is just becoming visible now.

change in channel morphology one year after the removal of the dam. There is a noticeable shift in the active channel margin and thalweg and the first signs of the lahar intrusion begins to appear.

The morphological characteristics shown in the transects for the 2008 lidar acquisition are prominent in this map. The bar visible in the 2006 lidar has been completely mobilized and a wide alluvium terrace dominates the eastern shore still covering the crib structure (GPS points D – G). A more permanent terrace has formed to the east of the lahar intrusion and on the southwest bank across from GPS point B. The active channel has a more sinuous pattern and the influence of the lahar intrusion is shown. Alluvium and gravel bars are shown on either flank of the active channel and continue to progress downstream as would be expected based the research discussed in this paper. The point density difference between the 2006 and 2008 acquisitions is noticeable in the detail of the features shown.

The current positioning of the active channel and bars adds testament to the competency of the Sandy River. A comparison of active channel margins (Figure 32) shows the amount of lateral offset between the two lidar flights, of note is the change in sinuosity between years also correlates to known research on the progression of meander bends in relation to bar and terrace formation what was mentioned in the various papers on CEM's. When comparing active channels, the first features noticeable is the influence of the lahar intrusion on the active channel position. The scour of the prominent bar that was visible in 2006 shows how much sediment had accumulated behind the lahar intrusion and the lack of cohesion in that portion of the reach due to its influence. In the 2011 lidar the morphology is more pronounced with the lahar intrusion still influencing the channel pattern and the first appearance of the crib structure showing on a lidar return.

2008 Channel Change Year 1 after removal

Plate 4

Figure 32. Active channel change between 2006 and 2008. The influence of the lahar in channel pattern is evident here.

As previously mentioned in this paper January of 2011 saw a significant flood event that undoubtedly helped shape the confines of the channel and the features, we see in the

hillshade DEM. The active channel has migrated significantly to the east (Figure 33) and the large gravel bar is beginning to form with the margins of the head prominent already in the hillshade (GPS points I – K).

The alluvium terrace that was visible and made a prominent feature in the 2008 lidar has mostly eroded into the channel and is contributing to the aggradation of the sand bar downstream at GPS points B and C. Given the competence of the Sandy and the geologic constraints the lahar dike placed on the reservoir I hypothesize that the large reverser sorted cobbles that make up the gravel bar at GPS point H were deposited during past debris flows and the effect of the resistant dikes created these impediments in the reach, that are technically their own geomorphic formations now given the lack of sufficient flow to continue to mobilize them. The morphology here has created a narrow constriction point that creates a pool-riffle formation near GPS point I on the bar head.

Comparing the active channel change between the 2008 flight and 2011 flight we again see the continued shift in thalweg to the northwest with sinuosity curve continuing to progress downstream and the meander bends becoming more stable in their position (Figure 34). The bars continue to aggrade at GPS points B and C. The 39,000 cfs event from January would be a significant driver in the morphological changes shown in the active channel position between these two lidar flights. Figure 35 shows how the river has continued to incise over the years, and the adjustments to the overall geomorphology of the reach, with the gravel/boulder bars moving slightly downstream and aggradation of sediment occurring at the end of the last armored bar just upstream (~150 meters) of the area the dam was in prior to removal.

2011 Channel Characteristics Year 4 after removal

Plate 5

Figure 33. Channel morphology shown in the 2011 hillshade DEM, the lahar intrusion is a driving factor the shape of the reach and influence on the aggradation of the gravel bar marked by GPS point H.

2011 Channel Change Year 4 after removal

Plate 6

Figure 34. Active channel change between 2008 and 2011. We see the bar being built back up at GPS point H.

Sediment aggradation on the last bar significantly increased from the 2014 field study and photos taken in July of 2018 extending the end of the bar ~50 meters and creating a

broad beach (~12 meters) with intermixed boulders (>256mm) and cobbles (64 – 256mm). Lack of significant vegetation on the bar and the beach show the continued power of the seasonal variability of the Sandy River and will lead to continued changes in the geomorphic characteristics of the bar. Further weathering and plucking of the lahar dikes have not made significant changes to their margins, nor in the channel position the cobble and boulder bars that extend to the north behind each of the two significant lahar intrusions on the east bank.

The lahar dike at the foreset bed of the bar has not had significant change to its structure; the sign and cross that had been atop the intrusion were removed when the area was made a park. The riffle to the south the lahar has extended ~1 meter downstream based from visual comparisons and a pool now encompasses the front two thirds of the lahar intrusion extending from front to back east to west before continuing into another riffle and deep main channel. The southernmost lahar dike still has a significant accumulation of large wooded debris on top of it, and some smoothing and removal of the fines on the south face as the river come around it to the northwest. The backside of the dike continues to exfoliate from cavitation forces during peak flows, but the difference is negligible between the 2014 and 2018 field excursions.

The wooden crib structure that emerged from the sediment between 2008 and 2011 has continued to come apart and the channel has migrated laterally to the east under the structure ~1 meter as shown in the July 2018 photos. The log ramp that had extended into the pool/rapid in the 2014 field photos no longer exists and a large boulder is ~1 meter to the west in the middle of the rapids. The bar on either side of this channel are ~0.5 meters high with a good angle of repose and well armored boulder structure. The remaining

2012 Channel Characteristics Year 5 after removal

Plate 7

Figure 35. Channel morphology shown in the 2012 hillshade DEM, the minor adjustments to the morphology from 2011 shows a channel close to equilibrium.

wooden structure is mostly buried in the boulders and cobbles on the east bank and will still be a significant point on the river for some time.

The cobble and boulder bar to the west of the wooden structure has continued to aggrade and is ~1 meter higher than in the 2014 field study based on current conditions. The boulders on all the bars are reverse sorted and intermixed with sand and gravel showing the competency of the river during winter flows. The pool at the end of this bar has migrated ~0.5 meters to the south and degraded the sediment that had accumulated at the end of that same bar in 2014, creating a ~1-meter-deep pool in the area the beach had occupied in 2014. A low-grade riffle sets at the top of this pool and the original pool from 2014 has increased flow but is still ~1 meter deep. The rapid/riffle complex directly northwest of the pool going downstream remains unchanged in any measurable way visually, but the lahar intrusion on the west bank has continued to erode and now has an ~0.5-meter channel between its outer margin and the main intrusion embedded in the bank.

Subsequent slope failures on the west bank have allowed some minor lateral migration to the west and could account for some of the additional sediment found on the further downstream bar discussed above. The geomorphic characteristics noted in the lidar acquisitions and corroborated by time in the field, both in 2014 and 2018, show that lidar is a significant tool for helping identify and monitor geomorphic features and fluvial geomorphic conditions. The gradient profiles show aggradation and degradation upstream and downstream of the dam removal with the 2011 and 2012 comparisons showing the former impoundment coming into equilibrium and showing the importance of sequential lidar for looking for fluxes between lidar years (Figure 36). Change shown in each of the lateral profiles are significant between 2006 and 2008, and again between 2008 and 2011, with the 2011 and 2012 profiles showing the quasi-equilibrium state of the river at the time of those flights. Channel width and sinuosity showed significant change between the

2012 Channel Change Year 5 after removal

Plate 8

Figure 36. Active channel change between 2011 and 2012. Very little overall change in the channel thalweg, further degradation of the channel has occurred.

original 2006 lidar flight and the 2012 acquisition (Figure 37). There was an overall net elevation change of -1.9 meters across the entire impoundment from 2006 to 2012 and a

total of -28,502 cubic meters of change in the overall morphological characteristics that we see in the 2012 bare earth hillshade DEM. The sand bar visible in the 2006 hillshade has been replaced by a large cobbled bar that is approximately 3 meters high at the head. Overall geomorphic change is a result of the underlying geology of the reach and overall competence of the Sandy River. High resolution map plates of the figures in this section are available at the end of this paper in.

The need for tools that allow researchers to efficiently, safely, and cost effectively monitor river morphology continues to grow. High resolution lidar provides fluvial geomorphologists the ability to monitor flow hydraulics in relation to channel morphology, flood prone and avulsion potential areas, aggradation and degradation of the channel margins and allows for more comprehensive analysis of the entire drainage system and the impacts to the overall watershed environment. When used in conjunction with existing CEMs the ability of lidar to monitor an array of processes at work simultaneously strengthens the already strong argument in its favor. I have shown that sequential lidar runs over a short temporal range provides a comprehensive tool for identifying and monitoring channel morphology.

Some things that I would do differently given what I found in this research would be to first work with the LAS data files and use the 3D visualization tools available in QT Modeler to better define the overall geomorphological response in the reach, and to more accurately classify the active channel bank margins. Another benefit to using the raw LAS data is that it also allows you to look at the individual point returns and evaluate the classification for each point, giving you even more control on the level of detail for the features you want to define and extract.

Channel Comparison 2006 - 2012

Plate 9

Figure 37. Overall active channel pattern changes between 2006 and 2012. Morphological differences in the overall configuration of the channel position and elevation is shown.

I would also explore more of the techniques for using the orthophoto color bands to derive depth features to extrapolate bathymetric feature in the 2006 – 2011 lidar runs so I

could compare them to the 2012 bathymetric data that I did not look at in this study since there wasn't other data to compare it to. Adding the bathymetric component to the overall response of the Marmot Dam removal would have given more weight to my hypothesis that water surface elevations differences between lidar flights indicate changes in bedform that correlate to the continued downstream adjustment of the reach.

For future work on this concept and continued monitoring of the study area I would like to explore the use of unmanned aerial vehicles (UAV) and structure from motion (SFM) as an additional tool to provide more detailed analysis of geomorphic change in the area and as an additional tool to use with sequential lidar. Given the progression of the technology, the use of drone mounted lidar sensors aren't the far off and the overall technological advances in lidar continue to open avenues for more detailed studies of the overall bedform change using bathymetric lidar. I will continue to delve into the use of lidar for monitoring geohazards and hazard mitigation in our region and hope to influence decisions around the appropriate temporal schedule for sequential lidar acquisitions. The need for a defined schedule based on geomorphic and geologic principles is something that should be undertaken on a regional level with Oregon and the rest of the Pacific Northwest leading the way in the advancement of this valuable technology.

7.0 Conclusion

The study furthers the case for sequential lidar on highly competent and marginally active river systems such as the Sandy River. Most rivers flowing out of the mountain ranges west of the Cascades have the potential for lateral migration, and lidar is an asset in the monitoring and planning that should be involved along the most vulnerable of areas. As climate change continues to adjust the storage capacity and intensity of winter storms in the Pacific Northwest, the need for proper mitigation and planning around the likelihood of channel migration occurring will become a reality.

Proper study of the potential for channel migration induced avulsions needs sequential lidar for monitoring. The practical uses of lidar are further enhanced by sequential acquisition flights from between three and five years depending on a reaches channel migration potential and vulnerability of local populations and infrastructure. Susceptibility should be measured for hazard potential, and sequential lidar is a necessary tool to accomplish this. Of all the findings in this study the one of most import is that of having sequential data to formulate best management practices and hazard mitigation/response efforts around natural hazards in areas prone to flood.

The impact of the seasonal variability for the Sandy River was shown in the quick overall transition of the reach to a state of equilibrium, more specifically the 30,000 cfs flow that occurred on January 2nd, 2009 and the 39,000 cfs flow on January 14th, 2011 produced the most dramatic geomorphic change between the 2008 and 2011 lidar acquisitions. The river has continued to incise and migrate laterally to the east above the lahar intrusion and to west just beyond it, erosion of the bed materials (including cobbles, boulders and bedrock) are unlikely and sediment fines continue to scour off the boulder

bar above the lahar intrusion and aggrade downstream at GPS points B and C, forming a coarse boulder and sand mixed beach at GPS point C, and transitioning to a sand covered beach at GPS point B. The intrusive lahar dikes are highly resistant and will likely take many decades to erode, thus establishing equilibrium in the rivers current state.

The sequential DEMs permitted calculation of reach-scale volumetric erosion and aggradation rates, although it was necessary to set a threshold to account for noise in the lidar of ± 2.5 feet and polygon area size ≤ 20 m² to account for vegetation and low pulse return data near the margins and interpolation errors in digitizing. My study further shows the capability of lidar to measure rates of aggradation and degradation for an entire river system instead of reach specific extrapolations and that repeat lidar flights can more than adequately assess the changing nature of entire stream reaches more rapidly and more cost effectively than traditional field techniques. As such the more active a hazard in a given region the more often lidar should be acquired. Rivers in the western portion of the Pacific Northwest are highly competent and have greater avulsion potential than their counterparts on the eastern side of the Cascades and areas to the west of the Coast Range and coastal regions necessitate a more aggressive acquisition schedule. Having robust sequential lidar data in populated areas is an asset to hazard management and disaster recovery efforts after events. It also allows us to make informed decisions regarding infrastructure placement and urban planning in areas not as heavily developed.

I have shown the effectiveness of sequential lidar as a tool to detect morphological changes, providing a safe, efficient and effective tool for fluvial geomorphologists and showing the necessity of both sequential lidar and up to date lidar. Some things to consider from this research:

- The utility of Lidar to do river management with repeat returns, having successive lidar acquisitions run on the watershed level will help us to gain insight into the correlation to precipitation events and geomorphological change in a given reach.
- Lidar can be used to assess the validity of channel evolution models. Sequential runs of lidar can be used to adjust the overall effectiveness of current CEM's and create new ones that consider reach specific geomorphology.
- Dam removal projects should incorporate initial lidar flights prior to removal and follow acquisitions based on known CEM's for the region and overall region-specific physiography.
- Sequential lidar should be used for hazard mitigation and geohazards analysis with an acquisition timeframe that is appropriate for the region's physiography, geology, geomorphology and the return interval of the hazard being monitored.

8.0 References

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9.0 Appendix A: Differential Correction File

```
Searching for base files...

File      H:\SandyRiverData\Base\UNAVCO,
Boring, OR (p427)\p4272860.14o.Z downloaded.
File      H:\SandyRiverData\Base\UNAVCO,
Boring, OR (p427)\brdc2860.14n.Z downloaded.
Successfully found or downloaded 2 of 2 files.
Search complete.

-----Base Data Details:-----
Using reference position from base provider:
Name: UNAVCO, Boring, OR (p427)
Position: 45°25'48.64526"N,
122°20'26.26803"W, 149.22 m
Source: H:\SandyRiverData\Base\UNAVCO,
Boring, OR (p427)
p4272860.14o.Z
Local time: 10/12/2014 4:59:45 PM to
10/13/2014 4:59:30 PM
Position: 45°25'48.64440"N,
122°20'26.27160"W, 149.32 m, 0.01 m Antenna
height
Distance from base provider: 0.08m

-----Coverage Details:-----
Rover file: R101313A.SSF
Local time: 10/13/2014 1:57:49 PM to
10/13/2014 2:23:15 PM
100% total coverage
100% coverage by p4272860.14o.Z

Rover file: R101311A.SSF
Local time: 10/13/2014 11:41:50 AM to
10/13/2014 11:45:35 AM
100% total coverage
100% coverage by p4272860.14o.Z

Rover file: R101312A.SSF
Local time: 10/13/2014 12:14:54 PM to
10/13/2014 12:17:55 PM
100% total coverage
100% coverage by p4272860.14o.Z

Rover file: R101312B.SSF
Local time: 10/13/2014 12:28:17 PM to
10/13/2014 12:31:00 PM
100% total coverage
100% coverage by p4272860.14o.Z

Rover file: R101314A.SSF
Local time: 10/13/2014 2:37:05 PM to
10/13/2014 2:41:10 PM

100% total coverage
100% coverage by p4272860.14o.Z

Rover file: R101314B.SSF
Local time: 10/13/2014 2:44:27 PM to
10/13/2014 2:49:40 PM
100% total coverage
100% coverage by p4272860.14o.Z

-----
Differentially correcting...
Differential correction settings:
Use smart automatic filtering: On
Re-correct real-time positions: On
Output positions: Corrected only

-----
Processing rover file, R101313A.SSF ...
...to          output          file,
H:\SandyRiverData\R101313A.cor
Carrier processing...
No carrier processing performed as file
has no carrier data
Corrected 0 positions
Code processing...
Selected 160 positions for post-
processing
Corrected 146 positions
Failed to correct 14 positions
Filtered out 14 uncorrected positions
(only "Corrected" positions selected for
output)

-----
Processing rover file, R101311A.SSF ...
...to          output          file,
H:\SandyRiverData\R101311A.cor
Carrier processing...
No carrier processing performed as file
has no carrier data
Corrected 0 positions
Code processing...
Selected 30 positions for post-processing
Corrected 30 positions

-----
Processing rover file, R101312A.SSF ...
...to          output          file,
H:\SandyRiverData\R101312A.cor
Carrier processing...
No carrier processing performed as file
has no carrier data
```


Corrected 0 positions
Code processing...
Selected 32 positions for post-processing
Corrected 32 positions

Processing rover file, R101312B.SSF ...
...to output file,
H:\SandyRiverData\R101312B.cor
Carrier processing...
No carrier processing performed as file
has no carrier data
Corrected 0 positions
Code processing...
Selected 30 positions for post-processing
Corrected 29 positions
Failed to correct 1 positions
Filtered out 1 uncorrected positions
(only "Corrected" positions selected for
output)

Processing rover file, R101314A.SSF ...
...to output file,
H:\SandyRiverData\R101314A.cor
Carrier processing...
No carrier processing performed as file
has no carrier data
Corrected 0 positions
Code processing...
Selected 30 positions for post-processing
Corrected 30 positions

Processing rover file, R101314B.SSF ...

Differential correction complete.

...to output file,
H:\SandyRiverData\R101314B.cor
Carrier processing...
No carrier processing performed as file
has no carrier data
Corrected 0 positions
Code processing...
Selected 44 positions for post-processing
Corrected 43 positions
Failed to correct 1 positions
Filtered out 1 uncorrected positions
(only "Corrected" positions selected for
output)

Differential Correction Summary:
6 files processed. In these files:
310 (95.09%) of 326 selected positions
were code corrected by post-processing
0 (0.00%) of 0 selected positions were
carrier corrected by post-processing

Estimated accuracies for 310 corrected
positions are as follows:

Range Percentage	
-----	-----
0-5cm	-
5-15cm	-
15-30cm	-
30-50cm	63.55%
0.5-1m	36.45%
1-2m	-
2-5m	-
>5m	-

10.0 Appendix B: Transect Tables

10.1 Transect A – Spillway – All Returns:

Distance	Z	DEM	Year	Distance	Z	DEM	Year
0.000	227.485	Surface	2006	0.000	227.428	Surface	2011
2.983	227.414	Surface	2006	2.983	227.343	Surface	2011
5.965	227.276	Surface	2006	5.965	227.265	Surface	2011
8.948	227.183	Surface	2006	8.948	227.169	Surface	2011
11.930	227.123	Surface	2006	11.930	227.047	Surface	2011
14.913	227.058	Surface	2006	14.913	226.914	Surface	2011
17.895	226.985	Surface	2006	17.895	226.777	Surface	2011
20.878	226.917	Surface	2006	20.878	226.583	Surface	2011
23.860	226.822	Surface	2006	23.860	226.367	Surface	2011
26.843	226.355	Surface	2006	26.843	225.692	Surface	2011
29.826	225.426	Surface	2006	29.826	224.476	Surface	2011
32.808	224.213	Surface	2006	32.808	223.136	Surface	2011
35.791	223.121	Surface	2006	35.791	221.798	Surface	2011
38.774	220.981	Surface	2006	38.774	220.459	Surface	2011
41.756	218.937	Surface	2006	41.756	219.109	Surface	2011
44.739	216.808	Surface	2006	44.739	217.728	Surface	2011
47.721	214.775	Surface	2006	47.721	216.311	Surface	2011
50.704	214.174	Surface	2006	50.704	214.854	Surface	2011
53.686	214.417	Surface	2006	53.686	213.889	Surface	2011
56.669	214.194	Surface	2006	56.669	213.636	Surface	2011
59.651	213.784	Surface	2006	59.651	213.629	Surface	2011
62.634	213.140	Surface	2006	62.634	213.643	Surface	2011
65.617	212.720	Surface	2006	65.617	213.644	Surface	2011
68.599	212.437	Surface	2006	68.599	213.610	Surface	2011
71.582	212.280	Surface	2006	71.582	213.580	Surface	2011
74.564	212.151	Surface	2006	74.564	213.597	Surface	2011
77.547	212.014	Surface	2006	77.547	213.608	Surface	2011
80.529	211.906	Surface	2006	80.529	213.595	Surface	2011
83.512	211.820	Surface	2006	83.512	213.567	Surface	2011
86.494	211.748	Surface	2006	86.494	213.534	Surface	2011
89.477	211.660	Surface	2006	89.477	213.512	Surface	2011
92.460	211.629	Surface	2006	92.460	213.520	Surface	2011
95.442	211.609	Surface	2006	95.442	213.541	Surface	2011
98.425	211.619	Surface	2006	98.425	213.536	Surface	2011
101.407	211.630	Surface	2006	101.407	213.537	Surface	2011
104.390	211.615	Surface	2006	104.390	213.549	Surface	2011
107.373	211.609	Surface	2006	107.373	213.561	Surface	2011
110.355	211.627	Surface	2006	110.355	213.576	Surface	2011
113.338	211.622	Surface	2006	113.338	213.561	Surface	2011
116.320	211.596	Surface	2006	116.320	213.546	Surface	2011
119.303	211.595	Surface	2006	119.303	213.550	Surface	2011
122.285	211.608	Surface	2006	122.285	213.567	Surface	2011
125.268	211.619	Surface	2006	125.268	213.571	Surface	2011
128.250	211.613	Surface	2006	128.250	213.537	Surface	2011

131.233	211.606	Surface	2006	131.233	213.514	Surface	2011
134.216	211.611	Surface	2006	134.216	213.546	Surface	2011
137.198	211.626	Surface	2006	137.198	213.636	Surface	2011
140.181	211.634	Surface	2006	140.181	213.698	Surface	2011
143.163	211.622	Surface	2006	143.163	213.755	Surface	2011
146.146	211.613	Surface	2006	146.146	213.818	Surface	2011
149.128	211.609	Surface	2006	149.128	213.862	Surface	2011
152.111	211.598	Surface	2006	152.111	213.906	Surface	2011
155.094	211.604	Surface	2006	155.094	213.928	Surface	2011
158.076	211.622	Surface	2006	158.076	213.940	Surface	2011
161.059	211.806	Surface	2006	161.059	213.931	Surface	2011
164.041	212.325	Surface	2006	164.041	213.946	Surface	2011
167.024	212.863	Surface	2006	167.024	213.998	Surface	2011
170.006	213.073	Surface	2006	170.006	214.045	Surface	2011
172.989	212.870	Surface	2006	172.989	214.058	Surface	2011
175.971	212.686	Surface	2006	175.971	214.081	Surface	2011
178.954	212.692	Surface	2006	178.954	214.120	Surface	2011
181.937	212.684	Surface	2006	181.937	214.133	Surface	2011
184.919	212.699	Surface	2006	184.919	214.125	Surface	2011
187.902	212.754	Surface	2006	187.902	214.130	Surface	2011
190.884	212.811	Surface	2006	190.884	214.155	Surface	2011
193.867	212.838	Surface	2006	193.867	214.143	Surface	2011
196.850	212.880	Surface	2006	196.850	214.124	Surface	2011
199.832	212.889	Surface	2006	199.832	214.115	Surface	2011
202.815	212.894	Surface	2006	202.815	214.129	Surface	2011
205.797	212.925	Surface	2006	205.797	214.156	Surface	2011
208.780	212.956	Surface	2006	208.780	214.166	Surface	2011
211.762	213.131	Surface	2006	211.762	214.155	Surface	2011
214.745	213.552	Surface	2006	214.745	214.137	Surface	2011
217.727	214.017	Surface	2006	217.727	214.130	Surface	2011
220.710	214.379	Surface	2006	220.710	214.137	Surface	2011
223.693	214.746	Surface	2006	223.693	214.138	Surface	2011
226.675	215.063	Surface	2006	226.675	214.153	Surface	2011
229.658	215.202	Surface	2006	229.658	214.170	Surface	2011
232.640	215.240	Surface	2006	232.640	214.171	Surface	2011
235.623	215.339	Surface	2006	235.623	214.204	Surface	2011
238.605	215.453	Surface	2006	238.605	214.318	Surface	2011
241.588	215.583	Surface	2006	241.588	214.622	Surface	2011
244.570	215.290	Surface	2006	244.570	215.422	Surface	2011
247.553	215.743	Surface	2006	247.553	216.765	Surface	2011
250.536	217.553	Surface	2006	250.536	218.441	Surface	2011
253.518	219.411	Surface	2006	253.518	220.152	Surface	2011
256.501	220.719	Surface	2006	256.501	221.656	Surface	2011
259.484	221.949	Surface	2006	259.484	222.511	Surface	2011
262.466	222.542	Surface	2006	262.466	222.835	Surface	2011
265.449	222.848	Surface	2006	265.449	223.025	Surface	2011
268.431	222.923	Surface	2006	268.431	223.087	Surface	2011
271.414	222.752	Surface	2006	271.414	223.146	Surface	2011
274.396	222.555	Surface	2006	274.396	223.285	Surface	2011

277.379	222.488	Surface	2006	277.379	223.448	Surface	2011
280.361	222.469	Surface	2006	280.361	223.622	Surface	2011
283.344	222.486	Surface	2006	283.344	223.808	Surface	2011
286.327	222.480	Surface	2006	286.327	223.999	Surface	2011
289.309	222.491	Surface	2006	289.309	224.180	Surface	2011
292.292	222.505	Surface	2006	292.292	224.343	Surface	2011
295.274	222.836	Surface	2006	295.274	224.537	Surface	2011
298.257	223.453	Surface	2006	298.257	224.783	Surface	2011
301.239	224.033	Surface	2006	301.239	224.955	Surface	2011
304.222	224.601	Surface	2006	304.222	225.086	Surface	2011
307.204	225.268	Surface	2006	307.204	225.280	Surface	2011
310.187	225.860	Surface	2006	310.187	225.479	Surface	2011
313.170	226.198	Surface	2006	313.170	225.717	Surface	2011
316.152	226.375	Surface	2006	316.152	225.955	Surface	2011
319.135	226.511	Surface	2006	319.135	226.126	Surface	2011
322.118	226.643	Surface	2006	322.118	226.288	Surface	2011
325.100	226.692	Surface	2006	325.100	226.379	Surface	2011
328.083	226.681	Surface	2006	328.083	226.438	Surface	2011
331.065	226.690	Surface	2006	331.065	226.490	Surface	2011
334.048	226.666	Surface	2006	334.048	226.583	Surface	2011
337.030	226.627	Surface	2006	337.030	226.626	Surface	2011
340.013	226.695	Surface	2006	340.013	226.686	Surface	2011
342.995	226.788	Surface	2006	342.995	226.797	Surface	2011
345.978	226.917	Surface	2006	345.978	226.899	Surface	2011
348.961	227.005	Surface	2006	348.961	226.956	Surface	2011
0.000	227.482	Surface	2008	0.000	227.706	Surface	2012
3.261	227.360	Surface	2008	3.261	227.616	Surface	2012
6.523	227.323	Surface	2008	6.523	227.464	Surface	2012
9.784	227.314	Surface	2008	9.784	227.328	Surface	2012
13.045	227.220	Surface	2008	13.045	227.163	Surface	2012
16.307	227.047	Surface	2008	16.307	226.987	Surface	2012
19.568	226.902	Surface	2008	19.568	226.962	Surface	2012
22.829	226.867	Surface	2008	22.829	226.696	Surface	2012
26.090	226.420	Surface	2008	26.090	225.808	Surface	2012
29.352	225.158	Surface	2008	29.352	224.585	Surface	2012
32.613	223.704	Surface	2008	32.613	223.201	Surface	2012
35.875	222.259	Surface	2008	35.875	221.781	Surface	2012
39.136	220.825	Surface	2008	39.136	220.354	Surface	2012
42.397	219.388	Surface	2008	42.397	218.926	Surface	2012
45.658	217.947	Surface	2008	45.658	217.499	Surface	2012
48.920	216.514	Surface	2008	48.920	216.071	Surface	2012
52.181	215.121	Surface	2008	52.181	214.643	Surface	2012
55.442	214.137	Surface	2008	55.442	213.506	Surface	2012
58.703	213.999	Surface	2008	58.703	213.215	Surface	2012
61.965	213.961	Surface	2008	61.965	213.021	Surface	2012
65.226	213.923	Surface	2008	65.226	212.883	Surface	2012
68.488	213.874	Surface	2008	68.488	212.760	Surface	2012
71.749	213.812	Surface	2008	71.749	212.719	Surface	2012
75.010	213.825	Surface	2008	75.010	212.717	Surface	2012

78.271	213.847	Surface	2008	78.271	212.737	Surface	2012
81.533	213.860	Surface	2008	81.533	212.746	Surface	2012
84.794	213.868	Surface	2008	84.794	212.750	Surface	2012
88.056	213.875	Surface	2008	88.056	212.750	Surface	2012
91.317	213.791	Surface	2008	91.317	212.739	Surface	2012
94.578	213.800	Surface	2008	94.578	212.727	Surface	2012
97.839	213.787	Surface	2008	97.839	212.739	Surface	2012
101.101	213.799	Surface	2008	101.101	212.750	Surface	2012
104.362	213.816	Surface	2008	104.362	212.752	Surface	2012
107.623	213.838	Surface	2008	107.623	212.785	Surface	2012
110.885	213.820	Surface	2008	110.885	212.754	Surface	2012
114.146	213.784	Surface	2008	114.146	212.767	Surface	2012
117.407	213.789	Surface	2008	117.407	212.782	Surface	2012
120.669	213.807	Surface	2008	120.669	212.781	Surface	2012
123.930	213.847	Surface	2008	123.930	213.035	Surface	2012
127.191	213.901	Surface	2008	127.191	213.376	Surface	2012
130.453	214.216	Surface	2008	130.453	213.590	Surface	2012
133.714	214.666	Surface	2008	133.714	213.719	Surface	2012
136.975	214.878	Surface	2008	136.975	213.795	Surface	2012
140.236	215.017	Surface	2008	140.236	213.871	Surface	2012
143.498	215.146	Surface	2008	143.498	213.926	Surface	2012
146.759	215.174	Surface	2008	146.759	213.952	Surface	2012
150.020	215.192	Surface	2008	150.020	213.988	Surface	2012
153.282	215.225	Surface	2008	153.282	214.024	Surface	2012
156.543	215.227	Surface	2008	156.543	214.037	Surface	2012
159.804	215.219	Surface	2008	159.804	214.051	Surface	2012
163.066	215.245	Surface	2008	163.066	214.059	Surface	2012
166.327	215.257	Surface	2008	166.327	214.050	Surface	2012
169.588	215.229	Surface	2008	169.588	214.047	Surface	2012
172.849	215.204	Surface	2008	172.849	214.057	Surface	2012
176.111	215.219	Surface	2008	176.111	214.065	Surface	2012
179.372	215.254	Surface	2008	179.372	214.079	Surface	2012
182.634	215.261	Surface	2008	182.634	214.087	Surface	2012
185.895	215.260	Surface	2008	185.895	214.090	Surface	2012
189.156	215.247	Surface	2008	189.156	214.082	Surface	2012
192.417	215.226	Surface	2008	192.417	214.079	Surface	2012
195.679	215.193	Surface	2008	195.679	214.087	Surface	2012
198.940	215.191	Surface	2008	198.940	214.083	Surface	2012
202.202	215.223	Surface	2008	202.202	214.087	Surface	2012
205.463	215.205	Surface	2008	205.463	214.080	Surface	2012
208.724	215.144	Surface	2008	208.724	214.094	Surface	2012
211.985	215.105	Surface	2008	211.985	214.087	Surface	2012
215.247	215.097	Surface	2008	215.247	214.081	Surface	2012
218.508	215.062	Surface	2008	218.508	214.071	Surface	2012
221.769	215.021	Surface	2008	221.769	214.076	Surface	2012
225.031	214.962	Surface	2008	225.031	214.083	Surface	2012
228.292	214.908	Surface	2008	228.292	214.089	Surface	2012
231.553	214.872	Surface	2008	231.553	214.095	Surface	2012
234.815	214.861	Surface	2008	234.815	214.110	Surface	2012

238.076	214.863	Surface	2008	238.076	214.139	Surface	2012
241.337	215.027	Surface	2008	241.337	214.144	Surface	2012
244.598	215.298	Surface	2008	244.598	214.688	Surface	2012
247.860	215.936	Surface	2008	247.860	217.016	Surface	2012
251.121	217.077	Surface	2008	251.121	219.250	Surface	2012
254.382	218.916	Surface	2008	254.382	220.454	Surface	2012
257.644	220.745	Surface	2008	257.644	221.562	Surface	2012
260.905	222.042	Surface	2008	260.905	222.432	Surface	2012
264.166	222.630	Surface	2008	264.166	222.834	Surface	2012
267.428	222.948	Surface	2008	267.428	223.078	Surface	2012
270.689	223.097	Surface	2008	270.689	223.144	Surface	2012
273.950	223.233	Surface	2008	273.950	223.254	Surface	2012
277.212	223.398	Surface	2008	277.212	223.417	Surface	2012
280.473	223.546	Surface	2008	280.473	223.596	Surface	2012
283.734	223.732	Surface	2008	283.734	223.814	Surface	2012
286.995	223.926	Surface	2008	286.995	224.066	Surface	2012
290.257	224.146	Surface	2008	290.257	224.256	Surface	2012
293.518	224.326	Surface	2008	293.518	224.450	Surface	2012
296.780	224.546	Surface	2008	296.780	224.662	Surface	2012
300.041	224.817	Surface	2008	300.041	224.888	Surface	2012
303.302	225.006	Surface	2008	303.302	225.077	Surface	2012
306.563	225.182	Surface	2008	306.563	225.233	Surface	2012
309.825	225.373	Surface	2008	309.825	225.443	Surface	2012
313.086	225.552	Surface	2008	313.086	225.665	Surface	2012
316.348	225.774	Surface	2008	316.348	225.885	Surface	2012
319.609	226.052	Surface	2008	319.609	226.135	Surface	2012
322.870	226.257	Surface	2008	322.870	226.338	Surface	2012
326.131	226.405	Surface	2008	326.131	226.474	Surface	2012
329.393	226.581	Surface	2008	329.393	226.578	Surface	2012
332.654	226.750	Surface	2008	332.654	226.697	Surface	2012
335.915	226.790	Surface	2008	335.915	226.746	Surface	2012
339.177	226.747	Surface	2008	339.177	226.789	Surface	2012
342.438	226.762	Surface	2008	342.438	226.840	Surface	2012
345.699	226.857	Surface	2008	345.699	226.920	Surface	2012
348.961	226.951	Surface	2008	348.961	227.008	Surface	2012

10.2 Transect B – Dam Head – All Returns:

Distance	Z	DEM	Year	Distance	Z	DEM	Year
0.000	226.088	Surface	2006	0.000	226.090	Surface	2011
2.998	226.066	Surface	2006	2.998	226.056	Surface	2011
5.997	226.041	Surface	2006	5.997	226.027	Surface	2011
8.996	226.051	Surface	2006	8.996	226.003	Surface	2011
11.994	226.055	Surface	2006	11.994	225.987	Surface	2011
14.993	226.034	Surface	2006	14.993	225.976	Surface	2011
17.992	226.050	Surface	2006	17.992	225.991	Surface	2011
20.990	226.077	Surface	2006	20.990	226.046	Surface	2011
23.989	226.110	Surface	2006	23.989	226.097	Surface	2011
26.987	226.134	Surface	2006	26.987	226.142	Surface	2011
29.986	226.161	Surface	2006	29.986	226.158	Surface	2011
32.985	226.187	Surface	2006	32.985	226.133	Surface	2011
35.983	226.190	Surface	2006	35.983	226.071	Surface	2011
38.982	226.080	Surface	2006	38.982	225.959	Surface	2011
41.981	225.888	Surface	2006	41.981	225.786	Surface	2011
44.979	225.682	Surface	2006	44.979	225.545	Surface	2011
47.978	225.475	Surface	2006	47.978	225.294	Surface	2011
50.976	225.359	Surface	2006	50.976	225.234	Surface	2011
53.975	225.316	Surface	2006	53.975	225.230	Surface	2011
56.973	225.297	Surface	2006	56.973	225.245	Surface	2011
59.972	225.264	Surface	2006	59.972	225.262	Surface	2011
62.971	225.004	Surface	2006	62.971	225.084	Surface	2011
65.969	224.663	Surface	2006	65.969	224.482	Surface	2011
68.968	224.382	Surface	2006	68.968	223.610	Surface	2011
71.966	224.304	Surface	2006	71.966	222.370	Surface	2011
74.965	224.295	Surface	2006	74.965	220.833	Surface	2011
77.964	224.249	Surface	2006	77.964	219.150	Surface	2011
80.962	224.194	Surface	2006	80.962	217.773	Surface	2011
83.961	224.182	Surface	2006	83.961	216.909	Surface	2011
86.960	224.182	Surface	2006	86.960	216.122	Surface	2011
89.958	224.184	Surface	2006	89.958	215.559	Surface	2011
92.957	224.187	Surface	2006	92.957	215.508	Surface	2011
95.955	224.189	Surface	2006	95.955	215.544	Surface	2011
98.954	224.189	Surface	2006	98.954	215.584	Surface	2011
101.952	224.188	Surface	2006	101.952	215.573	Surface	2011
104.951	224.189	Surface	2006	104.951	215.534	Surface	2011
107.950	224.180	Surface	2006	107.950	215.554	Surface	2011
110.948	224.160	Surface	2006	110.948	215.557	Surface	2011
113.947	224.145	Surface	2006	113.947	215.559	Surface	2011
116.945	224.142	Surface	2006	116.945	215.554	Surface	2011
119.944	224.143	Surface	2006	119.944	215.524	Surface	2011
122.943	224.145	Surface	2006	122.943	215.494	Surface	2011
125.941	224.150	Surface	2006	125.941	215.485	Surface	2011
128.940	224.154	Surface	2006	128.940	215.488	Surface	2011
131.939	224.158	Surface	2006	131.939	215.444	Surface	2011

134.937	224.159	Surface	2006	134.937	215.450	Surface	2011
137.936	224.159	Surface	2006	137.936	215.427	Surface	2011
140.934	224.155	Surface	2006	140.934	215.373	Surface	2011
143.933	224.145	Surface	2006	143.933	215.330	Surface	2011
146.931	224.126	Surface	2006	146.931	215.286	Surface	2011
149.930	224.134	Surface	2006	149.930	215.233	Surface	2011
152.929	224.157	Surface	2006	152.929	215.161	Surface	2011
155.927	224.168	Surface	2006	155.927	215.086	Surface	2011
158.926	224.167	Surface	2006	158.926	215.008	Surface	2011
161.925	224.154	Surface	2006	161.925	214.951	Surface	2011
164.923	224.153	Surface	2006	164.923	214.939	Surface	2011
167.922	224.148	Surface	2006	167.922	214.866	Surface	2011
170.920	224.133	Surface	2006	170.920	214.823	Surface	2011
173.919	224.123	Surface	2006	173.919	214.761	Surface	2011
176.918	224.123	Surface	2006	176.918	214.693	Surface	2011
179.916	224.126	Surface	2006	179.916	214.624	Surface	2011
182.915	224.133	Surface	2006	182.915	214.539	Surface	2011
185.913	224.139	Surface	2006	185.913	214.427	Surface	2011
188.912	224.142	Surface	2006	188.912	214.299	Surface	2011
191.910	224.124	Surface	2006	191.910	214.300	Surface	2011
194.909	224.118	Surface	2006	194.909	214.303	Surface	2011
197.908	224.133	Surface	2006	197.908	214.306	Surface	2011
200.906	224.133	Surface	2006	200.906	214.309	Surface	2011
203.905	224.138	Surface	2006	203.905	214.323	Surface	2011
206.904	224.148	Surface	2006	206.904	214.349	Surface	2011
209.902	224.144	Surface	2006	209.902	214.374	Surface	2011
212.901	224.140	Surface	2006	212.901	214.381	Surface	2011
215.899	224.159	Surface	2006	215.899	214.380	Surface	2011
218.898	224.173	Surface	2006	218.898	214.373	Surface	2011
221.897	224.168	Surface	2006	221.897	214.370	Surface	2011
224.895	224.167	Surface	2006	224.895	214.342	Surface	2011
227.894	224.164	Surface	2006	227.894	214.328	Surface	2011
230.892	224.162	Surface	2006	230.892	214.335	Surface	2011
233.891	224.161	Surface	2006	233.891	214.322	Surface	2011
236.889	224.162	Surface	2006	236.889	214.331	Surface	2011
239.888	224.163	Surface	2006	239.888	214.348	Surface	2011
242.887	224.166	Surface	2006	242.887	214.359	Surface	2011
245.885	224.162	Surface	2006	245.885	214.342	Surface	2011
248.884	224.144	Surface	2006	248.884	214.325	Surface	2011
251.883	224.127	Surface	2006	251.883	214.326	Surface	2011
254.881	224.132	Surface	2006	254.881	214.354	Surface	2011
257.880	224.128	Surface	2006	257.880	214.368	Surface	2011
260.878	224.125	Surface	2006	260.878	214.372	Surface	2011
263.877	224.107	Surface	2006	263.877	214.351	Surface	2011
266.876	224.064	Surface	2006	266.876	214.314	Surface	2011
269.874	224.023	Surface	2006	269.874	214.332	Surface	2011
272.873	224.007	Surface	2006	272.873	214.527	Surface	2011
275.871	223.987	Surface	2006	275.871	214.883	Surface	2011
278.870	223.973	Surface	2006	278.870	215.538	Surface	2011

281.868	223.971	Surface	2006	281.868	217.089	Surface	2011
284.867	223.962	Surface	2006	284.867	219.574	Surface	2011
287.866	223.962	Surface	2006	287.866	222.011	Surface	2011
290.864	223.951	Surface	2006	290.864	223.139	Surface	2011
293.863	223.925	Surface	2006	293.863	223.578	Surface	2011
296.862	223.901	Surface	2006	296.862	223.861	Surface	2011
299.860	223.846	Surface	2006	299.860	224.102	Surface	2011
302.859	223.795	Surface	2006	302.859	224.327	Surface	2011
305.857	223.816	Surface	2006	305.857	224.539	Surface	2011
308.856	223.918	Surface	2006	308.856	224.726	Surface	2011
311.855	224.302	Surface	2006	311.855	224.884	Surface	2011
314.853	224.820	Surface	2006	314.853	225.047	Surface	2011
317.852	225.312	Surface	2006	317.852	225.179	Surface	2011
320.850	225.731	Surface	2006	320.850	225.337	Surface	2011
323.849	226.024	Surface	2006	323.849	225.563	Surface	2011
326.847	226.258	Surface	2006	326.847	225.791	Surface	2011
329.846	226.441	Surface	2006	329.846	225.978	Surface	2011
332.845	226.562	Surface	2006	332.845	226.104	Surface	2011
335.843	226.583	Surface	2006	335.843	226.112	Surface	2011
338.842	226.531	Surface	2006	338.842	226.072	Surface	2011
341.841	226.482	Surface	2006	341.841	226.041	Surface	2011
344.839	226.478	Surface	2006	344.839	226.044	Surface	2011
347.838	226.609	Surface	2006	347.838	226.048	Surface	2011
350.836	226.744	Surface	2006	350.836	226.032	Surface	2011
353.835	226.734	Surface	2006	353.835	226.023	Surface	2011
356.834	226.749	Surface	2006	356.834	226.134	Surface	2011
359.832	226.863	Surface	2006	359.832	226.292	Surface	2011
362.831	227.190	Surface	2006	362.831	226.446	Surface	2011
365.830	227.471	Surface	2006	365.830	226.653	Surface	2011
368.828	227.754	Surface	2006	368.828	227.140	Surface	2011
0.000	226.090	Surface	2008	0.000	226.179	Surface	2012
3.264	226.049	Surface	2008	3.264	226.158	Surface	2012
6.528	226.005	Surface	2008	6.528	226.077	Surface	2012
9.792	226.010	Surface	2008	9.792	225.996	Surface	2012
13.056	226.006	Surface	2008	13.056	225.979	Surface	2012
16.320	226.041	Surface	2008	16.320	226.056	Surface	2012
19.584	226.145	Surface	2008	19.584	226.225	Surface	2012
22.848	226.271	Surface	2008	22.848	226.422	Surface	2012
26.112	226.388	Surface	2008	26.112	226.570	Surface	2012
29.376	226.418	Surface	2008	29.376	226.570	Surface	2012
32.640	226.465	Surface	2008	32.640	226.472	Surface	2012
35.904	226.329	Surface	2008	35.904	226.374	Surface	2012
39.167	226.045	Surface	2008	39.167	226.276	Surface	2012
42.432	225.795	Surface	2008	42.432	226.126	Surface	2012
45.696	225.511	Surface	2008	45.696	225.860	Surface	2012
48.959	225.349	Surface	2008	48.959	225.441	Surface	2012
52.223	225.335	Surface	2008	52.223	225.312	Surface	2012
55.487	225.319	Surface	2008	55.487	225.285	Surface	2012
58.751	225.272	Surface	2008	58.751	225.268	Surface	2012

62.015	224.933	Surface	2008	62.015	225.186	Surface	2012
65.279	224.291	Surface	2008	65.279	224.864	Surface	2012
68.543	223.543	Surface	2008	68.543	224.142	Surface	2012
71.807	222.624	Surface	2008	71.807	223.083	Surface	2012
75.071	221.326	Surface	2008	75.071	221.786	Surface	2012
78.335	219.760	Surface	2008	78.335	220.027	Surface	2012
81.599	218.384	Surface	2008	81.599	218.446	Surface	2012
84.863	217.329	Surface	2008	84.863	217.202	Surface	2012
88.127	216.723	Surface	2008	88.127	216.202	Surface	2012
91.391	216.533	Surface	2008	91.391	215.595	Surface	2012
94.655	216.537	Surface	2008	94.655	215.481	Surface	2012
97.919	216.591	Surface	2008	97.919	215.526	Surface	2012
101.183	216.689	Surface	2008	101.183	215.601	Surface	2012
104.447	216.816	Surface	2008	104.447	215.697	Surface	2012
107.711	216.950	Surface	2008	107.711	215.782	Surface	2012
110.975	217.095	Surface	2008	110.975	215.819	Surface	2012
114.239	217.216	Surface	2008	114.239	215.842	Surface	2012
117.503	217.273	Surface	2008	117.503	215.839	Surface	2012
120.767	217.318	Surface	2008	120.767	215.815	Surface	2012
124.031	217.366	Surface	2008	124.031	215.783	Surface	2012
127.295	217.382	Surface	2008	127.295	215.752	Surface	2012
130.558	217.380	Surface	2008	130.558	215.711	Surface	2012
133.823	217.347	Surface	2008	133.823	215.643	Surface	2012
137.087	217.222	Surface	2008	137.087	215.550	Surface	2012
140.350	216.984	Surface	2008	140.350	215.440	Surface	2012
143.614	216.741	Surface	2008	143.614	215.344	Surface	2012
146.878	216.505	Surface	2008	146.878	215.259	Surface	2012
150.142	216.279	Surface	2008	150.142	215.177	Surface	2012
153.406	216.069	Surface	2008	153.406	215.087	Surface	2012
156.670	215.942	Surface	2008	156.670	215.029	Surface	2012
159.934	215.841	Surface	2008	159.934	214.965	Surface	2012
163.198	215.785	Surface	2008	163.198	214.841	Surface	2012
166.462	215.747	Surface	2008	166.462	214.755	Surface	2012
169.726	215.723	Surface	2008	169.726	214.718	Surface	2012
172.990	215.672	Surface	2008	172.990	214.628	Surface	2012
176.254	215.648	Surface	2008	176.254	214.504	Surface	2012
179.518	215.576	Surface	2008	179.518	214.384	Surface	2012
182.782	215.471	Surface	2008	182.782	214.273	Surface	2012
186.046	215.278	Surface	2008	186.046	214.194	Surface	2012
189.310	215.021	Surface	2008	189.310	214.189	Surface	2012
192.574	214.952	Surface	2008	192.574	214.181	Surface	2012
195.838	214.903	Surface	2008	195.838	214.190	Surface	2012
199.102	214.866	Surface	2008	199.102	214.202	Surface	2012
202.366	214.847	Surface	2008	202.366	214.215	Surface	2012
205.630	214.852	Surface	2008	205.630	214.209	Surface	2012
208.894	214.840	Surface	2008	208.894	214.207	Surface	2012
212.158	214.773	Surface	2008	212.158	214.206	Surface	2012
215.422	214.755	Surface	2008	215.422	214.201	Surface	2012
218.686	214.811	Surface	2008	218.686	214.211	Surface	2012

221.949	214.792	Surface	2008	221.949	214.205	Surface	2012
225.214	214.708	Surface	2008	225.214	214.204	Surface	2012
228.478	214.745	Surface	2008	228.478	214.215	Surface	2012
231.741	214.734	Surface	2008	231.741	214.203	Surface	2012
235.005	214.720	Surface	2008	235.005	214.208	Surface	2012
238.270	214.746	Surface	2008	238.270	214.193	Surface	2012
241.533	214.767	Surface	2008	241.533	214.210	Surface	2012
244.797	214.747	Surface	2008	244.797	214.178	Surface	2012
248.061	214.749	Surface	2008	248.061	214.219	Surface	2012
251.325	214.738	Surface	2008	251.325	214.225	Surface	2012
254.589	214.694	Surface	2008	254.589	214.228	Surface	2012
257.853	214.659	Surface	2008	257.853	214.212	Surface	2012
261.117	214.671	Surface	2008	261.117	214.215	Surface	2012
264.381	214.705	Surface	2008	264.381	214.203	Surface	2012
267.645	214.726	Surface	2008	267.645	214.256	Surface	2012
270.909	214.714	Surface	2008	270.909	214.361	Surface	2012
274.173	214.712	Surface	2008	274.173	214.672	Surface	2012
277.437	214.928	Surface	2008	277.437	215.366	Surface	2012
280.701	215.626	Surface	2008	280.701	216.844	Surface	2012
283.965	216.533	Surface	2008	283.965	218.974	Surface	2012
287.229	218.729	Surface	2008	287.229	221.816	Surface	2012
290.493	221.550	Surface	2008	290.493	223.167	Surface	2012
293.757	223.110	Surface	2008	293.757	223.611	Surface	2012
297.021	223.735	Surface	2008	297.021	223.918	Surface	2012
300.285	224.050	Surface	2008	300.285	224.186	Surface	2012
303.549	224.287	Surface	2008	303.549	224.437	Surface	2012
306.813	224.545	Surface	2008	306.813	224.678	Surface	2012
310.077	224.744	Surface	2008	310.077	224.878	Surface	2012
313.341	224.936	Surface	2008	313.341	225.074	Surface	2012
316.605	225.098	Surface	2008	316.605	225.217	Surface	2012
319.869	225.207	Surface	2008	319.869	225.409	Surface	2012
323.132	225.401	Surface	2008	323.132	225.740	Surface	2012
326.396	225.725	Surface	2008	326.396	226.107	Surface	2012
329.661	225.928	Surface	2008	329.661	226.315	Surface	2012
332.924	225.955	Surface	2008	332.924	226.344	Surface	2012
336.188	225.925	Surface	2008	336.188	226.284	Surface	2012
339.452	225.860	Surface	2008	339.452	226.165	Surface	2012
342.716	225.787	Surface	2008	342.716	226.069	Surface	2012
345.980	225.764	Surface	2008	345.980	226.109	Surface	2012
349.244	225.794	Surface	2008	349.244	226.127	Surface	2012
352.508	225.800	Surface	2008	352.508	226.046	Surface	2012
355.772	225.827	Surface	2008	355.772	226.019	Surface	2012
359.036	225.934	Surface	2008	359.036	226.127	Surface	2012
362.300	226.056	Surface	2008	362.300	226.244	Surface	2012
365.564	226.156	Surface	2008	365.564	226.402	Surface	2012
368.828	226.267	Surface	2008	368.828	226.594	Surface	2012

10.3 Transect C – Gravel Bar – All Returns:

Distance	Z	DEM	Year	Distance	Z	DEM	Year
0.000	231.647	Surface	2006	0.000	231.190	Surface	2011
2.993	231.593	Surface	2006	2.993	231.152	Surface	2011
5.987	231.525	Surface	2006	5.987	231.121	Surface	2011
8.980	231.323	Surface	2006	8.980	231.060	Surface	2011
11.973	231.024	Surface	2006	11.973	230.775	Surface	2011
14.966	230.641	Surface	2006	14.966	230.162	Surface	2011
17.960	230.096	Surface	2006	17.960	229.548	Surface	2011
20.953	229.308	Surface	2006	20.953	228.858	Surface	2011
23.946	228.484	Surface	2006	23.946	228.003	Surface	2011
26.939	227.639	Surface	2006	26.939	227.070	Surface	2011
29.933	226.678	Surface	2006	29.933	226.095	Surface	2011
32.926	225.949	Surface	2006	32.926	225.076	Surface	2011
35.919	225.422	Surface	2006	35.919	224.102	Surface	2011
38.913	224.934	Surface	2006	38.913	223.122	Surface	2011
41.906	224.533	Surface	2006	41.906	222.130	Surface	2011
44.899	224.510	Surface	2006	44.899	221.493	Surface	2011
47.893	224.847	Surface	2006	47.893	221.284	Surface	2011
50.886	224.976	Surface	2006	50.886	221.175	Surface	2011
53.879	224.978	Surface	2006	53.879	221.066	Surface	2011
56.872	224.968	Surface	2006	56.872	220.915	Surface	2011
59.866	224.957	Surface	2006	59.866	220.538	Surface	2011
62.859	224.947	Surface	2006	62.859	219.695	Surface	2011
65.852	224.936	Surface	2006	65.852	218.848	Surface	2011
68.846	224.925	Surface	2006	68.846	218.029	Surface	2011
71.839	224.915	Surface	2006	71.839	217.188	Surface	2011
74.832	224.906	Surface	2006	74.832	216.246	Surface	2011
77.825	224.894	Surface	2006	77.825	215.346	Surface	2011
80.819	224.881	Surface	2006	80.819	214.980	Surface	2011
83.812	224.866	Surface	2006	83.812	214.929	Surface	2011
86.805	224.849	Surface	2006	86.805	214.972	Surface	2011
89.798	224.833	Surface	2006	89.798	215.063	Surface	2011
92.792	224.813	Surface	2006	92.792	215.098	Surface	2011
95.785	224.795	Surface	2006	95.785	214.928	Surface	2011
98.778	224.777	Surface	2006	98.778	214.905	Surface	2011
101.772	224.757	Surface	2006	101.772	214.899	Surface	2011
104.765	224.739	Surface	2006	104.765	214.910	Surface	2011
107.758	224.721	Surface	2006	107.758	214.917	Surface	2011
110.751	224.702	Surface	2006	110.751	214.908	Surface	2011
113.745	224.683	Surface	2006	113.745	214.902	Surface	2011
116.738	224.664	Surface	2006	116.738	214.883	Surface	2011
119.731	224.647	Surface	2006	119.731	214.867	Surface	2011
122.724	224.628	Surface	2006	122.724	214.878	Surface	2011
125.718	224.606	Surface	2006	125.718	214.869	Surface	2011
128.711	224.591	Surface	2006	128.711	214.846	Surface	2011
131.704	224.568	Surface	2006	131.704	214.834	Surface	2011

134.698	224.549	Surface	2006	134.698	214.880	Surface	2011
137.691	224.528	Surface	2006	137.691	214.930	Surface	2011
140.684	224.505	Surface	2006	140.684	214.936	Surface	2011
143.678	224.486	Surface	2006	143.678	214.966	Surface	2011
146.671	224.465	Surface	2006	146.671	215.008	Surface	2011
149.664	224.444	Surface	2006	149.664	215.108	Surface	2011
152.657	224.423	Surface	2006	152.657	215.210	Surface	2011
155.651	224.400	Surface	2006	155.651	215.288	Surface	2011
158.644	224.379	Surface	2006	158.644	215.358	Surface	2011
161.637	224.359	Surface	2006	161.637	215.422	Surface	2011
164.631	224.338	Surface	2006	164.631	215.463	Surface	2011
167.624	224.318	Surface	2006	167.624	215.470	Surface	2011
170.617	224.295	Surface	2006	170.617	215.464	Surface	2011
173.610	224.273	Surface	2006	173.610	215.479	Surface	2011
176.604	224.253	Surface	2006	176.604	215.493	Surface	2011
179.597	224.232	Surface	2006	179.597	215.521	Surface	2011
182.590	224.211	Surface	2006	182.590	215.564	Surface	2011
185.583	224.191	Surface	2006	185.583	215.608	Surface	2011
188.577	224.171	Surface	2006	188.577	215.651	Surface	2011
191.570	224.181	Surface	2006	191.570	215.693	Surface	2011
194.563	224.193	Surface	2006	194.563	215.738	Surface	2011
197.557	224.205	Surface	2006	197.557	215.812	Surface	2011
200.550	224.208	Surface	2006	200.550	215.911	Surface	2011
203.543	224.172	Surface	2006	203.543	216.047	Surface	2011
206.536	224.111	Surface	2006	206.536	216.113	Surface	2011
209.530	224.132	Surface	2006	209.530	216.121	Surface	2011
212.523	224.137	Surface	2006	212.523	216.139	Surface	2011
215.516	224.121	Surface	2006	215.516	216.122	Surface	2011
218.510	224.123	Surface	2006	218.510	216.074	Surface	2011
221.503	224.119	Surface	2006	221.503	215.958	Surface	2011
224.496	224.136	Surface	2006	224.496	215.889	Surface	2011
227.489	224.166	Surface	2006	227.489	215.913	Surface	2011
230.483	224.162	Surface	2006	230.483	216.139	Surface	2011
233.476	224.180	Surface	2006	233.476	216.464	Surface	2011
236.469	224.369	Surface	2006	236.469	216.901	Surface	2011
239.462	224.590	Surface	2006	239.462	217.300	Surface	2011
242.456	224.770	Surface	2006	242.456	217.557	Surface	2011
245.449	224.942	Surface	2006	245.449	217.772	Surface	2011
248.442	225.103	Surface	2006	248.442	218.080	Surface	2011
251.436	225.179	Surface	2006	251.436	218.531	Surface	2011
254.429	225.178	Surface	2006	254.429	218.927	Surface	2011
257.422	225.165	Surface	2006	257.422	220.170	Surface	2011
260.416	225.212	Surface	2006	260.416	222.639	Surface	2011
263.409	225.349	Surface	2006	263.409	224.315	Surface	2011
266.402	225.530	Surface	2006	266.402	225.658	Surface	2011
269.395	225.568	Surface	2006	269.395	226.243	Surface	2011
272.388	225.529	Surface	2006	272.388	226.355	Surface	2011
275.382	225.586	Surface	2006	275.382	226.336	Surface	2011
278.375	225.680	Surface	2006	278.375	226.187	Surface	2011

281.369	225.779	Surface	2006	281.369	226.141	Surface	2011
284.362	225.835	Surface	2006	284.362	226.241	Surface	2011
287.355	225.778	Surface	2006	287.355	226.360	Surface	2011
290.348	225.701	Surface	2006	290.348	226.479	Surface	2011
293.342	225.715	Surface	2006	293.342	226.580	Surface	2011
296.335	225.736	Surface	2006	296.335	226.762	Surface	2011
299.328	225.760	Surface	2006	299.328	226.861	Surface	2011
302.321	225.776	Surface	2006	302.321	226.802	Surface	2011
305.315	225.791	Surface	2006	305.315	226.724	Surface	2011
308.308	225.804	Surface	2006	308.308	226.641	Surface	2011
311.301	225.804	Surface	2006	311.301	226.579	Surface	2011
314.295	225.765	Surface	2006	314.295	226.570	Surface	2011
317.288	225.763	Surface	2006	317.288	226.646	Surface	2011
320.281	226.014	Surface	2006	320.281	226.747	Surface	2011
323.275	226.284	Surface	2006	323.275	226.854	Surface	2011
326.268	226.456	Surface	2006	326.268	226.969	Surface	2011
329.261	226.625	Surface	2006	329.261	227.085	Surface	2011
332.254	226.813	Surface	2006	332.254	227.201	Surface	2011
335.247	226.999	Surface	2006	335.247	227.317	Surface	2011
338.241	227.186	Surface	2006	338.241	227.432	Surface	2011
341.234	227.373	Surface	2006	341.234	227.547	Surface	2011
344.227	227.556	Surface	2006	344.227	227.777	Surface	2011
347.221	227.746	Surface	2006	347.221	228.147	Surface	2011
350.214	228.036	Surface	2006	350.214	228.413	Surface	2011
353.207	228.231	Surface	2006	353.207	228.491	Surface	2011
356.201	228.359	Surface	2006	356.201	228.643	Surface	2011
0.000	231.627	Surface	2008	0.000	231.250	Surface	2012
3.268	231.532	Surface	2008	3.268	231.171	Surface	2012
6.536	231.435	Surface	2008	6.536	231.313	Surface	2012
9.804	231.116	Surface	2008	9.804	231.336	Surface	2012
13.072	230.392	Surface	2008	13.072	230.750	Surface	2012
16.340	229.642	Surface	2008	16.340	230.051	Surface	2012
19.607	228.958	Surface	2008	19.607	229.333	Surface	2012
22.875	228.378	Surface	2008	22.875	228.610	Surface	2012
26.143	227.867	Surface	2008	26.143	227.895	Surface	2012
29.411	227.269	Surface	2008	29.411	227.147	Surface	2012
32.679	226.169	Surface	2008	32.679	226.289	Surface	2012
35.947	224.883	Surface	2008	35.947	225.228	Surface	2012
39.215	223.597	Surface	2008	39.215	223.878	Surface	2012
42.483	222.242	Surface	2008	42.483	222.515	Surface	2012
45.751	221.483	Surface	2008	45.751	221.647	Surface	2012
49.019	221.318	Surface	2008	49.019	221.386	Surface	2012
52.286	221.246	Surface	2008	52.286	221.287	Surface	2012
55.554	221.105	Surface	2008	55.554	221.109	Surface	2012
58.822	220.789	Surface	2008	58.822	220.946	Surface	2012
62.090	220.220	Surface	2008	62.090	220.670	Surface	2012
65.358	219.277	Surface	2008	65.358	219.881	Surface	2012
68.626	218.321	Surface	2008	68.626	218.848	Surface	2012
71.894	217.357	Surface	2008	71.894	217.596	Surface	2012

75.162	216.367	Surface	2008	75.162	216.322	Surface	2012
78.429	215.954	Surface	2008	78.429	215.450	Surface	2012
81.697	216.010	Surface	2008	81.697	215.083	Surface	2012
84.965	216.283	Surface	2008	84.965	215.010	Surface	2012
88.233	216.438	Surface	2008	88.233	215.007	Surface	2012
91.501	216.535	Surface	2008	91.501	215.012	Surface	2012
94.769	216.754	Surface	2008	94.769	215.008	Surface	2012
98.037	216.957	Surface	2008	98.037	215.001	Surface	2012
101.305	217.069	Surface	2008	101.305	215.009	Surface	2012
104.573	217.051	Surface	2008	104.573	214.992	Surface	2012
107.840	216.946	Surface	2008	107.840	215.013	Surface	2012
111.109	216.844	Surface	2008	111.109	215.003	Surface	2012
114.376	216.779	Surface	2008	114.376	214.977	Surface	2012
117.644	216.728	Surface	2008	117.644	214.985	Surface	2012
120.912	216.744	Surface	2008	120.912	214.995	Surface	2012
124.180	216.796	Surface	2008	124.180	214.983	Surface	2012
127.448	216.724	Surface	2008	127.448	214.985	Surface	2012
130.716	216.673	Surface	2008	130.716	214.990	Surface	2012
133.984	216.658	Surface	2008	133.984	214.990	Surface	2012
137.252	216.602	Surface	2008	137.252	214.999	Surface	2012
140.519	216.577	Surface	2008	140.519	214.979	Surface	2012
143.787	216.597	Surface	2008	143.787	214.971	Surface	2012
147.055	216.613	Surface	2008	147.055	214.977	Surface	2012
150.323	216.613	Surface	2008	150.323	214.988	Surface	2012
153.591	216.582	Surface	2008	153.591	214.993	Surface	2012
156.859	216.486	Surface	2008	156.859	215.026	Surface	2012
160.127	216.358	Surface	2008	160.127	215.144	Surface	2012
163.395	216.272	Surface	2008	163.395	215.201	Surface	2012
166.663	216.182	Surface	2008	166.663	215.278	Surface	2012
169.930	216.088	Surface	2008	169.930	215.320	Surface	2012
173.198	215.971	Surface	2008	173.198	215.436	Surface	2012
176.466	215.839	Surface	2008	176.466	215.528	Surface	2012
179.734	215.836	Surface	2008	179.734	215.519	Surface	2012
183.002	215.823	Surface	2008	183.002	215.558	Surface	2012
186.270	215.819	Surface	2008	186.270	215.667	Surface	2012
189.538	215.816	Surface	2008	189.538	215.760	Surface	2012
192.806	215.803	Surface	2008	192.806	215.881	Surface	2012
196.074	215.769	Surface	2008	196.074	216.093	Surface	2012
199.341	215.752	Surface	2008	199.341	216.279	Surface	2012
202.609	215.796	Surface	2008	202.609	216.352	Surface	2012
205.877	215.813	Surface	2008	205.877	216.436	Surface	2012
209.145	215.832	Surface	2008	209.145	216.502	Surface	2012
212.413	215.825	Surface	2008	212.413	216.527	Surface	2012
215.681	215.793	Surface	2008	215.681	216.550	Surface	2012
218.949	215.737	Surface	2008	218.949	216.501	Surface	2012
222.217	215.720	Surface	2008	222.217	216.332	Surface	2012
225.485	215.887	Surface	2008	225.485	216.167	Surface	2012
228.753	216.251	Surface	2008	228.753	216.014	Surface	2012
232.020	216.819	Surface	2008	232.020	216.122	Surface	2012

235.288	217.506	Surface	2008	235.288	216.807	Surface	2012
238.556	218.213	Surface	2008	238.556	217.279	Surface	2012
241.824	218.924	Surface	2008	241.824	217.522	Surface	2012
245.092	219.595	Surface	2008	245.092	217.716	Surface	2012
248.360	220.300	Surface	2008	248.360	217.993	Surface	2012
251.628	220.996	Surface	2008	251.628	218.439	Surface	2012
254.896	221.659	Surface	2008	254.896	219.017	Surface	2012
258.164	222.353	Surface	2008	258.164	219.753	Surface	2012
261.432	223.039	Surface	2008	261.432	220.621	Surface	2012
264.700	223.768	Surface	2008	264.700	221.649	Surface	2012
267.967	224.489	Surface	2008	267.967	222.920	Surface	2012
271.235	224.814	Surface	2008	271.235	224.231	Surface	2012
274.503	224.956	Surface	2008	274.503	225.282	Surface	2012
277.771	225.042	Surface	2008	277.771	225.683	Surface	2012
281.039	225.148	Surface	2008	281.039	225.737	Surface	2012
284.307	225.292	Surface	2008	284.307	225.801	Surface	2012
287.575	225.538	Surface	2008	287.575	225.933	Surface	2012
290.843	225.792	Surface	2008	290.843	226.178	Surface	2012
294.111	225.898	Surface	2008	294.111	226.232	Surface	2012
297.378	225.982	Surface	2008	297.378	226.209	Surface	2012
300.646	226.081	Surface	2008	300.646	226.117	Surface	2012
303.914	226.181	Surface	2008	303.914	225.990	Surface	2012
307.182	226.274	Surface	2008	307.182	225.912	Surface	2012
310.450	226.352	Surface	2008	310.450	225.863	Surface	2012
313.718	226.414	Surface	2008	313.718	225.820	Surface	2012
316.986	226.457	Surface	2008	316.986	225.787	Surface	2012
320.254	226.485	Surface	2008	320.254	225.846	Surface	2012
323.522	226.515	Surface	2008	323.522	226.004	Surface	2012
326.789	226.588	Surface	2008	326.789	226.204	Surface	2012
330.057	226.661	Surface	2008	330.057	226.399	Surface	2012
333.325	226.726	Surface	2008	333.325	226.587	Surface	2012
336.593	226.868	Surface	2008	336.593	226.719	Surface	2012
339.861	227.122	Surface	2008	339.861	226.801	Surface	2012
343.129	227.408	Surface	2008	343.129	226.984	Surface	2012
346.397	227.716	Surface	2008	346.397	227.387	Surface	2012
349.665	228.076	Surface	2008	349.665	227.819	Surface	2012
352.933	228.457	Surface	2008	352.933	228.169	Surface	2012
356.201	228.713	Surface	2008	356.201	228.535	Surface	2012

10.4 Transect D – Lahar Dike – All Returns:

Distance	Z	DEM	Year	Distance	Z	DEM	Year
0.000	231.131	Surface	2006	0.000	231.034	Surface	2011
2.994	231.140	Surface	2006	2.994	231.007	Surface	2011
5.988	231.111	Surface	2006	5.988	230.992	Surface	2011
8.982	231.047	Surface	2006	8.982	230.992	Surface	2011
11.976	230.962	Surface	2006	11.976	230.954	Surface	2011
14.970	230.847	Surface	2006	14.970	230.902	Surface	2011
17.964	230.721	Surface	2006	17.964	230.795	Surface	2011
20.958	230.253	Surface	2006	20.958	230.431	Surface	2011
23.952	229.620	Surface	2006	23.952	229.937	Surface	2011
26.945	228.936	Surface	2006	26.945	229.398	Surface	2011
29.940	228.316	Surface	2006	29.940	228.455	Surface	2011
32.933	227.718	Surface	2006	32.933	226.979	Surface	2011
35.927	227.119	Surface	2006	35.927	225.343	Surface	2011
38.921	226.566	Surface	2006	38.921	223.699	Surface	2011
41.915	226.121	Surface	2006	41.915	222.046	Surface	2011
44.909	226.081	Surface	2006	44.909	220.398	Surface	2011
47.903	226.125	Surface	2006	47.903	219.136	Surface	2011
50.897	226.176	Surface	2006	50.897	218.651	Surface	2011
53.891	226.296	Surface	2006	53.891	218.468	Surface	2011
56.885	226.557	Surface	2006	56.885	218.252	Surface	2011
59.879	226.809	Surface	2006	59.879	217.998	Surface	2011
62.873	226.814	Surface	2006	62.873	217.666	Surface	2011
65.867	226.787	Surface	2006	65.867	217.121	Surface	2011
68.861	226.812	Surface	2006	68.861	216.808	Surface	2011
71.855	226.789	Surface	2006	71.855	216.711	Surface	2011
74.849	226.739	Surface	2006	74.849	216.667	Surface	2011
77.843	226.710	Surface	2006	77.843	216.648	Surface	2011
80.836	226.747	Surface	2006	80.836	216.647	Surface	2011
83.831	226.799	Surface	2006	83.831	216.639	Surface	2011
86.824	226.855	Surface	2006	86.824	216.633	Surface	2011
89.818	226.910	Surface	2006	89.818	216.633	Surface	2011
92.812	226.900	Surface	2006	92.812	216.647	Surface	2011
95.806	226.876	Surface	2006	95.806	216.657	Surface	2011
98.800	226.866	Surface	2006	98.800	216.667	Surface	2011
101.794	226.800	Surface	2006	101.794	216.656	Surface	2011
104.788	226.755	Surface	2006	104.788	216.648	Surface	2011
107.782	226.707	Surface	2006	107.782	216.604	Surface	2011
110.776	226.691	Surface	2006	110.776	216.557	Surface	2011
113.770	226.649	Surface	2006	113.770	216.570	Surface	2011
116.764	226.581	Surface	2006	116.764	216.511	Surface	2011
119.758	226.489	Surface	2006	119.758	216.510	Surface	2011
122.752	226.271	Surface	2006	122.752	216.600	Surface	2011
125.746	226.045	Surface	2006	125.746	216.701	Surface	2011
128.740	225.851	Surface	2006	128.740	216.765	Surface	2011
131.734	225.650	Surface	2006	131.734	216.836	Surface	2011

134.727	225.508	Surface	2006	134.727	217.072	Surface	2011
137.721	225.430	Surface	2006	137.721	217.292	Surface	2011
140.715	225.392	Surface	2006	140.715	217.374	Surface	2011
143.709	225.362	Surface	2006	143.709	217.427	Surface	2011
146.703	225.403	Surface	2006	146.703	217.485	Surface	2011
149.697	225.424	Surface	2006	149.697	217.569	Surface	2011
152.691	225.453	Surface	2006	152.691	217.648	Surface	2011
155.685	225.492	Surface	2006	155.685	217.734	Surface	2011
158.679	225.508	Surface	2006	158.679	217.829	Surface	2011
161.673	225.516	Surface	2006	161.673	217.909	Surface	2011
164.667	225.460	Surface	2006	164.667	217.947	Surface	2011
167.661	225.392	Surface	2006	167.661	217.928	Surface	2011
170.655	225.341	Surface	2006	170.655	217.951	Surface	2011
173.649	225.287	Surface	2006	173.649	217.990	Surface	2011
176.643	225.208	Surface	2006	176.643	217.996	Surface	2011
179.637	225.102	Surface	2006	179.637	217.989	Surface	2011
182.630	225.008	Surface	2006	182.630	217.969	Surface	2011
185.625	224.912	Surface	2006	185.625	217.981	Surface	2011
188.618	224.894	Surface	2006	188.618	218.017	Surface	2011
191.612	224.895	Surface	2006	191.612	218.037	Surface	2011
194.607	224.878	Surface	2006	194.607	218.042	Surface	2011
197.600	224.861	Surface	2006	197.600	218.054	Surface	2011
200.594	224.867	Surface	2006	200.594	218.072	Surface	2011
203.588	224.884	Surface	2006	203.588	218.080	Surface	2011
206.582	224.906	Surface	2006	206.582	218.069	Surface	2011
209.576	224.928	Surface	2006	209.576	218.062	Surface	2011
212.570	224.954	Surface	2006	212.570	218.073	Surface	2011
215.564	224.970	Surface	2006	215.564	218.077	Surface	2011
218.558	224.952	Surface	2006	218.558	218.075	Surface	2011
221.552	224.924	Surface	2006	221.552	218.072	Surface	2011
224.546	224.897	Surface	2006	224.546	218.067	Surface	2011
227.540	224.895	Surface	2006	227.540	218.078	Surface	2011
230.534	224.899	Surface	2006	230.534	218.099	Surface	2011
233.528	224.919	Surface	2006	233.528	218.104	Surface	2011
236.521	224.937	Surface	2006	236.521	218.090	Surface	2011
239.516	224.938	Surface	2006	239.516	218.087	Surface	2011
242.510	224.946	Surface	2006	242.510	218.105	Surface	2011
245.503	224.930	Surface	2006	245.503	218.136	Surface	2011
248.497	224.907	Surface	2006	248.497	218.157	Surface	2011
251.491	224.905	Surface	2006	251.491	218.190	Surface	2011
254.485	224.907	Surface	2006	254.485	218.223	Surface	2011
257.479	224.909	Surface	2006	257.479	218.236	Surface	2011
260.473	224.910	Surface	2006	260.473	218.258	Surface	2011
263.467	224.887	Surface	2006	263.467	218.273	Surface	2011
266.461	224.860	Surface	2006	266.461	218.242	Surface	2011
269.455	224.861	Surface	2006	269.455	218.175	Surface	2011
272.449	224.860	Surface	2006	272.449	218.137	Surface	2011
275.443	224.834	Surface	2006	275.443	218.132	Surface	2011
278.437	224.800	Surface	2006	278.437	218.110	Surface	2011

281.431	224.771	Surface	2006	281.431	218.136	Surface	2011
284.425	224.770	Surface	2006	284.425	218.234	Surface	2011
287.419	224.769	Surface	2006	287.419	218.348	Surface	2011
290.413	224.727	Surface	2006	290.413	218.774	Surface	2011
293.406	224.699	Surface	2006	293.406	219.687	Surface	2011
296.401	224.681	Surface	2006	296.401	220.809	Surface	2011
299.394	224.670	Surface	2006	299.394	222.125	Surface	2011
302.388	224.671	Surface	2006	302.388	223.461	Surface	2011
305.382	224.662	Surface	2006	305.382	224.152	Surface	2011
308.376	224.643	Surface	2006	308.376	224.277	Surface	2011
311.370	224.651	Surface	2006	311.370	224.342	Surface	2011
314.364	224.735	Surface	2006	314.364	224.424	Surface	2011
317.358	224.914	Surface	2006	317.358	224.601	Surface	2011
320.352	225.072	Surface	2006	320.352	224.768	Surface	2011
323.346	225.146	Surface	2006	323.346	224.752	Surface	2011
326.340	225.220	Surface	2006	326.340	224.666	Surface	2011
329.334	225.285	Surface	2006	329.334	224.546	Surface	2011
332.328	225.353	Surface	2006	332.328	224.285	Surface	2011
335.322	225.417	Surface	2006	335.322	223.900	Surface	2011
338.316	225.503	Surface	2006	338.316	223.510	Surface	2011
341.310	225.587	Surface	2006	341.310	223.182	Surface	2011
344.304	225.640	Surface	2006	344.304	222.908	Surface	2011
347.297	225.675	Surface	2006	347.297	222.700	Surface	2011
350.292	225.653	Surface	2006	350.292	222.589	Surface	2011
353.285	225.531	Surface	2006	353.285	222.506	Surface	2011
356.279	225.348	Surface	2006	356.279	222.454	Surface	2011
359.273	225.139	Surface	2006	359.273	222.489	Surface	2011
362.267	224.969	Surface	2006	362.267	222.547	Surface	2011
365.261	224.834	Surface	2006	365.261	222.533	Surface	2011
368.255	224.745	Surface	2006	368.255	222.562	Surface	2011
371.249	224.715	Surface	2006	371.249	222.719	Surface	2011
374.243	224.673	Surface	2006	374.243	222.873	Surface	2011
377.237	224.626	Surface	2006	377.237	222.983	Surface	2011
380.231	224.566	Surface	2006	380.231	223.005	Surface	2011
383.225	224.546	Surface	2006	383.225	222.976	Surface	2011
386.219	224.561	Surface	2006	386.219	222.995	Surface	2011
389.213	224.578	Surface	2006	389.213	223.037	Surface	2011
392.207	224.595	Surface	2006	392.207	223.093	Surface	2011
395.201	224.607	Surface	2006	395.201	223.163	Surface	2011
398.195	224.582	Surface	2006	398.195	223.206	Surface	2011
401.188	224.636	Surface	2006	401.188	223.207	Surface	2011
404.183	224.754	Surface	2006	404.183	223.181	Surface	2011
407.177	224.841	Surface	2006	407.177	223.192	Surface	2011
410.170	224.909	Surface	2006	410.170	223.256	Surface	2011
413.164	224.980	Surface	2006	413.164	223.353	Surface	2011
416.158	225.043	Surface	2006	416.158	223.475	Surface	2011
419.152	225.094	Surface	2006	419.152	223.475	Surface	2011
422.146	225.174	Surface	2006	422.146	223.336	Surface	2011
425.140	225.237	Surface	2006	425.140	223.218	Surface	2011

428.134	225.260	Surface	2006	428.134	223.266	Surface	2011
431.128	225.248	Surface	2006	431.128	223.409	Surface	2011
434.122	225.203	Surface	2006	434.122	223.663	Surface	2011
437.116	225.117	Surface	2006	437.116	224.059	Surface	2011
440.110	225.006	Surface	2006	440.110	224.392	Surface	2011
443.104	224.887	Surface	2006	443.104	224.635	Surface	2011
446.098	224.909	Surface	2006	446.098	224.944	Surface	2011
449.092	225.132	Surface	2006	449.092	225.223	Surface	2011
452.086	225.517	Surface	2006	452.086	225.485	Surface	2011
455.080	226.049	Surface	2006	455.080	225.773	Surface	2011
458.073	226.647	Surface	2006	458.073	226.089	Surface	2011
461.068	226.973	Surface	2006	461.068	226.376	Surface	2011
464.061	227.062	Surface	2006	464.061	226.627	Surface	2011
467.055	227.138	Surface	2006	467.055	226.878	Surface	2011
470.049	227.273	Surface	2006	470.049	227.128	Surface	2011
473.043	227.467	Surface	2006	473.043	227.334	Surface	2011
476.037	227.722	Surface	2006	476.037	227.437	Surface	2011
479.031	228.076	Surface	2006	479.031	227.488	Surface	2011
482.025	228.481	Surface	2006	482.025	227.599	Surface	2011
485.019	228.904	Surface	2006	485.019	228.044	Surface	2011
488.013	229.657	Surface	2006	488.013	228.898	Surface	2011
491.007	230.702	Surface	2006	491.007	229.793	Surface	2011
494.001	231.759	Surface	2006	494.001	230.765	Surface	2011
496.995	232.754	Surface	2006	496.995	231.760	Surface	2011
499.989	233.675	Surface	2006	499.989	232.546	Surface	2011
502.983	234.569	Surface	2006	502.983	233.160	Surface	2011
505.977	235.454	Surface	2006	505.977	233.791	Surface	2011
508.971	236.124	Surface	2006	508.971	234.446	Surface	2011
511.964	236.359	Surface	2006	511.964	235.125	Surface	2011
514.959	236.344	Surface	2006	514.959	235.806	Surface	2011
517.952	236.311	Surface	2006	517.952	236.266	Surface	2011
520.946	236.284	Surface	2006	520.946	236.270	Surface	2011
0.000	230.949	Surface	2008	0.000	231.074	Surface	2012
3.276	230.932	Surface	2008	3.276	231.076	Surface	2012
6.553	230.918	Surface	2008	6.553	231.129	Surface	2012
9.829	230.938	Surface	2008	9.829	231.187	Surface	2012
13.106	230.948	Surface	2008	13.106	231.075	Surface	2012
16.382	230.832	Surface	2008	16.382	230.745	Surface	2012
19.658	230.557	Surface	2008	19.658	230.448	Surface	2012
22.935	230.059	Surface	2008	22.935	230.210	Surface	2012
26.211	229.383	Surface	2008	26.211	229.642	Surface	2012
29.488	228.491	Surface	2008	29.488	228.627	Surface	2012
32.764	227.207	Surface	2008	32.764	227.478	Surface	2012
36.040	225.714	Surface	2008	36.040	225.958	Surface	2012
39.317	224.097	Surface	2008	39.317	224.176	Surface	2012
42.593	222.377	Surface	2008	42.593	221.743	Surface	2012
45.870	221.291	Surface	2008	45.870	219.556	Surface	2012
49.146	220.894	Surface	2008	49.146	218.729	Surface	2012
52.422	220.633	Surface	2008	52.422	218.572	Surface	2012

55.699	220.459	Surface	2008	55.699	218.429	Surface	2012
58.975	220.389	Surface	2008	58.975	218.148	Surface	2012
62.251	220.334	Surface	2008	62.251	217.711	Surface	2012
65.528	220.328	Surface	2008	65.528	217.246	Surface	2012
68.804	220.322	Surface	2008	68.804	217.013	Surface	2012
72.081	220.324	Surface	2008	72.081	216.971	Surface	2012
75.357	220.388	Surface	2008	75.357	216.997	Surface	2012
78.634	220.463	Surface	2008	78.634	217.025	Surface	2012
81.910	220.501	Surface	2008	81.910	217.050	Surface	2012
85.186	220.518	Surface	2008	85.186	217.081	Surface	2012
88.463	220.527	Surface	2008	88.463	217.145	Surface	2012
91.739	220.533	Surface	2008	91.739	217.265	Surface	2012
95.015	220.524	Surface	2008	95.015	217.337	Surface	2012
98.292	220.528	Surface	2008	98.292	217.355	Surface	2012
101.568	220.512	Surface	2008	101.568	217.293	Surface	2012
104.845	220.484	Surface	2008	104.845	217.258	Surface	2012
108.121	220.459	Surface	2008	108.121	217.322	Surface	2012
111.397	220.352	Surface	2008	111.397	217.350	Surface	2012
114.674	220.083	Surface	2008	114.674	217.364	Surface	2012
117.950	219.647	Surface	2008	117.950	217.428	Surface	2012
121.226	219.247	Surface	2008	121.226	217.493	Surface	2012
124.503	218.975	Surface	2008	124.503	217.534	Surface	2012
127.779	218.763	Surface	2008	127.779	217.541	Surface	2012
131.056	218.560	Surface	2008	131.056	217.545	Surface	2012
134.332	218.395	Surface	2008	134.332	217.591	Surface	2012
137.609	218.322	Surface	2008	137.609	217.660	Surface	2012
140.885	218.313	Surface	2008	140.885	217.738	Surface	2012
144.161	218.315	Surface	2008	144.161	217.767	Surface	2012
147.437	218.298	Surface	2008	147.437	217.766	Surface	2012
150.714	218.274	Surface	2008	150.714	217.809	Surface	2012
153.990	218.250	Surface	2008	153.990	217.867	Surface	2012
157.267	218.228	Surface	2008	157.267	217.898	Surface	2012
160.543	218.221	Surface	2008	160.543	217.902	Surface	2012
163.820	218.227	Surface	2008	163.820	217.900	Surface	2012
167.096	218.221	Surface	2008	167.096	217.904	Surface	2012
170.372	218.206	Surface	2008	170.372	217.918	Surface	2012
173.649	218.203	Surface	2008	173.649	217.940	Surface	2012
176.925	218.238	Surface	2008	176.925	217.950	Surface	2012
180.201	218.287	Surface	2008	180.201	217.955	Surface	2012
183.478	218.308	Surface	2008	183.478	217.963	Surface	2012
186.754	218.280	Surface	2008	186.754	217.962	Surface	2012
190.031	218.269	Surface	2008	190.031	217.954	Surface	2012
193.307	218.274	Surface	2008	193.307	217.934	Surface	2012
196.584	218.283	Surface	2008	196.584	217.929	Surface	2012
199.860	218.304	Surface	2008	199.860	217.932	Surface	2012
203.136	218.284	Surface	2008	203.136	217.923	Surface	2012
206.413	218.284	Surface	2008	206.413	217.920	Surface	2012
209.689	218.313	Surface	2008	209.689	217.918	Surface	2012
212.965	218.325	Surface	2008	212.965	217.937	Surface	2012

216.242	218.332	Surface	2008	216.242	217.960	Surface	2012
219.518	218.353	Surface	2008	219.518	217.965	Surface	2012
222.795	218.360	Surface	2008	222.795	217.954	Surface	2012
226.071	218.304	Surface	2008	226.071	218.002	Surface	2012
229.347	218.327	Surface	2008	229.347	218.103	Surface	2012
232.624	218.441	Surface	2008	232.624	218.177	Surface	2012
235.900	218.508	Surface	2008	235.900	218.201	Surface	2012
239.177	218.553	Surface	2008	239.177	218.195	Surface	2012
242.453	218.603	Surface	2008	242.453	218.244	Surface	2012
245.729	218.672	Surface	2008	245.729	218.306	Surface	2012
249.006	218.716	Surface	2008	249.006	218.357	Surface	2012
252.282	218.720	Surface	2008	252.282	218.435	Surface	2012
255.559	218.785	Surface	2008	255.559	218.514	Surface	2012
258.835	218.919	Surface	2008	258.835	218.601	Surface	2012
262.111	219.058	Surface	2008	262.111	218.682	Surface	2012
265.388	219.188	Surface	2008	265.388	218.700	Surface	2012
268.664	219.312	Surface	2008	268.664	218.587	Surface	2012
271.941	219.416	Surface	2008	271.941	218.360	Surface	2012
275.217	219.508	Surface	2008	275.217	218.117	Surface	2012
278.493	219.578	Surface	2008	278.493	218.007	Surface	2012
281.770	219.549	Surface	2008	281.770	218.006	Surface	2012
285.046	219.426	Surface	2008	285.046	218.028	Surface	2012
288.322	219.289	Surface	2008	288.322	218.263	Surface	2012
291.599	219.633	Surface	2008	291.599	219.187	Surface	2012
294.875	220.809	Surface	2008	294.875	220.485	Surface	2012
298.152	222.318	Surface	2008	298.152	222.183	Surface	2012
301.428	223.663	Surface	2008	301.428	223.836	Surface	2012
304.705	224.296	Surface	2008	304.705	224.308	Surface	2012
307.981	224.275	Surface	2008	307.981	224.320	Surface	2012
311.257	224.364	Surface	2008	311.257	224.395	Surface	2012
314.534	224.507	Surface	2008	314.534	224.545	Surface	2012
317.810	224.745	Surface	2008	317.810	224.783	Surface	2012
321.086	225.042	Surface	2008	321.086	225.057	Surface	2012
324.363	225.157	Surface	2008	324.363	225.067	Surface	2012
327.639	225.233	Surface	2008	327.639	224.743	Surface	2012
330.916	225.351	Surface	2008	330.916	224.317	Surface	2012
334.192	225.287	Surface	2008	334.192	223.895	Surface	2012
337.469	224.872	Surface	2008	337.469	223.480	Surface	2012
340.745	224.425	Surface	2008	340.745	223.151	Surface	2012
344.021	224.102	Surface	2008	344.021	222.814	Surface	2012
347.297	223.791	Surface	2008	347.297	222.579	Surface	2012
350.574	223.512	Surface	2008	350.574	222.582	Surface	2012
353.850	223.240	Surface	2008	353.850	222.598	Surface	2012
357.127	222.982	Surface	2008	357.127	222.557	Surface	2012
360.403	222.806	Surface	2008	360.403	222.611	Surface	2012
363.680	222.733	Surface	2008	363.680	222.620	Surface	2012
366.956	222.808	Surface	2008	366.956	222.522	Surface	2012
370.232	222.996	Surface	2008	370.232	222.573	Surface	2012
373.509	223.236	Surface	2008	373.509	222.804	Surface	2012

376.785	223.495	Surface	2008	376.785	222.966	Surface	2012
380.061	223.809	Surface	2008	380.061	223.111	Surface	2012
383.338	224.202	Surface	2008	383.338	223.277	Surface	2012
386.614	224.411	Surface	2008	386.614	223.382	Surface	2012
389.891	224.416	Surface	2008	389.891	223.258	Surface	2012
393.167	224.436	Surface	2008	393.167	223.178	Surface	2012
396.444	224.486	Surface	2008	396.444	223.197	Surface	2012
399.720	224.564	Surface	2008	399.720	223.177	Surface	2012
402.996	224.671	Surface	2008	402.996	223.178	Surface	2012
406.273	224.767	Surface	2008	406.273	223.168	Surface	2012
409.549	224.858	Surface	2008	409.549	223.158	Surface	2012
412.825	224.947	Surface	2008	412.825	223.303	Surface	2012
416.102	225.019	Surface	2008	416.102	223.399	Surface	2012
419.378	225.083	Surface	2008	419.378	223.315	Surface	2012
422.655	225.153	Surface	2008	422.655	223.221	Surface	2012
425.931	225.241	Surface	2008	425.931	223.212	Surface	2012
429.207	225.292	Surface	2008	429.207	223.218	Surface	2012
432.484	225.255	Surface	2008	432.484	223.465	Surface	2012
435.760	225.164	Surface	2008	435.760	223.892	Surface	2012
439.037	225.064	Surface	2008	439.037	224.316	Surface	2012
442.313	224.963	Surface	2008	442.313	224.710	Surface	2012
445.589	224.907	Surface	2008	445.589	224.962	Surface	2012
448.866	225.042	Surface	2008	448.866	225.152	Surface	2012
452.142	225.386	Surface	2008	452.142	225.491	Surface	2012
455.418	225.816	Surface	2008	455.418	225.897	Surface	2012
458.695	226.269	Surface	2008	458.695	226.363	Surface	2012
461.971	226.696	Surface	2008	461.971	226.899	Surface	2012
465.248	227.143	Surface	2008	465.248	227.305	Surface	2012
468.524	227.471	Surface	2008	468.524	227.512	Surface	2012
471.801	227.570	Surface	2008	471.801	227.566	Surface	2012
475.077	227.561	Surface	2008	475.077	227.565	Surface	2012
478.353	227.598	Surface	2008	478.353	227.596	Surface	2012
481.630	228.116	Surface	2008	481.630	227.833	Surface	2012
484.906	229.226	Surface	2008	484.906	228.377	Surface	2012
488.182	230.334	Surface	2008	488.182	229.197	Surface	2012
491.459	231.438	Surface	2008	491.459	230.172	Surface	2012
494.735	232.553	Surface	2008	494.735	231.328	Surface	2012
498.012	233.745	Surface	2008	498.012	232.823	Surface	2012
501.288	234.855	Surface	2008	501.288	234.394	Surface	2012
504.565	235.489	Surface	2008	504.565	235.562	Surface	2012
507.841	235.804	Surface	2008	507.841	236.127	Surface	2012
511.117	236.034	Surface	2008	511.117	236.431	Surface	2012
514.393	236.146	Surface	2008	514.393	236.454	Surface	2012
517.670	236.258	Surface	2008	517.670	236.430	Surface	2012
520.946	236.234	Surface	2008	520.946	236.359	Surface	2012

10.5 Transect E – End of Rapids/Pool Bank – All Returns:

Distance	Z	DEM	Year	Distance	Z	DEM	Year
0.000	231.918	Surface	2006	0.000	232.047	Surface	2011
2.989	231.636	Surface	2006	2.989	232.039	Surface	2011
5.979	231.335	Surface	2006	5.979	232.022	Surface	2011
8.968	231.015	Surface	2006	8.968	231.966	Surface	2011
11.957	230.714	Surface	2006	11.957	231.846	Surface	2011
14.946	230.413	Surface	2006	14.946	231.728	Surface	2011
17.936	230.114	Surface	2006	17.936	231.543	Surface	2011
20.925	229.804	Surface	2006	20.925	231.014	Surface	2011
23.915	229.443	Surface	2006	23.915	230.394	Surface	2011
26.904	229.073	Surface	2006	26.904	229.798	Surface	2011
29.893	228.752	Surface	2006	29.893	229.193	Surface	2011
32.882	228.474	Surface	2006	32.882	228.583	Surface	2011
35.872	228.205	Surface	2006	35.872	227.974	Surface	2011
38.861	227.904	Surface	2006	38.861	227.659	Surface	2011
41.850	227.559	Surface	2006	41.850	227.504	Surface	2011
44.839	227.327	Surface	2006	44.839	227.364	Surface	2011
47.829	227.283	Surface	2006	47.829	227.277	Surface	2011
50.818	227.187	Surface	2006	50.818	227.245	Surface	2011
53.807	227.058	Surface	2006	53.807	227.212	Surface	2011
56.797	226.924	Surface	2006	56.797	227.144	Surface	2011
59.786	226.791	Surface	2006	59.786	227.048	Surface	2011
62.775	226.663	Surface	2006	62.775	226.911	Surface	2011
65.765	226.637	Surface	2006	65.765	226.728	Surface	2011
68.754	226.675	Surface	2006	68.754	226.594	Surface	2011
71.743	226.717	Surface	2006	71.743	226.670	Surface	2011
74.733	226.738	Surface	2006	74.733	226.775	Surface	2011
77.722	226.753	Surface	2006	77.722	226.778	Surface	2011
80.711	226.701	Surface	2006	80.711	226.748	Surface	2011
83.700	226.692	Surface	2006	83.700	226.715	Surface	2011
86.690	226.745	Surface	2006	86.690	226.732	Surface	2011
89.679	226.825	Surface	2006	89.679	226.788	Surface	2011
92.668	226.906	Surface	2006	92.668	226.840	Surface	2011
95.658	226.933	Surface	2006	95.658	226.879	Surface	2011
98.647	226.893	Surface	2006	98.647	226.888	Surface	2011
101.636	226.844	Surface	2006	101.636	226.884	Surface	2011
104.626	226.824	Surface	2006	104.626	226.896	Surface	2011
107.615	226.854	Surface	2006	107.615	226.921	Surface	2011
110.604	226.894	Surface	2006	110.604	226.946	Surface	2011
113.594	226.891	Surface	2006	113.594	226.856	Surface	2011
116.583	226.854	Surface	2006	116.583	226.632	Surface	2011
119.572	226.819	Surface	2006	119.572	226.364	Surface	2011
122.561	226.830	Surface	2006	122.561	226.021	Surface	2011
125.551	226.861	Surface	2006	125.551	225.596	Surface	2011
128.540	226.860	Surface	2006	128.540	225.099	Surface	2011
131.529	226.848	Surface	2006	131.529	224.564	Surface	2011

134.518	226.853	Surface	2006	134.518	224.030	Surface	2011
137.508	226.868	Surface	2006	137.508	223.580	Surface	2011
140.497	226.843	Surface	2006	140.497	223.118	Surface	2011
143.486	226.629	Surface	2006	143.486	222.553	Surface	2011
146.476	226.309	Surface	2006	146.476	222.147	Surface	2011
149.465	225.966	Surface	2006	149.465	222.001	Surface	2011
152.454	225.597	Surface	2006	152.454	221.987	Surface	2011
155.444	225.268	Surface	2006	155.444	222.021	Surface	2011
158.433	225.107	Surface	2006	158.433	222.133	Surface	2011
161.422	225.067	Surface	2006	161.422	222.299	Surface	2011
164.412	225.037	Surface	2006	164.412	222.386	Surface	2011
167.401	224.994	Surface	2006	167.401	222.356	Surface	2011
170.390	224.986	Surface	2006	170.390	222.198	Surface	2011
173.379	225.027	Surface	2006	173.379	221.931	Surface	2011
176.369	225.087	Surface	2006	176.369	221.606	Surface	2011
179.358	225.116	Surface	2006	179.358	221.232	Surface	2011
182.347	225.124	Surface	2006	182.347	220.934	Surface	2011
185.337	225.132	Surface	2006	185.337	220.640	Surface	2011
188.326	225.140	Surface	2006	188.326	220.294	Surface	2011
191.315	225.147	Surface	2006	191.315	219.939	Surface	2011
194.305	225.154	Surface	2006	194.305	219.597	Surface	2011
197.294	225.145	Surface	2006	197.294	219.366	Surface	2011
200.283	225.114	Surface	2006	200.283	219.308	Surface	2011
203.273	225.092	Surface	2006	203.273	219.309	Surface	2011
206.262	225.089	Surface	2006	206.262	219.321	Surface	2011
209.251	225.107	Surface	2006	209.251	219.302	Surface	2011
212.240	225.110	Surface	2006	212.240	219.222	Surface	2011
215.230	225.089	Surface	2006	215.230	219.107	Surface	2011
218.219	225.083	Surface	2006	218.219	219.011	Surface	2011
221.208	225.118	Surface	2006	221.208	218.922	Surface	2011
224.197	225.109	Surface	2006	224.197	218.888	Surface	2011
227.187	225.048	Surface	2006	227.187	218.852	Surface	2011
230.176	225.047	Surface	2006	230.176	218.790	Surface	2011
233.166	225.057	Surface	2006	233.166	218.750	Surface	2011
236.155	225.020	Surface	2006	236.155	218.703	Surface	2011
239.144	225.011	Surface	2006	239.144	218.658	Surface	2011
242.133	225.052	Surface	2006	242.133	218.614	Surface	2011
245.123	225.104	Surface	2006	245.123	218.559	Surface	2011
248.112	225.128	Surface	2006	248.112	218.495	Surface	2011
251.101	225.132	Surface	2006	251.101	218.410	Surface	2011
254.091	225.127	Surface	2006	254.091	218.336	Surface	2011
257.080	225.110	Surface	2006	257.080	218.352	Surface	2011
260.069	225.083	Surface	2006	260.069	218.508	Surface	2011
263.058	225.038	Surface	2006	263.058	218.692	Surface	2011
266.048	225.011	Surface	2006	266.048	218.921	Surface	2011
269.037	225.007	Surface	2006	269.037	219.227	Surface	2011
272.027	225.009	Surface	2006	272.027	219.568	Surface	2011
275.016	225.001	Surface	2006	275.016	219.863	Surface	2011
278.005	224.974	Surface	2006	278.005	220.075	Surface	2011

280.994	224.956	Surface	2006	280.994	220.191	Surface	2011
283.984	224.965	Surface	2006	283.984	220.310	Surface	2011
286.973	224.981	Surface	2006	286.973	220.404	Surface	2011
289.962	225.029	Surface	2006	289.962	220.438	Surface	2011
292.952	225.121	Surface	2006	292.952	220.456	Surface	2011
295.941	225.227	Surface	2006	295.941	220.516	Surface	2011
298.930	225.323	Surface	2006	298.930	220.534	Surface	2011
301.919	225.440	Surface	2006	301.919	220.468	Surface	2011
304.909	225.555	Surface	2006	304.909	220.377	Surface	2011
307.898	225.637	Surface	2006	307.898	220.369	Surface	2011
310.888	225.729	Surface	2006	310.888	220.385	Surface	2011
313.877	225.825	Surface	2006	313.877	220.327	Surface	2011
316.866	225.884	Surface	2006	316.866	220.248	Surface	2011
319.855	225.905	Surface	2006	319.855	220.222	Surface	2011
322.845	225.958	Surface	2006	322.845	220.178	Surface	2011
325.834	226.045	Surface	2006	325.834	220.127	Surface	2011
328.823	226.079	Surface	2006	328.823	220.097	Surface	2011
331.812	226.127	Surface	2006	331.812	220.041	Surface	2011
334.802	226.220	Surface	2006	334.802	219.970	Surface	2011
337.791	226.413	Surface	2006	337.791	219.937	Surface	2011
340.780	226.713	Surface	2006	340.780	219.918	Surface	2011
343.770	226.892	Surface	2006	343.770	219.895	Surface	2011
346.759	226.957	Surface	2006	346.759	219.832	Surface	2011
349.748	226.987	Surface	2006	349.748	219.742	Surface	2011
352.738	227.037	Surface	2006	352.738	219.662	Surface	2011
355.727	227.088	Surface	2006	355.727	219.579	Surface	2011
358.716	227.117	Surface	2006	358.716	219.487	Surface	2011
361.706	227.127	Surface	2006	361.706	219.324	Surface	2011
364.695	227.107	Surface	2006	364.695	219.089	Surface	2011
367.684	227.091	Surface	2006	367.684	218.824	Surface	2011
370.673	227.086	Surface	2006	370.673	218.565	Surface	2011
373.663	227.085	Surface	2006	373.663	218.380	Surface	2011
376.652	227.078	Surface	2006	376.652	218.295	Surface	2011
379.641	227.043	Surface	2006	379.641	218.224	Surface	2011
382.631	227.014	Surface	2006	382.631	218.170	Surface	2011
385.620	226.999	Surface	2006	385.620	218.128	Surface	2011
388.609	226.971	Surface	2006	388.609	218.101	Surface	2011
391.599	226.923	Surface	2006	391.599	218.138	Surface	2011
394.588	226.864	Surface	2006	394.588	218.143	Surface	2011
397.577	226.772	Surface	2006	397.577	218.151	Surface	2011
400.567	226.592	Surface	2006	400.567	218.159	Surface	2011
403.556	226.253	Surface	2006	403.556	218.154	Surface	2011
406.545	225.782	Surface	2006	406.545	218.151	Surface	2011
409.534	225.276	Surface	2006	409.534	218.124	Surface	2011
412.524	224.829	Surface	2006	412.524	218.126	Surface	2011
415.513	224.746	Surface	2006	415.513	218.121	Surface	2011
418.502	224.731	Surface	2006	418.502	218.098	Surface	2011
421.491	224.683	Surface	2006	421.491	218.161	Surface	2011
424.481	224.630	Surface	2006	424.481	218.194	Surface	2011

427.470	224.710	Surface	2006	427.470	218.141	Surface	2011
430.459	224.724	Surface	2006	430.459	218.156	Surface	2011
433.449	224.702	Surface	2006	433.449	218.170	Surface	2011
436.438	224.680	Surface	2006	436.438	218.160	Surface	2011
439.427	224.660	Surface	2006	439.427	218.139	Surface	2011
442.417	224.640	Surface	2006	442.417	218.122	Surface	2011
445.406	224.622	Surface	2006	445.406	218.123	Surface	2011
448.395	224.604	Surface	2006	448.395	218.197	Surface	2011
451.385	224.585	Surface	2006	451.385	218.241	Surface	2011
454.374	224.565	Surface	2006	454.374	218.652	Surface	2011
457.363	224.558	Surface	2006	457.363	219.299	Surface	2011
460.352	224.674	Surface	2006	460.352	220.165	Surface	2011
463.342	225.429	Surface	2006	463.342	221.377	Surface	2011
466.331	226.527	Surface	2006	466.331	222.565	Surface	2011
469.320	227.621	Surface	2006	469.320	223.790	Surface	2011
472.310	228.711	Surface	2006	472.310	225.082	Surface	2011
475.299	229.756	Surface	2006	475.299	226.378	Surface	2011
478.288	230.677	Surface	2006	478.288	227.674	Surface	2011
481.278	231.599	Surface	2006	481.278	228.970	Surface	2011
484.267	232.522	Surface	2006	484.267	230.266	Surface	2011
487.256	233.445	Surface	2006	487.256	231.563	Surface	2011
490.246	234.406	Surface	2006	490.246	232.820	Surface	2011
493.235	235.401	Surface	2006	493.235	233.264	Surface	2011
496.224	236.382	Surface	2006	496.224	233.815	Surface	2011
499.213	236.762	Surface	2006	499.213	234.423	Surface	2011
502.203	236.913	Surface	2006	502.203	235.060	Surface	2011
505.192	236.961	Surface	2006	505.192	235.773	Surface	2011
508.181	236.936	Surface	2006	508.181	236.497	Surface	2011
511.170	236.921	Surface	2006	511.170	236.806	Surface	2011
514.160	236.928	Surface	2006	514.160	236.843	Surface	2011
517.149	237.042	Surface	2006	517.149	236.944	Surface	2011
0.000	231.891	Surface	2008	0.000	232.002	Surface	2012
3.273	231.873	Surface	2008	3.273	231.887	Surface	2012
6.546	231.843	Surface	2008	6.546	231.777	Surface	2012
9.819	231.824	Surface	2008	9.819	231.681	Surface	2012
13.092	231.877	Surface	2008	13.092	231.597	Surface	2012
16.366	231.430	Surface	2008	16.366	231.342	Surface	2012
19.638	230.764	Surface	2008	19.638	230.793	Surface	2012
22.912	230.079	Surface	2008	22.912	230.144	Surface	2012
26.185	229.408	Surface	2008	26.185	229.495	Surface	2012
29.458	228.746	Surface	2008	29.458	228.839	Surface	2012
32.731	228.285	Surface	2008	32.731	228.161	Surface	2012
36.004	228.055	Surface	2008	36.004	227.637	Surface	2012
39.277	227.804	Surface	2008	39.277	227.357	Surface	2012
42.550	227.478	Surface	2008	42.550	227.146	Surface	2012
45.823	227.363	Surface	2008	45.823	227.152	Surface	2012
49.096	227.284	Surface	2008	49.096	227.059	Surface	2012
52.370	227.213	Surface	2008	52.370	226.945	Surface	2012
55.643	227.196	Surface	2008	55.643	226.829	Surface	2012

58.916	227.168	Surface	2008	58.916	226.740	Surface	2012
62.189	226.932	Surface	2008	62.189	226.617	Surface	2012
65.462	226.623	Surface	2008	65.462	226.481	Surface	2012
68.735	226.535	Surface	2008	68.735	226.527	Surface	2012
72.008	226.555	Surface	2008	72.008	226.675	Surface	2012
75.281	226.645	Surface	2008	75.281	226.734	Surface	2012
78.554	226.695	Surface	2008	78.554	226.731	Surface	2012
81.828	226.680	Surface	2008	81.828	226.739	Surface	2012
85.100	226.726	Surface	2008	85.100	226.732	Surface	2012
88.374	226.807	Surface	2008	88.374	226.747	Surface	2012
91.647	226.854	Surface	2008	91.647	226.814	Surface	2012
94.920	226.901	Surface	2008	94.920	226.845	Surface	2012
98.193	226.886	Surface	2008	98.193	226.871	Surface	2012
101.466	226.853	Surface	2008	101.466	226.916	Surface	2012
104.739	226.813	Surface	2008	104.739	227.024	Surface	2012
108.012	226.836	Surface	2008	108.012	227.097	Surface	2012
111.285	226.887	Surface	2008	111.285	227.141	Surface	2012
114.558	226.871	Surface	2008	114.558	227.019	Surface	2012
117.832	226.545	Surface	2008	117.832	226.832	Surface	2012
121.104	226.123	Surface	2008	121.104	226.430	Surface	2012
124.378	225.646	Surface	2008	124.378	225.898	Surface	2012
127.651	225.042	Surface	2008	127.651	225.279	Surface	2012
130.924	224.461	Surface	2008	130.924	224.635	Surface	2012
134.197	223.929	Surface	2008	134.197	224.111	Surface	2012
137.470	223.473	Surface	2008	137.470	223.599	Surface	2012
140.743	222.980	Surface	2008	140.743	223.041	Surface	2012
144.016	222.505	Surface	2008	144.016	222.436	Surface	2012
147.289	222.083	Surface	2008	147.289	222.109	Surface	2012
150.562	221.808	Surface	2008	150.562	222.027	Surface	2012
153.836	221.834	Surface	2008	153.836	222.028	Surface	2012
157.109	221.969	Surface	2008	157.109	222.118	Surface	2012
160.382	222.111	Surface	2008	160.382	222.300	Surface	2012
163.655	222.237	Surface	2008	163.655	222.431	Surface	2012
166.928	222.330	Surface	2008	166.928	222.437	Surface	2012
170.201	222.366	Surface	2008	170.201	222.352	Surface	2012
173.474	222.343	Surface	2008	173.474	221.999	Surface	2012
176.747	222.358	Surface	2008	176.747	221.533	Surface	2012
180.020	222.383	Surface	2008	180.020	221.181	Surface	2012
183.294	222.417	Surface	2008	183.294	220.866	Surface	2012
186.566	222.453	Surface	2008	186.566	220.708	Surface	2012
189.840	222.493	Surface	2008	189.840	220.468	Surface	2012
193.113	222.492	Surface	2008	193.113	219.805	Surface	2012
196.386	222.490	Surface	2008	196.386	219.466	Surface	2012
199.659	222.368	Surface	2008	199.659	219.457	Surface	2012
202.932	222.102	Surface	2008	202.932	219.506	Surface	2012
206.205	221.816	Surface	2008	206.205	219.501	Surface	2012
209.478	221.528	Surface	2008	209.478	219.485	Surface	2012
212.751	221.290	Surface	2008	212.751	219.423	Surface	2012
216.024	221.131	Surface	2008	216.024	219.326	Surface	2012

219.298	220.974	Surface	2008	219.298	219.177	Surface	2012
222.570	220.805	Surface	2008	222.570	219.032	Surface	2012
225.844	220.730	Surface	2008	225.844	218.919	Surface	2012
229.117	220.734	Surface	2008	229.117	218.930	Surface	2012
232.390	220.747	Surface	2008	232.390	218.913	Surface	2012
235.663	220.792	Surface	2008	235.663	218.871	Surface	2012
238.936	220.817	Surface	2008	238.936	218.811	Surface	2012
242.209	220.647	Surface	2008	242.209	218.783	Surface	2012
245.482	220.376	Surface	2008	245.482	218.696	Surface	2012
248.755	220.060	Surface	2008	248.755	218.606	Surface	2012
252.028	219.810	Surface	2008	252.028	218.512	Surface	2012
255.302	219.633	Surface	2008	255.302	218.420	Surface	2012
258.575	219.544	Surface	2008	258.575	218.456	Surface	2012
261.848	219.501	Surface	2008	261.848	218.676	Surface	2012
265.121	219.461	Surface	2008	265.121	218.951	Surface	2012
268.394	219.426	Surface	2008	268.394	219.304	Surface	2012
271.667	219.446	Surface	2008	271.667	219.659	Surface	2012
274.940	219.470	Surface	2008	274.940	219.970	Surface	2012
278.213	219.447	Surface	2008	278.213	220.180	Surface	2012
281.486	219.406	Surface	2008	281.486	220.293	Surface	2012
284.759	219.400	Surface	2008	284.759	220.414	Surface	2012
288.032	219.333	Surface	2008	288.032	220.490	Surface	2012
291.306	219.185	Surface	2008	291.306	220.489	Surface	2012
294.579	218.961	Surface	2008	294.579	220.491	Surface	2012
297.852	218.857	Surface	2008	297.852	220.516	Surface	2012
301.125	218.799	Surface	2008	301.125	220.453	Surface	2012
304.398	218.766	Surface	2008	304.398	220.414	Surface	2012
307.671	218.783	Surface	2008	307.671	220.402	Surface	2012
310.944	218.785	Surface	2008	310.944	220.374	Surface	2012
314.217	218.776	Surface	2008	314.217	220.325	Surface	2012
317.490	218.784	Surface	2008	317.490	220.269	Surface	2012
320.764	218.812	Surface	2008	320.764	220.237	Surface	2012
324.036	218.897	Surface	2008	324.036	220.174	Surface	2012
327.310	219.015	Surface	2008	327.310	220.124	Surface	2012
330.583	219.181	Surface	2008	330.583	220.086	Surface	2012
333.856	219.344	Surface	2008	333.856	220.034	Surface	2012
337.129	219.415	Surface	2008	337.129	219.998	Surface	2012
340.402	219.444	Surface	2008	340.402	219.954	Surface	2012
343.675	219.478	Surface	2008	343.675	219.892	Surface	2012
346.948	219.485	Surface	2008	346.948	219.749	Surface	2012
350.221	219.490	Surface	2008	350.221	219.530	Surface	2012
353.494	219.473	Surface	2008	353.494	219.305	Surface	2012
356.768	219.417	Surface	2008	356.768	219.096	Surface	2012
360.041	219.372	Surface	2008	360.041	218.940	Surface	2012
363.314	219.323	Surface	2008	363.314	218.790	Surface	2012
366.587	219.216	Surface	2008	366.587	218.599	Surface	2012
369.860	219.136	Surface	2008	369.860	218.394	Surface	2012
373.133	219.133	Surface	2008	373.133	218.182	Surface	2012
376.406	219.149	Surface	2008	376.406	218.035	Surface	2012

379.679	219.181	Surface	2008	379.679	217.988	Surface	2012
382.952	219.192	Surface	2008	382.952	218.001	Surface	2012
386.225	219.135	Surface	2008	386.225	217.990	Surface	2012
389.498	219.179	Surface	2008	389.498	217.989	Surface	2012
392.772	219.212	Surface	2008	392.772	218.005	Surface	2012
396.045	219.191	Surface	2008	396.045	217.999	Surface	2012
399.318	219.280	Surface	2008	399.318	217.996	Surface	2012
402.591	219.423	Surface	2008	402.591	218.000	Surface	2012
405.864	219.613	Surface	2008	405.864	218.000	Surface	2012
409.137	219.901	Surface	2008	409.137	218.005	Surface	2012
412.410	220.325	Surface	2008	412.410	218.010	Surface	2012
415.683	220.936	Surface	2008	415.683	218.005	Surface	2012
418.956	221.601	Surface	2008	418.956	217.987	Surface	2012
422.230	222.269	Surface	2008	422.230	217.979	Surface	2012
425.502	223.006	Surface	2008	425.502	217.991	Surface	2012
428.776	223.670	Surface	2008	428.776	217.990	Surface	2012
432.049	224.011	Surface	2008	432.049	217.980	Surface	2012
435.322	223.985	Surface	2008	435.322	217.974	Surface	2012
438.595	223.816	Surface	2008	438.595	217.968	Surface	2012
441.868	223.741	Surface	2008	441.868	217.978	Surface	2012
445.141	223.746	Surface	2008	445.141	217.996	Surface	2012
448.414	223.771	Surface	2008	448.414	218.013	Surface	2012
451.687	223.792	Surface	2008	451.687	218.338	Surface	2012
454.960	223.810	Surface	2008	454.960	219.015	Surface	2012
458.234	224.022	Surface	2008	458.234	220.237	Surface	2012
461.506	224.632	Surface	2008	461.506	222.604	Surface	2012
464.780	225.661	Surface	2008	464.780	225.296	Surface	2012
468.053	226.891	Surface	2008	468.053	226.950	Surface	2012
471.326	228.121	Surface	2008	471.326	227.930	Surface	2012
474.599	229.340	Surface	2008	474.599	228.965	Surface	2012
477.872	230.534	Surface	2008	477.872	229.958	Surface	2012
481.145	231.647	Surface	2008	481.145	230.908	Surface	2012
484.418	232.744	Surface	2008	484.418	231.901	Surface	2012
487.691	233.586	Surface	2008	487.691	232.880	Surface	2012
490.964	234.220	Surface	2008	490.964	233.912	Surface	2012
494.238	235.159	Surface	2008	494.238	234.826	Surface	2012
497.511	236.095	Surface	2008	497.511	235.509	Surface	2012
500.784	236.673	Surface	2008	500.784	236.286	Surface	2012
504.057	236.908	Surface	2008	504.057	236.883	Surface	2012
507.330	236.889	Surface	2008	507.330	236.973	Surface	2012
510.603	236.801	Surface	2008	510.603	236.904	Surface	2012
513.876	236.792	Surface	2008	513.876	236.894	Surface	2012
517.149	236.917	Surface	2008	517.149	237.000	Surface	2012

10.6 Transect F – Crib Structure North Points – All Returns:

Distance	Z	DEM	Year	Distance	Z	DEM	Year
0.000	235.255	Surface	2006	0.000	235.362	Surface	2011
2.983	234.858	Surface	2006	2.983	234.888	Surface	2011
5.967	234.358	Surface	2006	5.967	234.417	Surface	2011
8.950	233.824	Surface	2006	8.950	233.984	Surface	2011
11.933	233.288	Surface	2006	11.933	233.562	Surface	2011
14.917	232.752	Surface	2006	14.917	233.161	Surface	2011
17.900	232.215	Surface	2006	17.900	232.715	Surface	2011
20.883	231.677	Surface	2006	20.883	232.292	Surface	2011
23.866	231.167	Surface	2006	23.866	231.908	Surface	2011
26.850	230.663	Surface	2006	26.850	231.424	Surface	2011
29.833	230.157	Surface	2006	29.833	230.851	Surface	2011
32.816	229.643	Surface	2006	32.816	230.300	Surface	2011
35.800	229.129	Surface	2006	35.800	229.741	Surface	2011
38.783	228.615	Surface	2006	38.783	229.177	Surface	2011
41.766	228.130	Surface	2006	41.766	228.617	Surface	2011
44.750	227.732	Surface	2006	44.750	228.083	Surface	2011
47.733	227.427	Surface	2006	47.733	227.608	Surface	2011
50.716	227.181	Surface	2006	50.716	227.054	Surface	2011
53.700	226.983	Surface	2006	53.700	226.466	Surface	2011
56.683	226.780	Surface	2006	56.683	226.132	Surface	2011
59.666	226.585	Surface	2006	59.666	225.797	Surface	2011
62.650	226.388	Surface	2006	62.650	225.462	Surface	2011
65.633	226.194	Surface	2006	65.633	225.127	Surface	2011
68.616	225.991	Surface	2006	68.616	224.844	Surface	2011
71.599	225.866	Surface	2006	71.599	224.706	Surface	2011
74.583	225.696	Surface	2006	74.583	224.505	Surface	2011
77.566	225.576	Surface	2006	77.566	224.287	Surface	2011
80.549	225.523	Surface	2006	80.549	224.090	Surface	2011
83.533	225.514	Surface	2006	83.533	223.898	Surface	2011
86.516	225.459	Surface	2006	86.516	223.685	Surface	2011
89.499	225.443	Surface	2006	89.499	223.497	Surface	2011
92.483	225.444	Surface	2006	92.483	223.463	Surface	2011
95.466	225.468	Surface	2006	95.466	223.519	Surface	2011
98.449	225.458	Surface	2006	98.449	223.555	Surface	2011
101.432	225.436	Surface	2006	101.432	223.586	Surface	2011
104.416	225.433	Surface	2006	104.416	223.640	Surface	2011
107.399	225.423	Surface	2006	107.399	223.708	Surface	2011
110.382	225.436	Surface	2006	110.382	223.747	Surface	2011
113.366	225.410	Surface	2006	113.366	223.676	Surface	2011
116.349	225.386	Surface	2006	116.349	223.516	Surface	2011
119.333	225.426	Surface	2006	119.333	223.338	Surface	2011
122.316	225.447	Surface	2006	122.316	223.093	Surface	2011
125.299	225.459	Surface	2006	125.299	222.620	Surface	2011
128.282	225.442	Surface	2006	128.282	222.104	Surface	2011
131.266	225.443	Surface	2006	131.266	221.660	Surface	2011

134.249	225.445	Surface	2006	134.249	221.341	Surface	2011
137.232	225.439	Surface	2006	137.232	221.041	Surface	2011
140.216	225.453	Surface	2006	140.216	220.844	Surface	2011
143.199	225.465	Surface	2006	143.199	220.801	Surface	2011
146.182	225.445	Surface	2006	146.182	220.760	Surface	2011
149.166	225.454	Surface	2006	149.166	220.738	Surface	2011
152.149	225.459	Surface	2006	152.149	220.753	Surface	2011
155.132	225.460	Surface	2006	155.132	220.795	Surface	2011
158.115	225.473	Surface	2006	158.115	220.836	Surface	2011
161.099	225.476	Surface	2006	161.099	220.832	Surface	2011
164.082	225.450	Surface	2006	164.082	220.809	Surface	2011
167.065	225.424	Surface	2006	167.065	220.800	Surface	2011
170.049	225.405	Surface	2006	170.049	220.794	Surface	2011
173.032	225.438	Surface	2006	173.032	220.793	Surface	2011
176.015	225.443	Surface	2006	176.015	220.795	Surface	2011
178.999	225.440	Surface	2006	178.999	220.789	Surface	2011
181.982	225.451	Surface	2006	181.982	220.780	Surface	2011
184.965	225.424	Surface	2006	184.965	220.791	Surface	2011
187.948	225.409	Surface	2006	187.948	220.827	Surface	2011
190.932	225.423	Surface	2006	190.932	220.844	Surface	2011
193.915	225.421	Surface	2006	193.915	220.838	Surface	2011
196.899	225.414	Surface	2006	196.899	220.845	Surface	2011
199.882	225.411	Surface	2006	199.882	220.875	Surface	2011
202.865	225.415	Surface	2006	202.865	220.863	Surface	2011
205.849	225.420	Surface	2006	205.849	220.837	Surface	2011
208.832	225.429	Surface	2006	208.832	220.804	Surface	2011
211.815	225.433	Surface	2006	211.815	220.780	Surface	2011
214.798	225.376	Surface	2006	214.798	220.791	Surface	2011
217.782	225.404	Surface	2006	217.782	220.794	Surface	2011
220.765	225.405	Surface	2006	220.765	220.768	Surface	2011
223.748	225.411	Surface	2006	223.748	220.742	Surface	2011
226.732	225.433	Surface	2006	226.732	220.727	Surface	2011
229.715	225.600	Surface	2006	229.715	220.706	Surface	2011
232.698	225.849	Surface	2006	232.698	220.674	Surface	2011
235.682	226.046	Surface	2006	235.682	220.672	Surface	2011
238.665	226.202	Surface	2006	238.665	220.628	Surface	2011
241.648	226.359	Surface	2006	241.648	220.557	Surface	2011
244.631	226.496	Surface	2006	244.631	220.499	Surface	2011
247.615	226.580	Surface	2006	247.615	220.463	Surface	2011
250.598	226.655	Surface	2006	250.598	220.425	Surface	2011
253.581	226.707	Surface	2006	253.581	220.356	Surface	2011
256.565	226.735	Surface	2006	256.565	220.239	Surface	2011
259.548	226.758	Surface	2006	259.548	220.145	Surface	2011
262.531	226.785	Surface	2006	262.531	220.110	Surface	2011
265.515	226.801	Surface	2006	265.515	220.067	Surface	2011
268.498	226.812	Surface	2006	268.498	220.016	Surface	2011
271.481	226.831	Surface	2006	271.481	219.890	Surface	2011
274.465	226.842	Surface	2006	274.465	219.637	Surface	2011
277.448	226.835	Surface	2006	277.448	219.202	Surface	2011

280.431	226.825	Surface	2006	280.431	218.897	Surface	2011
283.415	226.843	Surface	2006	283.415	218.740	Surface	2011
286.398	226.874	Surface	2006	286.398	218.722	Surface	2011
289.381	226.868	Surface	2006	289.381	218.719	Surface	2011
292.365	226.876	Surface	2006	292.365	218.710	Surface	2011
295.348	226.906	Surface	2006	295.348	218.686	Surface	2011
298.331	226.902	Surface	2006	298.331	218.687	Surface	2011
301.314	226.894	Surface	2006	301.314	218.686	Surface	2011
304.298	226.881	Surface	2006	304.298	218.672	Surface	2011
307.281	226.881	Surface	2006	307.281	218.649	Surface	2011
310.264	226.924	Surface	2006	310.264	218.640	Surface	2011
313.248	226.876	Surface	2006	313.248	218.671	Surface	2011
316.231	226.812	Surface	2006	316.231	218.713	Surface	2011
319.214	226.757	Surface	2006	319.214	218.736	Surface	2011
322.198	226.672	Surface	2006	322.198	218.738	Surface	2011
325.181	226.655	Surface	2006	325.181	218.736	Surface	2011
328.164	226.667	Surface	2006	328.164	218.740	Surface	2011
331.147	226.683	Surface	2006	331.147	218.745	Surface	2011
334.131	226.629	Surface	2006	334.131	218.741	Surface	2011
337.114	226.496	Surface	2006	337.114	218.734	Surface	2011
340.097	226.340	Surface	2006	340.097	218.744	Surface	2011
343.081	226.194	Surface	2006	343.081	218.802	Surface	2011
346.064	226.085	Surface	2006	346.064	218.977	Surface	2011
349.047	225.984	Surface	2006	349.047	219.219	Surface	2011
352.031	225.863	Surface	2006	352.031	219.428	Surface	2011
355.014	225.755	Surface	2006	355.014	219.613	Surface	2011
357.997	225.677	Surface	2006	357.997	219.742	Surface	2011
360.981	225.503	Surface	2006	360.981	219.885	Surface	2011
363.964	225.346	Surface	2006	363.964	220.005	Surface	2011
366.947	225.121	Surface	2006	366.947	220.144	Surface	2011
369.931	224.934	Surface	2006	369.931	220.147	Surface	2011
372.914	224.784	Surface	2006	372.914	220.109	Surface	2011
375.897	224.727	Surface	2006	375.897	220.213	Surface	2011
378.880	224.722	Surface	2006	378.880	220.339	Surface	2011
381.864	224.724	Surface	2006	381.864	220.427	Surface	2011
384.847	224.721	Surface	2006	384.847	220.549	Surface	2011
387.830	224.718	Surface	2006	387.830	220.701	Surface	2011
390.814	224.713	Surface	2006	390.814	220.914	Surface	2011
393.797	224.710	Surface	2006	393.797	221.277	Surface	2011
396.780	224.712	Surface	2006	396.780	221.738	Surface	2011
399.764	224.722	Surface	2006	399.764	222.241	Surface	2011
402.747	224.727	Surface	2006	402.747	222.740	Surface	2011
405.730	224.726	Surface	2006	405.730	223.241	Surface	2011
408.714	224.725	Surface	2006	408.714	223.756	Surface	2011
411.697	224.726	Surface	2006	411.697	224.212	Surface	2011
414.680	224.787	Surface	2006	414.680	224.523	Surface	2011
417.663	225.040	Surface	2006	417.663	224.785	Surface	2011
420.647	225.720	Surface	2006	420.647	225.215	Surface	2011
423.630	226.726	Surface	2006	423.630	226.112	Surface	2011

426.613	227.724	Surface	2006	426.613	227.107	Surface	2011
429.597	228.658	Surface	2006	429.597	227.976	Surface	2011
432.580	229.404	Surface	2006	432.580	228.746	Surface	2011
435.564	230.079	Surface	2006	435.564	229.412	Surface	2011
438.547	230.783	Surface	2006	438.547	230.085	Surface	2011
441.530	231.617	Surface	2006	441.530	231.089	Surface	2011
444.513	232.469	Surface	2006	444.513	231.940	Surface	2011
447.497	233.236	Surface	2006	447.497	232.729	Surface	2011
450.480	233.874	Surface	2006	450.480	233.518	Surface	2011
453.463	234.489	Surface	2006	453.463	234.306	Surface	2011
456.447	235.104	Surface	2006	456.447	235.129	Surface	2011
459.430	235.569	Surface	2006	459.430	235.723	Surface	2011
462.413	235.658	Surface	2006	462.413	236.048	Surface	2011
465.397	235.705	Surface	2006	465.397	236.173	Surface	2011
468.380	235.810	Surface	2006	468.380	236.206	Surface	2011
471.363	235.807	Surface	2006	471.363	236.219	Surface	2011
474.346	235.731	Surface	2006	474.346	236.245	Surface	2011
0.000	235.150	Surface	2008	0.000	235.104	Surface	2012
3.271	234.561	Surface	2008	3.271	234.561	Surface	2012
6.543	233.947	Surface	2008	6.543	234.091	Surface	2012
9.814	233.454	Surface	2008	9.814	233.666	Surface	2012
13.085	232.908	Surface	2008	13.085	233.228	Surface	2012
16.357	232.366	Surface	2008	16.357	232.733	Surface	2012
19.628	231.830	Surface	2008	19.628	232.235	Surface	2012
22.900	231.301	Surface	2008	22.900	231.758	Surface	2012
26.171	230.763	Surface	2008	26.171	231.269	Surface	2012
29.442	230.214	Surface	2008	29.442	230.731	Surface	2012
32.714	229.677	Surface	2008	32.714	230.163	Surface	2012
35.985	229.143	Surface	2008	35.985	229.447	Surface	2012
39.256	228.604	Surface	2008	39.256	228.710	Surface	2012
42.527	228.034	Surface	2008	42.527	228.093	Surface	2012
45.799	227.470	Surface	2008	45.799	227.564	Surface	2012
49.070	226.991	Surface	2008	49.070	227.045	Surface	2012
52.342	226.542	Surface	2008	52.342	226.630	Surface	2012
55.613	226.103	Surface	2008	55.613	226.270	Surface	2012
58.884	225.666	Surface	2008	58.884	225.885	Surface	2012
62.156	225.226	Surface	2008	62.156	225.503	Surface	2012
65.427	224.840	Surface	2008	65.427	225.120	Surface	2012
68.698	224.713	Surface	2008	68.698	224.888	Surface	2012
71.970	224.762	Surface	2008	71.970	224.910	Surface	2012
75.241	224.753	Surface	2008	75.241	224.854	Surface	2012
78.513	224.602	Surface	2008	78.513	224.683	Surface	2012
81.784	224.118	Surface	2008	81.784	224.344	Surface	2012
85.055	223.545	Surface	2008	85.055	223.905	Surface	2012
88.327	223.426	Surface	2008	88.327	223.538	Surface	2012
91.598	223.433	Surface	2008	91.598	223.445	Surface	2012
94.869	223.511	Surface	2008	94.869	223.528	Surface	2012
98.141	223.551	Surface	2008	98.141	223.577	Surface	2012
101.412	223.573	Surface	2008	101.412	223.602	Surface	2012

104.683	223.665	Surface	2008	104.683	223.691	Surface	2012
107.955	223.768	Surface	2008	107.955	223.751	Surface	2012
111.226	223.726	Surface	2008	111.226	223.715	Surface	2012
114.498	223.559	Surface	2008	114.498	223.605	Surface	2012
117.769	223.359	Surface	2008	117.769	223.421	Surface	2012
121.040	223.174	Surface	2008	121.040	223.135	Surface	2012
124.311	222.963	Surface	2008	124.311	222.609	Surface	2012
127.583	222.878	Surface	2008	127.583	222.035	Surface	2012
130.854	222.824	Surface	2008	130.854	221.609	Surface	2012
134.125	222.670	Surface	2008	134.125	221.292	Surface	2012
137.397	222.477	Surface	2008	137.397	220.922	Surface	2012
140.668	222.323	Surface	2008	140.668	220.708	Surface	2012
143.940	222.211	Surface	2008	143.940	220.682	Surface	2012
147.211	222.100	Surface	2008	147.211	220.716	Surface	2012
150.482	221.925	Surface	2008	150.482	220.727	Surface	2012
153.754	221.712	Surface	2008	153.754	220.772	Surface	2012
157.025	221.512	Surface	2008	157.025	220.841	Surface	2012
160.296	221.363	Surface	2008	160.296	220.860	Surface	2012
163.568	221.232	Surface	2008	163.568	220.853	Surface	2012
166.839	221.102	Surface	2008	166.839	220.846	Surface	2012
170.110	220.999	Surface	2008	170.110	220.849	Surface	2012
173.382	220.940	Surface	2008	173.382	220.835	Surface	2012
176.653	220.892	Surface	2008	176.653	220.833	Surface	2012
179.925	220.881	Surface	2008	179.925	220.829	Surface	2012
183.196	220.894	Surface	2008	183.196	220.735	Surface	2012
186.467	220.874	Surface	2008	186.467	220.625	Surface	2012
189.739	220.844	Surface	2008	189.739	220.505	Surface	2012
193.010	220.818	Surface	2008	193.010	220.399	Surface	2012
196.281	220.804	Surface	2008	196.281	220.406	Surface	2012
199.553	220.770	Surface	2008	199.553	220.357	Surface	2012
202.824	220.738	Surface	2008	202.824	220.246	Surface	2012
206.095	220.615	Surface	2008	206.095	220.332	Surface	2012
209.367	220.474	Surface	2008	209.367	220.338	Surface	2012
212.638	220.329	Surface	2008	212.638	220.159	Surface	2012
215.909	220.279	Surface	2008	215.909	220.083	Surface	2012
219.181	220.297	Surface	2008	219.181	220.116	Surface	2012
222.452	220.240	Surface	2008	222.452	220.021	Surface	2012
225.723	220.315	Surface	2008	225.723	219.980	Surface	2012
228.995	220.404	Surface	2008	228.995	220.005	Surface	2012
232.266	220.362	Surface	2008	232.266	219.978	Surface	2012
235.538	220.344	Surface	2008	235.538	219.918	Surface	2012
238.809	220.336	Surface	2008	238.809	219.863	Surface	2012
242.080	220.336	Surface	2008	242.080	219.789	Surface	2012
245.352	220.305	Surface	2008	245.352	219.763	Surface	2012
248.623	220.296	Surface	2008	248.623	219.727	Surface	2012
251.894	220.294	Surface	2008	251.894	219.717	Surface	2012
255.166	220.280	Surface	2008	255.166	219.660	Surface	2012
258.437	220.311	Surface	2008	258.437	219.582	Surface	2012
261.708	220.315	Surface	2008	261.708	219.536	Surface	2012

264.980	220.294	Surface	2008	264.980	219.496	Surface	2012
268.251	220.310	Surface	2008	268.251	219.440	Surface	2012
271.523	220.316	Surface	2008	271.523	219.420	Surface	2012
274.794	220.270	Surface	2008	274.794	219.369	Surface	2012
278.065	220.253	Surface	2008	278.065	219.280	Surface	2012
281.337	220.293	Surface	2008	281.337	219.220	Surface	2012
284.608	220.320	Surface	2008	284.608	219.192	Surface	2012
287.879	220.329	Surface	2008	287.879	219.170	Surface	2012
291.150	220.366	Surface	2008	291.150	219.117	Surface	2012
294.422	220.712	Surface	2008	294.422	219.041	Surface	2012
297.693	221.407	Surface	2008	297.693	218.942	Surface	2012
300.965	222.126	Surface	2008	300.965	218.909	Surface	2012
304.236	222.709	Surface	2008	304.236	218.874	Surface	2012
307.507	223.325	Surface	2008	307.507	218.788	Surface	2012
310.779	223.974	Surface	2008	310.779	218.798	Surface	2012
314.050	224.550	Surface	2008	314.050	218.801	Surface	2012
317.321	225.085	Surface	2008	317.321	218.807	Surface	2012
320.593	225.719	Surface	2008	320.593	218.800	Surface	2012
323.864	226.329	Surface	2008	323.864	218.785	Surface	2012
327.136	226.619	Surface	2008	327.136	218.754	Surface	2012
330.407	226.628	Surface	2008	330.407	218.751	Surface	2012
333.678	226.626	Surface	2008	333.678	218.803	Surface	2012
336.950	226.559	Surface	2008	336.950	218.853	Surface	2012
340.221	226.365	Surface	2008	340.221	218.904	Surface	2012
343.492	226.196	Surface	2008	343.492	218.919	Surface	2012
346.764	226.061	Surface	2008	346.764	218.984	Surface	2012
350.035	225.944	Surface	2008	350.035	219.270	Surface	2012
353.306	225.829	Surface	2008	353.306	219.582	Surface	2012
356.578	225.681	Surface	2008	356.578	219.821	Surface	2012
359.849	225.557	Surface	2008	359.849	219.986	Surface	2012
363.120	225.439	Surface	2008	363.120	220.200	Surface	2012
366.392	225.293	Surface	2008	366.392	220.226	Surface	2012
369.663	225.056	Surface	2008	369.663	220.130	Surface	2012
372.934	224.830	Surface	2008	372.934	220.066	Surface	2012
376.206	224.649	Surface	2008	376.206	220.176	Surface	2012
379.477	224.424	Surface	2008	379.477	220.400	Surface	2012
382.748	224.252	Surface	2008	382.748	220.600	Surface	2012
386.020	224.178	Surface	2008	386.020	220.756	Surface	2012
389.291	224.098	Surface	2008	389.291	220.962	Surface	2012
392.563	224.126	Surface	2008	392.563	221.320	Surface	2012
395.834	224.175	Surface	2008	395.834	221.716	Surface	2012
399.105	224.245	Surface	2008	399.105	222.262	Surface	2012
402.377	224.340	Surface	2008	402.377	222.937	Surface	2012
405.648	224.401	Surface	2008	405.648	223.529	Surface	2012
408.919	224.437	Surface	2008	408.919	224.012	Surface	2012
412.191	224.451	Surface	2008	412.191	224.354	Surface	2012
415.462	224.701	Surface	2008	415.462	224.666	Surface	2012
418.733	225.504	Surface	2008	418.733	225.061	Surface	2012
422.005	226.834	Surface	2008	422.005	225.778	Surface	2012

425.276	227.743	Surface	2008	425.276	226.832	Surface	2012
428.548	228.368	Surface	2008	428.548	227.919	Surface	2012
431.819	228.959	Surface	2008	431.819	228.691	Surface	2012
435.090	229.699	Surface	2008	435.090	229.405	Surface	2012
438.361	230.560	Surface	2008	438.361	230.502	Surface	2012
441.633	231.513	Surface	2008	441.633	231.689	Surface	2012
444.904	232.783	Surface	2008	444.904	232.798	Surface	2012
448.175	234.133	Surface	2008	448.175	233.949	Surface	2012
451.447	234.989	Surface	2008	451.447	234.937	Surface	2012
454.718	235.216	Surface	2008	454.718	235.327	Surface	2012
457.990	235.373	Surface	2008	457.990	235.609	Surface	2012
461.261	235.651	Surface	2008	461.261	235.811	Surface	2012
464.532	235.875	Surface	2008	464.532	235.801	Surface	2012
467.804	235.975	Surface	2008	467.804	235.728	Surface	2012
471.075	236.020	Surface	2008	471.075	235.711	Surface	2012
474.346	236.013	Surface	2008	474.346	235.673	Surface	2012

10.7 Transect G – Crib Structure South Points – All Returns:

Distance	Z	DEM	Year	Distance	Z	DEM	Year
0.000	238.709	Surface	2006	0.000	239.177	Surface	2011
2.996	237.991	Surface	2006	2.996	238.806	Surface	2011
5.993	237.267	Surface	2006	5.993	238.439	Surface	2011
8.989	236.543	Surface	2006	8.989	237.793	Surface	2011
11.985	235.823	Surface	2006	11.985	237.068	Surface	2011
14.981	235.098	Surface	2006	14.981	236.343	Surface	2011
17.978	234.391	Surface	2006	17.978	235.621	Surface	2011
20.974	233.650	Surface	2006	20.974	234.898	Surface	2011
23.970	232.977	Surface	2006	23.970	234.176	Surface	2011
26.966	232.291	Surface	2006	26.966	233.454	Surface	2011
29.963	231.594	Surface	2006	29.963	232.733	Surface	2011
32.959	230.985	Surface	2006	32.959	232.012	Surface	2011
35.955	230.285	Surface	2006	35.955	231.274	Surface	2011
38.952	229.498	Surface	2006	38.952	230.471	Surface	2011
41.948	228.873	Surface	2006	41.948	229.654	Surface	2011
44.944	228.393	Surface	2006	44.944	228.906	Surface	2011
47.940	227.957	Surface	2006	47.940	228.352	Surface	2011
50.937	227.506	Surface	2006	50.937	227.871	Surface	2011
53.933	227.093	Surface	2006	53.933	227.344	Surface	2011
56.929	226.692	Surface	2006	56.929	226.822	Surface	2011
59.926	226.383	Surface	2006	59.926	226.296	Surface	2011
62.922	226.211	Surface	2006	62.922	225.654	Surface	2011
65.918	226.054	Surface	2006	65.918	225.395	Surface	2011
68.914	225.911	Surface	2006	68.914	225.132	Surface	2011
71.911	225.764	Surface	2006	71.911	225.026	Surface	2011
74.907	225.604	Surface	2006	74.907	224.944	Surface	2011
77.903	225.481	Surface	2006	77.903	224.863	Surface	2011
80.900	225.504	Surface	2006	80.900	224.789	Surface	2011
83.896	225.512	Surface	2006	83.896	224.663	Surface	2011
86.892	225.509	Surface	2006	86.892	224.441	Surface	2011
89.888	225.425	Surface	2006	89.888	224.158	Surface	2011
92.885	225.462	Surface	2006	92.885	223.911	Surface	2011
95.881	225.488	Surface	2006	95.881	223.789	Surface	2011
98.877	225.513	Surface	2006	98.877	223.722	Surface	2011
101.873	225.500	Surface	2006	101.873	223.655	Surface	2011
104.870	225.492	Surface	2006	104.870	223.578	Surface	2011
107.866	225.508	Surface	2006	107.866	223.492	Surface	2011
110.862	225.536	Surface	2006	110.862	223.409	Surface	2011
113.859	225.534	Surface	2006	113.859	223.319	Surface	2011
116.855	225.534	Surface	2006	116.855	223.146	Surface	2011
119.851	225.534	Surface	2006	119.851	222.872	Surface	2011
122.847	225.537	Surface	2006	122.847	222.621	Surface	2011
125.844	225.550	Surface	2006	125.844	222.334	Surface	2011
128.840	225.545	Surface	2006	128.840	221.940	Surface	2011
131.836	225.534	Surface	2006	131.836	221.507	Surface	2011

134.833	225.535	Surface	2006	134.833	221.069	Surface	2011
137.829	225.539	Surface	2006	137.829	220.709	Surface	2011
140.825	225.525	Surface	2006	140.825	220.687	Surface	2011
143.821	225.498	Surface	2006	143.821	220.730	Surface	2011
146.818	225.509	Surface	2006	146.818	220.758	Surface	2011
149.814	225.546	Surface	2006	149.814	220.803	Surface	2011
152.810	225.565	Surface	2006	152.810	220.837	Surface	2011
155.807	225.555	Surface	2006	155.807	220.857	Surface	2011
158.803	225.541	Surface	2006	158.803	220.850	Surface	2011
161.799	225.538	Surface	2006	161.799	220.838	Surface	2011
164.795	225.539	Surface	2006	164.795	220.849	Surface	2011
167.792	225.561	Surface	2006	167.792	220.871	Surface	2011
170.788	225.576	Surface	2006	170.788	220.894	Surface	2011
173.784	225.536	Surface	2006	173.784	220.893	Surface	2011
176.780	225.545	Surface	2006	176.780	220.895	Surface	2011
179.777	225.558	Surface	2006	179.777	220.915	Surface	2011
182.773	225.553	Surface	2006	182.773	220.919	Surface	2011
185.769	225.531	Surface	2006	185.769	220.913	Surface	2011
188.766	225.499	Surface	2006	188.766	220.880	Surface	2011
191.762	225.515	Surface	2006	191.762	220.845	Surface	2011
194.758	225.511	Surface	2006	194.758	220.808	Surface	2011
197.754	225.510	Surface	2006	197.754	220.778	Surface	2011
200.751	225.505	Surface	2006	200.751	220.759	Surface	2011
203.747	225.492	Surface	2006	203.747	220.737	Surface	2011
206.743	225.472	Surface	2006	206.743	220.731	Surface	2011
209.740	225.486	Surface	2006	209.740	220.726	Surface	2011
212.736	225.515	Surface	2006	212.736	220.718	Surface	2011
215.732	225.506	Surface	2006	215.732	220.709	Surface	2011
218.728	225.481	Surface	2006	218.728	220.686	Surface	2011
221.725	225.488	Surface	2006	221.725	220.643	Surface	2011
224.721	225.614	Surface	2006	224.721	220.596	Surface	2011
227.717	225.804	Surface	2006	227.717	220.534	Surface	2011
230.713	225.994	Surface	2006	230.713	220.488	Surface	2011
233.710	226.140	Surface	2006	233.710	220.407	Surface	2011
236.706	226.257	Surface	2006	236.706	220.362	Surface	2011
239.702	226.363	Surface	2006	239.702	220.326	Surface	2011
242.699	226.452	Surface	2006	242.699	220.260	Surface	2011
245.695	226.522	Surface	2006	245.695	220.130	Surface	2011
248.691	226.582	Surface	2006	248.691	220.040	Surface	2011
251.687	226.636	Surface	2006	251.687	219.944	Surface	2011
254.683	226.655	Surface	2006	254.683	219.803	Surface	2011
257.680	226.666	Surface	2006	257.680	219.587	Surface	2011
260.676	226.665	Surface	2006	260.676	219.246	Surface	2011
263.673	226.701	Surface	2006	263.673	218.995	Surface	2011
266.669	226.750	Surface	2006	266.669	218.970	Surface	2011
269.665	226.756	Surface	2006	269.665	218.976	Surface	2011
272.661	226.755	Surface	2006	272.661	218.945	Surface	2011
275.658	226.783	Surface	2006	275.658	218.911	Surface	2011
278.654	226.831	Surface	2006	278.654	218.895	Surface	2011

281.650	226.883	Surface	2006	281.650	218.886	Surface	2011
284.647	226.924	Surface	2006	284.647	218.873	Surface	2011
287.643	226.951	Surface	2006	287.643	218.831	Surface	2011
290.639	226.934	Surface	2006	290.639	218.760	Surface	2011
293.635	226.871	Surface	2006	293.635	218.745	Surface	2011
296.632	226.782	Surface	2006	296.632	218.773	Surface	2011
299.628	226.726	Surface	2006	299.628	218.762	Surface	2011
302.624	226.719	Surface	2006	302.624	218.767	Surface	2011
305.620	226.717	Surface	2006	305.620	218.768	Surface	2011
308.617	226.692	Surface	2006	308.617	218.770	Surface	2011
311.613	226.648	Surface	2006	311.613	218.749	Surface	2011
314.609	226.628	Surface	2006	314.609	218.731	Surface	2011
317.606	226.615	Surface	2006	317.606	218.721	Surface	2011
320.602	226.589	Surface	2006	320.602	218.742	Surface	2011
323.598	226.509	Surface	2006	323.598	218.790	Surface	2011
326.594	226.427	Surface	2006	326.594	218.830	Surface	2011
329.590	226.348	Surface	2006	329.590	218.826	Surface	2011
332.587	226.279	Surface	2006	332.587	218.837	Surface	2011
335.583	226.213	Surface	2006	335.583	218.832	Surface	2011
338.580	226.149	Surface	2006	338.580	218.977	Surface	2011
341.576	226.075	Surface	2006	341.576	219.279	Surface	2011
344.572	225.991	Surface	2006	344.572	219.590	Surface	2011
347.568	225.897	Surface	2006	347.568	219.858	Surface	2011
350.565	225.703	Surface	2006	350.565	220.114	Surface	2011
353.561	225.501	Surface	2006	353.561	220.357	Surface	2011
356.557	225.324	Surface	2006	356.557	220.555	Surface	2011
359.553	225.102	Surface	2006	359.553	220.694	Surface	2011
362.550	224.954	Surface	2006	362.550	220.799	Surface	2011
365.546	224.829	Surface	2006	365.546	220.903	Surface	2011
368.542	224.738	Surface	2006	368.542	221.031	Surface	2011
371.539	224.675	Surface	2006	371.539	221.223	Surface	2011
374.535	224.635	Surface	2006	374.535	221.530	Surface	2011
377.531	224.647	Surface	2006	377.531	221.864	Surface	2011
380.527	224.686	Surface	2006	380.527	222.138	Surface	2011
383.524	224.694	Surface	2006	383.524	222.369	Surface	2011
386.520	224.694	Surface	2006	386.520	222.632	Surface	2011
389.516	224.696	Surface	2006	389.516	223.037	Surface	2011
392.513	224.701	Surface	2006	392.513	223.442	Surface	2011
395.509	224.738	Surface	2006	395.509	223.878	Surface	2011
398.505	224.905	Surface	2006	398.505	224.278	Surface	2011
401.501	225.179	Surface	2006	401.501	224.677	Surface	2011
404.497	225.489	Surface	2006	404.497	225.075	Surface	2011
407.494	225.816	Surface	2006	407.494	225.483	Surface	2011
410.490	226.375	Surface	2006	410.490	226.055	Surface	2011
413.486	227.113	Surface	2006	413.486	226.668	Surface	2011
416.483	227.640	Surface	2006	416.483	227.259	Surface	2011
419.479	228.016	Surface	2006	419.479	227.769	Surface	2011
422.475	228.394	Surface	2006	422.475	228.254	Surface	2011
425.472	228.770	Surface	2006	425.472	228.735	Surface	2011

428.468	229.133	Surface	2006	428.468	229.216	Surface	2011
431.464	229.411	Surface	2006	431.464	229.684	Surface	2011
434.460	229.661	Surface	2006	434.460	229.933	Surface	2011
437.457	229.905	Surface	2006	437.457	230.048	Surface	2011
440.453	230.136	Surface	2006	440.453	230.172	Surface	2011
443.449	230.385	Surface	2006	443.449	230.253	Surface	2011
446.446	230.391	Surface	2006	446.446	230.480	Surface	2011
449.442	230.595	Surface	2006	449.442	230.836	Surface	2011
452.438	231.028	Surface	2006	452.438	231.273	Surface	2011
455.434	231.812	Surface	2006	455.434	231.786	Surface	2011
458.430	232.464	Surface	2006	458.430	232.325	Surface	2011
461.427	232.614	Surface	2006	461.427	232.865	Surface	2011
464.423	232.747	Surface	2006	464.423	233.384	Surface	2011
467.420	232.888	Surface	2006	467.420	233.722	Surface	2011
470.416	233.041	Surface	2006	470.416	233.744	Surface	2011
473.412	233.196	Surface	2006	473.412	233.766	Surface	2011
476.408	233.364	Surface	2006	476.408	233.789	Surface	2011
0.000	238.985	Surface	2008	0.000	238.989	Surface	2012
3.263	238.188	Surface	2008	3.263	238.361	Surface	2012
6.526	237.433	Surface	2008	6.526	237.742	Surface	2012
9.789	236.705	Surface	2008	9.789	237.080	Surface	2012
13.052	235.984	Surface	2008	13.052	236.407	Surface	2012
16.315	235.250	Surface	2008	16.315	235.729	Surface	2012
19.578	234.535	Surface	2008	19.578	235.018	Surface	2012
22.841	233.827	Surface	2008	22.841	234.223	Surface	2012
26.105	233.106	Surface	2008	26.105	233.423	Surface	2012
29.368	232.382	Surface	2008	29.368	232.692	Surface	2012
32.631	231.670	Surface	2008	32.631	231.844	Surface	2012
35.894	230.933	Surface	2008	35.894	230.991	Surface	2012
39.157	230.137	Surface	2008	39.157	230.202	Surface	2012
42.420	229.323	Surface	2008	42.420	229.319	Surface	2012
45.683	228.512	Surface	2008	45.683	228.560	Surface	2012
48.946	227.771	Surface	2008	48.946	228.001	Surface	2012
52.209	227.063	Surface	2008	52.209	227.498	Surface	2012
55.472	226.315	Surface	2008	55.472	226.879	Surface	2012
58.735	225.612	Surface	2008	58.735	226.021	Surface	2012
61.998	225.171	Surface	2008	61.998	225.383	Surface	2012
65.262	225.024	Surface	2008	65.262	225.154	Surface	2012
68.524	224.976	Surface	2008	68.524	225.041	Surface	2012
71.788	224.976	Surface	2008	71.788	225.083	Surface	2012
75.051	224.958	Surface	2008	75.051	225.147	Surface	2012
78.314	224.804	Surface	2008	78.314	224.911	Surface	2012
81.577	224.649	Surface	2008	81.577	224.738	Surface	2012
84.840	224.493	Surface	2008	84.840	224.580	Surface	2012
88.103	224.156	Surface	2008	88.103	224.309	Surface	2012
91.366	223.824	Surface	2008	91.366	224.022	Surface	2012
94.629	223.760	Surface	2008	94.629	223.856	Surface	2012
97.892	223.694	Surface	2008	97.892	223.784	Surface	2012
101.155	223.598	Surface	2008	101.155	223.659	Surface	2012

104.418	223.510	Surface	2008	104.418	223.568	Surface	2012
107.681	223.427	Surface	2008	107.681	223.487	Surface	2012
110.944	223.341	Surface	2008	110.944	223.405	Surface	2012
114.208	223.212	Surface	2008	114.208	223.271	Surface	2012
117.470	223.059	Surface	2008	117.470	223.011	Surface	2012
120.734	222.937	Surface	2008	120.734	222.719	Surface	2012
123.997	222.793	Surface	2008	123.997	222.489	Surface	2012
127.260	222.622	Surface	2008	127.260	222.173	Surface	2012
130.523	222.492	Surface	2008	130.523	221.676	Surface	2012
133.786	222.369	Surface	2008	133.786	221.098	Surface	2012
137.049	222.168	Surface	2008	137.049	220.727	Surface	2012
140.312	221.897	Surface	2008	140.312	220.683	Surface	2012
143.575	221.635	Surface	2008	143.575	220.745	Surface	2012
146.838	221.455	Surface	2008	146.838	220.793	Surface	2012
150.101	221.283	Surface	2008	150.101	220.842	Surface	2012
153.364	221.155	Surface	2008	153.364	220.902	Surface	2012
156.627	221.093	Surface	2008	156.627	220.905	Surface	2012
159.890	221.084	Surface	2008	159.890	220.902	Surface	2012
163.154	221.037	Surface	2008	163.154	220.870	Surface	2012
166.417	221.036	Surface	2008	166.417	220.861	Surface	2012
169.680	221.056	Surface	2008	169.680	220.849	Surface	2012
172.943	221.057	Surface	2008	172.943	220.817	Surface	2012
176.206	221.008	Surface	2008	176.206	220.674	Surface	2012
179.469	220.993	Surface	2008	179.469	220.540	Surface	2012
182.732	220.991	Surface	2008	182.732	220.509	Surface	2012
185.995	220.982	Surface	2008	185.995	220.321	Surface	2012
189.258	220.911	Surface	2008	189.258	220.312	Surface	2012
192.521	220.833	Surface	2008	192.521	220.257	Surface	2012
195.784	220.712	Surface	2008	195.784	220.182	Surface	2012
199.047	220.586	Surface	2008	199.047	220.158	Surface	2012
202.311	220.442	Surface	2008	202.311	220.125	Surface	2012
205.573	220.343	Surface	2008	205.573	220.091	Surface	2012
208.837	220.274	Surface	2008	208.837	220.072	Surface	2012
212.100	220.283	Surface	2008	212.100	220.091	Surface	2012
215.363	220.316	Surface	2008	215.363	220.057	Surface	2012
218.626	220.315	Surface	2008	218.626	220.033	Surface	2012
221.889	220.356	Surface	2008	221.889	220.017	Surface	2012
225.152	220.373	Surface	2008	225.152	219.989	Surface	2012
228.415	220.321	Surface	2008	228.415	219.955	Surface	2012
231.678	220.263	Surface	2008	231.678	219.946	Surface	2012
234.941	220.278	Surface	2008	234.941	219.952	Surface	2012
238.204	220.305	Surface	2008	238.204	219.955	Surface	2012
241.467	220.312	Surface	2008	241.467	219.952	Surface	2012
244.730	220.310	Surface	2008	244.730	219.940	Surface	2012
247.993	220.300	Surface	2008	247.993	219.905	Surface	2012
251.257	220.285	Surface	2008	251.257	219.869	Surface	2012
254.519	220.243	Surface	2008	254.519	219.823	Surface	2012
257.783	220.240	Surface	2008	257.783	219.801	Surface	2012
261.046	220.277	Surface	2008	261.046	219.764	Surface	2012

264.309	220.352	Surface	2008	264.309	219.781	Surface	2012
267.572	220.380	Surface	2008	267.572	219.767	Surface	2012
270.835	220.367	Surface	2008	270.835	219.746	Surface	2012
274.098	220.389	Surface	2008	274.098	219.659	Surface	2012
277.361	220.606	Surface	2008	277.361	219.524	Surface	2012
280.624	221.039	Surface	2008	280.624	219.488	Surface	2012
283.887	221.715	Surface	2008	283.887	219.433	Surface	2012
287.150	222.418	Surface	2008	287.150	219.402	Surface	2012
290.413	223.060	Surface	2008	290.413	219.360	Surface	2012
293.676	223.662	Surface	2008	293.676	219.322	Surface	2012
296.940	224.439	Surface	2008	296.940	219.285	Surface	2012
300.202	225.441	Surface	2008	300.202	219.261	Surface	2012
303.466	226.388	Surface	2008	303.466	219.226	Surface	2012
306.729	226.637	Surface	2008	306.729	219.187	Surface	2012
309.992	226.636	Surface	2008	309.992	219.125	Surface	2012
313.255	226.591	Surface	2008	313.255	219.051	Surface	2012
316.518	226.542	Surface	2008	316.518	218.975	Surface	2012
319.781	226.542	Surface	2008	319.781	218.955	Surface	2012
323.044	226.499	Surface	2008	323.044	218.971	Surface	2012
326.307	226.409	Surface	2008	326.307	218.965	Surface	2012
329.570	226.324	Surface	2008	329.570	218.968	Surface	2012
332.833	226.262	Surface	2008	332.833	219.011	Surface	2012
336.096	226.218	Surface	2008	336.096	219.065	Surface	2012
339.359	226.155	Surface	2008	339.359	219.182	Surface	2012
342.622	226.065	Surface	2008	342.622	219.468	Surface	2012
345.886	225.975	Surface	2008	345.886	219.793	Surface	2012
349.148	225.839	Surface	2008	349.148	220.022	Surface	2012
352.412	225.642	Surface	2008	352.412	220.299	Surface	2012
355.675	225.425	Surface	2008	355.675	220.585	Surface	2012
358.938	225.208	Surface	2008	358.938	220.782	Surface	2012
362.201	225.037	Surface	2008	362.201	220.815	Surface	2012
365.464	224.880	Surface	2008	365.464	220.936	Surface	2012
368.727	224.766	Surface	2008	368.727	221.142	Surface	2012
371.990	224.675	Surface	2008	371.990	221.455	Surface	2012
375.253	224.640	Surface	2008	375.253	221.672	Surface	2012
378.516	224.612	Surface	2008	378.516	221.961	Surface	2012
381.779	224.523	Surface	2008	381.779	222.396	Surface	2012
385.042	224.339	Surface	2008	385.042	222.730	Surface	2012
388.305	224.181	Surface	2008	388.305	223.218	Surface	2012
391.568	224.097	Surface	2008	391.568	223.659	Surface	2012
394.832	224.159	Surface	2008	394.832	224.081	Surface	2012
398.094	224.321	Surface	2008	398.094	224.469	Surface	2012
401.358	224.625	Surface	2008	401.358	224.859	Surface	2012
404.621	225.126	Surface	2008	404.621	225.186	Surface	2012
407.884	225.616	Surface	2008	407.884	225.577	Surface	2012
411.147	226.101	Surface	2008	411.147	226.239	Surface	2012
414.410	226.580	Surface	2008	414.410	227.040	Surface	2012
417.673	227.065	Surface	2008	417.673	228.024	Surface	2012
420.936	227.624	Surface	2008	420.936	229.035	Surface	2012

424.199	228.271	Surface	2008	424.199	229.528	Surface	2012
427.462	228.792	Surface	2008	427.462	229.621	Surface	2012
430.725	229.179	Surface	2008	430.725	229.679	Surface	2012
433.988	229.472	Surface	2008	433.988	229.749	Surface	2012
437.251	229.717	Surface	2008	437.251	229.758	Surface	2012
440.515	229.982	Surface	2008	440.515	229.862	Surface	2012
443.778	230.187	Surface	2008	443.778	230.019	Surface	2012
447.040	230.457	Surface	2008	447.040	230.282	Surface	2012
450.304	230.933	Surface	2008	450.304	230.899	Surface	2012
453.567	231.581	Surface	2008	453.567	231.695	Surface	2012
456.830	232.161	Surface	2008	456.830	232.351	Surface	2012
460.093	232.476	Surface	2008	460.093	232.765	Surface	2012
463.356	232.620	Surface	2008	463.356	232.954	Surface	2012
466.619	232.698	Surface	2008	466.619	233.015	Surface	2012
469.882	232.839	Surface	2008	469.882	233.052	Surface	2012
473.145	232.987	Surface	2008	473.145	233.092	Surface	2012
476.408	233.155	Surface	2008	476.408	233.160	Surface	2012

10.8 Transect H – Knickpoint – All Returns:

Distance	Z	DEM	Year	Distance	Z	DEM	Year
0.000	255.134	Surface	2006	0.000	255.179	Surface	2011
2.998	255.158	Surface	2006	2.998	254.859	Surface	2011
5.997	255.194	Surface	2006	5.997	253.906	Surface	2011
8.995	254.814	Surface	2006	8.995	252.939	Surface	2011
11.994	253.873	Surface	2006	11.994	252.009	Surface	2011
14.992	252.880	Surface	2006	14.992	251.090	Surface	2011
17.991	251.895	Surface	2006	17.991	250.171	Surface	2011
20.989	250.856	Surface	2006	20.989	249.254	Surface	2011
23.988	249.606	Surface	2006	23.988	248.307	Surface	2011
26.986	248.250	Surface	2006	26.986	247.019	Surface	2011
29.984	247.145	Surface	2006	29.984	246.082	Surface	2011
32.983	246.202	Surface	2006	32.983	245.479	Surface	2011
35.981	245.411	Surface	2006	35.981	244.904	Surface	2011
38.980	244.772	Surface	2006	38.980	244.254	Surface	2011
41.978	244.163	Surface	2006	41.978	243.629	Surface	2011
44.977	243.654	Surface	2006	44.977	243.076	Surface	2011
47.975	243.264	Surface	2006	47.975	242.276	Surface	2011
50.973	242.709	Surface	2006	50.973	241.409	Surface	2011
53.972	241.929	Surface	2006	53.972	240.585	Surface	2011
56.970	241.028	Surface	2006	56.970	239.674	Surface	2011
59.969	240.020	Surface	2006	59.969	238.737	Surface	2011
62.967	239.354	Surface	2006	62.967	237.796	Surface	2011
65.965	238.637	Surface	2006	65.965	236.857	Surface	2011
68.964	237.849	Surface	2006	68.964	235.956	Surface	2011
71.963	236.787	Surface	2006	71.963	235.211	Surface	2011
74.961	235.771	Surface	2006	74.961	234.540	Surface	2011
77.959	234.874	Surface	2006	77.959	234.061	Surface	2011
80.958	233.943	Surface	2006	80.958	233.678	Surface	2011
83.956	233.309	Surface	2006	83.956	233.173	Surface	2011
86.955	232.788	Surface	2006	86.955	232.600	Surface	2011
89.953	232.289	Surface	2006	89.953	232.034	Surface	2011
92.951	232.043	Surface	2006	92.951	231.705	Surface	2011
95.950	231.969	Surface	2006	95.950	231.574	Surface	2011
98.948	231.903	Surface	2006	98.948	231.483	Surface	2011
101.947	231.849	Surface	2006	101.947	231.442	Surface	2011
104.945	231.803	Surface	2006	104.945	231.431	Surface	2011
107.944	231.792	Surface	2006	107.944	231.452	Surface	2011
110.942	231.779	Surface	2006	110.942	231.470	Surface	2011
113.941	231.808	Surface	2006	113.941	231.479	Surface	2011
116.939	231.848	Surface	2006	116.939	231.479	Surface	2011
119.938	232.000	Surface	2006	119.938	231.477	Surface	2011
122.936	232.116	Surface	2006	122.936	231.481	Surface	2011
125.934	232.272	Surface	2006	125.934	231.493	Surface	2011
128.933	232.457	Surface	2006	128.933	231.480	Surface	2011
131.931	232.546	Surface	2006	131.931	231.468	Surface	2011

134.930	232.611	Surface	2006	134.930	231.485	Surface	2011
137.928	232.709	Surface	2006	137.928	231.546	Surface	2011
140.927	232.769	Surface	2006	140.927	231.636	Surface	2011
143.925	232.835	Surface	2006	143.925	231.781	Surface	2011
146.923	232.857	Surface	2006	146.923	231.952	Surface	2011
149.922	232.834	Surface	2006	149.922	232.117	Surface	2011
152.920	232.816	Surface	2006	152.920	232.251	Surface	2011
155.919	232.795	Surface	2006	155.919	232.350	Surface	2011
158.917	232.724	Surface	2006	158.917	232.418	Surface	2011
161.916	232.615	Surface	2006	161.916	232.421	Surface	2011
164.914	232.549	Surface	2006	164.914	232.349	Surface	2011
167.913	232.500	Surface	2006	167.913	232.174	Surface	2011
170.911	232.451	Surface	2006	170.911	231.836	Surface	2011
173.909	232.370	Surface	2006	173.909	231.397	Surface	2011
176.908	232.239	Surface	2006	176.908	231.002	Surface	2011
179.906	232.101	Surface	2006	179.906	230.770	Surface	2011
182.905	231.978	Surface	2006	182.905	230.618	Surface	2011
185.903	231.841	Surface	2006	185.903	230.574	Surface	2011
188.901	231.693	Surface	2006	188.901	230.536	Surface	2011
191.900	231.518	Surface	2006	191.900	230.509	Surface	2011
194.898	231.365	Surface	2006	194.898	230.503	Surface	2011
197.897	231.317	Surface	2006	197.897	230.525	Surface	2011
200.895	231.320	Surface	2006	200.895	230.527	Surface	2011
203.894	231.295	Surface	2006	203.894	230.532	Surface	2011
206.892	231.190	Surface	2006	206.892	230.538	Surface	2011
209.891	231.125	Surface	2006	209.891	230.543	Surface	2011
212.889	231.112	Surface	2006	212.889	230.517	Surface	2011
215.887	231.148	Surface	2006	215.887	230.511	Surface	2011
218.886	231.007	Surface	2006	218.886	230.530	Surface	2011
221.884	230.977	Surface	2006	221.884	230.571	Surface	2011
224.883	231.159	Surface	2006	224.883	230.660	Surface	2011
227.881	231.307	Surface	2006	227.881	230.787	Surface	2011
230.880	231.540	Surface	2006	230.880	230.913	Surface	2011
233.878	231.743	Surface	2006	233.878	231.028	Surface	2011
236.876	231.836	Surface	2006	236.876	231.139	Surface	2011
239.875	231.855	Surface	2006	239.875	231.244	Surface	2011
242.873	231.842	Surface	2006	242.873	231.290	Surface	2011
245.872	231.868	Surface	2006	245.872	231.312	Surface	2011
248.870	231.881	Surface	2006	248.870	231.371	Surface	2011
251.869	231.910	Surface	2006	251.869	231.439	Surface	2011
254.867	231.862	Surface	2006	254.867	231.515	Surface	2011
257.866	231.928	Surface	2006	257.866	231.590	Surface	2011
260.864	231.923	Surface	2006	260.864	231.686	Surface	2011
263.863	231.957	Surface	2006	263.863	231.880	Surface	2011
266.861	232.110	Surface	2006	266.861	232.212	Surface	2011
269.859	232.434	Surface	2006	269.859	232.647	Surface	2011
272.858	232.876	Surface	2006	272.858	233.093	Surface	2011
275.856	233.387	Surface	2006	275.856	233.548	Surface	2011
278.855	234.065	Surface	2006	278.855	234.009	Surface	2011

281.853	234.699	Surface	2006	281.853	234.470	Surface	2011
284.851	235.124	Surface	2006	284.851	234.932	Surface	2011
287.850	235.489	Surface	2006	287.850	235.380	Surface	2011
290.849	235.851	Surface	2006	290.849	235.750	Surface	2011
293.847	236.209	Surface	2006	293.847	236.015	Surface	2011
296.845	236.561	Surface	2006	296.845	236.286	Surface	2011
299.844	236.879	Surface	2006	299.844	236.574	Surface	2011
302.842	237.174	Surface	2006	302.842	236.864	Surface	2011
305.841	237.462	Surface	2006	305.841	237.153	Surface	2011
308.839	237.749	Surface	2006	308.839	237.443	Surface	2011
311.837	238.038	Surface	2006	311.837	237.733	Surface	2011
314.836	238.328	Surface	2006	314.836	238.022	Surface	2011
317.834	238.627	Surface	2006	317.834	238.312	Surface	2011
320.833	238.944	Surface	2006	320.833	238.601	Surface	2011
323.831	239.276	Surface	2006	323.831	238.891	Surface	2011
326.830	239.612	Surface	2006	326.830	239.181	Surface	2011
329.828	239.936	Surface	2006	329.828	239.481	Surface	2011
332.826	240.146	Surface	2006	332.826	239.780	Surface	2011
335.825	240.172	Surface	2006	335.825	240.062	Surface	2011
338.823	240.208	Surface	2006	338.823	240.370	Surface	2011
341.822	240.369	Surface	2006	341.822	240.680	Surface	2011
344.820	240.597	Surface	2006	344.820	241.054	Surface	2011
347.819	240.918	Surface	2006	347.819	241.447	Surface	2011
350.817	241.226	Surface	2006	350.817	241.806	Surface	2011
353.816	241.515	Surface	2006	353.816	242.108	Surface	2011
356.814	241.797	Surface	2006	356.814	242.437	Surface	2011
359.812	242.075	Surface	2006	359.812	242.762	Surface	2011
362.811	242.367	Surface	2006	362.811	243.082	Surface	2011
365.809	242.673	Surface	2006	365.809	243.401	Surface	2011
368.808	242.991	Surface	2006	368.808	243.719	Surface	2011
371.806	243.328	Surface	2006	371.806	243.980	Surface	2011
374.805	243.867	Surface	2006	374.805	244.207	Surface	2011
377.803	244.240	Surface	2006	377.803	244.422	Surface	2011
380.802	244.530	Surface	2006	380.802	244.647	Surface	2011
383.800	244.874	Surface	2006	383.800	244.875	Surface	2011
386.798	245.184	Surface	2006	386.798	245.105	Surface	2011
389.797	245.416	Surface	2006	389.797	245.334	Surface	2011
392.795	245.621	Surface	2006	392.795	245.564	Surface	2011
395.794	245.827	Surface	2006	395.794	245.804	Surface	2011
398.792	246.073	Surface	2006	398.792	246.031	Surface	2011
0.000	255.321	Surface	2008	0.000	255.239	Surface	2012
3.269	255.341	Surface	2008	3.269	255.232	Surface	2012
6.537	255.092	Surface	2008	6.537	255.179	Surface	2012
9.806	253.902	Surface	2008	9.806	254.245	Surface	2012
13.075	252.762	Surface	2008	13.075	253.193	Surface	2012
16.344	251.666	Surface	2008	16.344	252.079	Surface	2012
19.613	250.554	Surface	2008	19.613	250.825	Surface	2012
22.882	249.391	Surface	2008	22.882	249.422	Surface	2012
26.150	248.459	Surface	2008	26.150	247.853	Surface	2012

29.419	247.239	Surface	2008	29.419	246.762	Surface	2012
32.688	246.036	Surface	2008	32.688	245.897	Surface	2012
35.957	245.305	Surface	2008	35.957	245.285	Surface	2012
39.226	244.636	Surface	2008	39.226	244.508	Surface	2012
42.494	243.993	Surface	2008	42.494	243.858	Surface	2012
45.763	243.236	Surface	2008	45.763	243.195	Surface	2012
49.032	242.432	Surface	2008	49.032	242.281	Surface	2012
52.301	241.540	Surface	2008	52.301	241.359	Surface	2012
55.569	240.637	Surface	2008	55.569	240.383	Surface	2012
58.838	239.845	Surface	2008	58.838	239.260	Surface	2012
62.107	239.115	Surface	2008	62.107	238.165	Surface	2012
65.376	238.365	Surface	2008	65.376	237.134	Surface	2012
68.645	237.458	Surface	2008	68.645	236.207	Surface	2012
71.913	236.264	Surface	2008	71.913	235.448	Surface	2012
75.182	235.051	Surface	2008	75.182	234.834	Surface	2012
78.451	234.126	Surface	2008	78.451	234.138	Surface	2012
81.720	233.348	Surface	2008	81.720	233.454	Surface	2012
84.989	232.596	Surface	2008	84.989	232.942	Surface	2012
88.257	232.045	Surface	2008	88.257	232.544	Surface	2012
91.526	231.845	Surface	2008	91.526	232.104	Surface	2012
94.795	231.780	Surface	2008	94.795	231.754	Surface	2012
98.064	231.763	Surface	2008	98.064	231.608	Surface	2012
101.332	231.761	Surface	2008	101.332	231.536	Surface	2012
104.601	231.752	Surface	2008	104.601	231.489	Surface	2012
107.870	231.718	Surface	2008	107.870	231.439	Surface	2012
111.139	231.697	Surface	2008	111.139	231.455	Surface	2012
114.408	231.791	Surface	2008	114.408	231.517	Surface	2012
117.676	231.994	Surface	2008	117.676	231.543	Surface	2012
120.945	232.069	Surface	2008	120.945	231.600	Surface	2012
124.214	232.267	Surface	2008	124.214	231.612	Surface	2012
127.483	232.454	Surface	2008	127.483	231.650	Surface	2012
130.752	232.576	Surface	2008	130.752	231.747	Surface	2012
134.020	232.690	Surface	2008	134.020	231.886	Surface	2012
137.289	232.754	Surface	2008	137.289	231.998	Surface	2012
140.558	232.779	Surface	2008	140.558	232.083	Surface	2012
143.827	232.781	Surface	2008	143.827	232.143	Surface	2012
147.096	232.811	Surface	2008	147.096	232.251	Surface	2012
150.364	232.824	Surface	2008	150.364	232.285	Surface	2012
153.633	232.723	Surface	2008	153.633	232.240	Surface	2012
156.902	232.632	Surface	2008	156.902	232.193	Surface	2012
160.171	232.571	Surface	2008	160.171	231.871	Surface	2012
163.439	232.489	Surface	2008	163.439	231.551	Surface	2012
166.708	232.427	Surface	2008	166.708	231.350	Surface	2012
169.977	232.350	Surface	2008	169.977	231.170	Surface	2012
173.246	232.258	Surface	2008	173.246	231.062	Surface	2012
176.515	232.130	Surface	2008	176.515	231.078	Surface	2012
179.783	231.969	Surface	2008	179.783	231.025	Surface	2012
183.052	231.813	Surface	2008	183.052	230.869	Surface	2012
186.321	231.636	Surface	2008	186.321	230.775	Surface	2012

189.590	231.366	Surface	2008	189.590	230.737	Surface	2012
192.858	231.147	Surface	2008	192.858	230.712	Surface	2012
196.127	231.121	Surface	2008	196.127	230.709	Surface	2012
199.396	231.132	Surface	2008	199.396	230.674	Surface	2012
202.665	231.075	Surface	2008	202.665	230.630	Surface	2012
205.934	231.034	Surface	2008	205.934	230.661	Surface	2012
209.202	231.012	Surface	2008	209.202	230.712	Surface	2012
212.471	231.002	Surface	2008	212.471	230.768	Surface	2012
215.740	230.977	Surface	2008	215.740	230.672	Surface	2012
219.009	230.970	Surface	2008	219.009	230.666	Surface	2012
222.278	231.136	Surface	2008	222.278	230.693	Surface	2012
225.546	231.260	Surface	2008	225.546	230.877	Surface	2012
228.815	231.497	Surface	2008	228.815	231.130	Surface	2012
232.084	231.724	Surface	2008	232.084	231.435	Surface	2012
235.353	231.716	Surface	2008	235.353	231.733	Surface	2012
238.621	231.716	Surface	2008	238.621	231.591	Surface	2012
241.890	231.754	Surface	2008	241.890	231.494	Surface	2012
245.159	231.772	Surface	2008	245.159	231.426	Surface	2012
248.428	231.813	Surface	2008	248.428	231.440	Surface	2012
251.697	231.860	Surface	2008	251.697	231.490	Surface	2012
254.965	231.901	Surface	2008	254.965	231.530	Surface	2012
258.234	231.950	Surface	2008	258.234	231.583	Surface	2012
261.503	231.978	Surface	2008	261.503	231.645	Surface	2012
264.772	232.029	Surface	2008	264.772	231.796	Surface	2012
268.041	232.327	Surface	2008	268.041	232.137	Surface	2012
271.309	232.908	Surface	2008	271.309	232.735	Surface	2012
274.578	233.564	Surface	2008	274.578	233.404	Surface	2012
277.847	234.223	Surface	2008	277.847	233.998	Surface	2012
281.116	234.770	Surface	2008	281.116	234.553	Surface	2012
284.384	235.151	Surface	2008	284.384	235.112	Surface	2012
287.653	235.489	Surface	2008	287.653	235.598	Surface	2012
290.922	235.841	Surface	2008	290.922	235.971	Surface	2012
294.191	236.237	Surface	2008	294.191	236.378	Surface	2012
297.460	236.664	Surface	2008	297.460	236.818	Surface	2012
300.728	237.090	Surface	2008	300.728	237.258	Surface	2012
303.997	237.520	Surface	2008	303.997	237.695	Surface	2012
307.266	237.950	Surface	2008	307.266	238.129	Surface	2012
310.535	238.386	Surface	2008	310.535	238.566	Surface	2012
313.804	238.822	Surface	2008	313.804	238.982	Surface	2012
317.072	239.255	Surface	2008	317.072	239.338	Surface	2012
320.341	239.596	Surface	2008	320.341	239.619	Surface	2012
323.610	239.707	Surface	2008	323.610	239.857	Surface	2012
326.879	239.909	Surface	2008	326.879	240.056	Surface	2012
330.147	240.065	Surface	2008	330.147	240.109	Surface	2012
333.417	240.179	Surface	2008	333.417	240.117	Surface	2012
336.685	240.251	Surface	2008	336.685	240.262	Surface	2012
339.954	240.313	Surface	2008	339.954	240.314	Surface	2012
343.223	240.617	Surface	2008	343.223	240.641	Surface	2012
346.491	240.958	Surface	2008	346.491	240.977	Surface	2012

349.760	241.333	Surface	2008	349.760	241.319	Surface	2012
353.029	241.790	Surface	2008	353.029	241.698	Surface	2012
356.298	242.202	Surface	2008	356.298	241.940	Surface	2012
359.567	242.520	Surface	2008	359.567	242.202	Surface	2012
362.836	242.807	Surface	2008	362.836	242.484	Surface	2012
366.104	243.070	Surface	2008	366.104	242.779	Surface	2012
369.373	243.316	Surface	2008	369.373	243.081	Surface	2012
372.642	243.688	Surface	2008	372.642	243.403	Surface	2012
375.911	244.173	Surface	2008	375.911	243.824	Surface	2012
379.180	244.645	Surface	2008	379.180	244.311	Surface	2012
382.448	244.999	Surface	2008	382.448	244.796	Surface	2012
385.717	245.248	Surface	2008	385.717	245.173	Surface	2012
388.986	245.476	Surface	2008	388.986	245.452	Surface	2012
392.255	245.700	Surface	2008	392.255	245.716	Surface	2012
395.523	245.920	Surface	2008	395.523	245.993	Surface	2012
398.792	246.064	Surface	2008	398.792	246.194	Surface	2012

11.0 Appendix C: Stream Gradient Profiles

11.1 Stream Gradient - 2006 Lidar:

Distance	Z	DEM	Year	Distance	Z	DEM	Year
0.000	233.418	Surface	2006	5284.769	226.781	Surface	2006
2.980	233.419	Surface	2006	5287.708	226.777	Surface	2006
5.959	233.413	Surface	2006	5290.647	226.784	Surface	2006
8.939	233.407	Surface	2006	5293.586	226.786	Surface	2006
11.919	233.406	Surface	2006	5296.524	226.762	Surface	2006
14.899	233.402	Surface	2006	5299.463	226.781	Surface	2006
17.878	233.403	Surface	2006	5302.402	226.786	Surface	2006
20.858	233.417	Surface	2006	5305.341	226.789	Surface	2006
23.838	233.412	Surface	2006	5308.280	226.781	Surface	2006
26.818	233.405	Surface	2006	5311.218	226.791	Surface	2006
29.797	233.417	Surface	2006	5314.157	226.792	Surface	2006
32.777	233.399	Surface	2006	5317.096	226.790	Surface	2006
35.757	233.390	Surface	2006	5320.035	226.787	Surface	2006
38.737	233.406	Surface	2006	5322.973	226.808	Surface	2006
41.716	233.399	Surface	2006	5325.912	226.831	Surface	2006
44.696	233.394	Surface	2006	5328.851	226.829	Surface	2006
47.676	233.390	Surface	2006	5331.790	226.822	Surface	2006
50.656	233.370	Surface	2006	5334.728	226.793	Surface	2006
53.635	233.391	Surface	2006	5337.667	226.782	Surface	2006
56.615	233.376	Surface	2006	5340.606	226.783	Surface	2006
59.595	233.366	Surface	2006	5343.544	226.779	Surface	2006
62.575	233.356	Surface	2006	5346.483	226.766	Surface	2006
65.555	233.352	Surface	2006	5349.422	226.770	Surface	2006
68.534	233.350	Surface	2006	5352.408	226.773	Surface	2006
71.514	233.357	Surface	2006	5355.394	226.752	Surface	2006
74.494	233.356	Surface	2006	5358.380	226.770	Surface	2006
77.444	233.343	Surface	2006	5361.366	226.777	Surface	2006
80.394	233.348	Surface	2006	5364.351	226.802	Surface	2006
83.345	233.351	Surface	2006	5367.337	226.826	Surface	2006
86.295	233.347	Surface	2006	5370.323	226.787	Surface	2006
89.245	233.325	Surface	2006	5373.309	226.784	Surface	2006
92.196	233.327	Surface	2006	5376.295	226.781	Surface	2006
95.146	233.330	Surface	2006	5379.281	226.777	Surface	2006
98.096	233.341	Surface	2006	5382.267	226.761	Surface	2006
101.047	233.331	Surface	2006	5385.253	226.767	Surface	2006
103.997	233.325	Surface	2006	5388.238	226.784	Surface	2006
106.947	233.313	Surface	2006	5391.224	226.792	Surface	2006
109.898	233.315	Surface	2006	5394.210	226.786	Surface	2006
112.848	233.311	Surface	2006	5397.196	226.783	Surface	2006
115.798	233.310	Surface	2006	5400.182	226.751	Surface	2006
118.749	233.309	Surface	2006	5403.168	226.753	Surface	2006
121.699	233.302	Surface	2006	5406.154	226.775	Surface	2006
124.649	233.297	Surface	2006	5409.140	226.779	Surface	2006

127.600	233.278	Surface	2006	5412.126	226.768	Surface	2006
130.550	233.285	Surface	2006	5415.111	226.759	Surface	2006
133.500	233.284	Surface	2006	5418.097	226.761	Surface	2006
136.451	233.278	Surface	2006	5421.083	226.760	Surface	2006
139.401	233.274	Surface	2006	5424.069	226.753	Surface	2006
142.351	233.282	Surface	2006	5427.055	226.755	Surface	2006
145.302	233.295	Surface	2006	5430.041	226.759	Surface	2006
148.252	233.287	Surface	2006	5433.026	226.757	Surface	2006
151.202	233.279	Surface	2006	5436.013	226.751	Surface	2006
154.153	233.272	Surface	2006	5438.998	226.741	Surface	2006
157.103	233.270	Surface	2006	5441.984	226.748	Surface	2006
160.053	233.245	Surface	2006	5444.970	226.715	Surface	2006
163.003	233.236	Surface	2006	5447.956	226.695	Surface	2006
165.954	233.247	Surface	2006	5450.942	226.697	Surface	2006
168.904	233.276	Surface	2006	5453.928	226.712	Surface	2006
171.854	233.272	Surface	2006	5456.913	226.719	Surface	2006
174.805	233.249	Surface	2006	5459.899	226.695	Surface	2006
177.755	233.253	Surface	2006	5462.885	226.695	Surface	2006
180.705	233.240	Surface	2006	5465.871	226.707	Surface	2006
183.656	233.230	Surface	2006	5468.857	226.716	Surface	2006
186.606	233.224	Surface	2006	5471.843	226.726	Surface	2006
189.556	233.213	Surface	2006	5474.829	226.748	Surface	2006
192.507	233.219	Surface	2006	5477.815	226.760	Surface	2006
195.457	233.220	Surface	2006	5480.801	226.762	Surface	2006
198.407	233.205	Surface	2006	5483.792	226.722	Surface	2006
201.358	233.189	Surface	2006	5486.783	226.694	Surface	2006
204.308	233.183	Surface	2006	5489.774	226.685	Surface	2006
207.258	233.200	Surface	2006	5492.765	226.694	Surface	2006
210.209	233.183	Surface	2006	5495.756	226.689	Surface	2006
213.159	233.178	Surface	2006	5498.747	226.686	Surface	2006
216.109	233.141	Surface	2006	5501.738	226.701	Surface	2006
219.059	233.141	Surface	2006	5504.729	226.697	Surface	2006
222.010	233.158	Surface	2006	5507.720	226.681	Surface	2006
224.960	233.170	Surface	2006	5510.711	226.681	Surface	2006
227.910	233.163	Surface	2006	5513.702	226.677	Surface	2006
230.861	233.174	Surface	2006	5516.693	226.675	Surface	2006
233.811	233.169	Surface	2006	5519.684	226.669	Surface	2006
236.761	233.138	Surface	2006	5522.675	226.672	Surface	2006
239.712	233.104	Surface	2006	5525.666	226.670	Surface	2006
242.662	233.115	Surface	2006	5528.658	226.658	Surface	2006
245.584	233.115	Surface	2006	5531.648	226.658	Surface	2006
248.507	233.124	Surface	2006	5534.639	226.666	Surface	2006
251.429	233.127	Surface	2006	5537.631	226.664	Surface	2006
254.351	233.132	Surface	2006	5540.622	226.656	Surface	2006
257.274	233.114	Surface	2006	5543.613	226.654	Surface	2006
260.196	233.106	Surface	2006	5546.604	226.653	Surface	2006
263.118	233.065	Surface	2006	5549.595	226.641	Surface	2006
266.041	233.052	Surface	2006	5552.586	226.635	Surface	2006
268.963	233.055	Surface	2006	5555.577	226.640	Surface	2006

271.885	233.062	Surface	2006	5558.568	226.646	Surface	2006
274.807	233.047	Surface	2006	5561.559	226.641	Surface	2006
277.730	233.022	Surface	2006	5564.550	226.650	Surface	2006
280.652	233.028	Surface	2006	5567.541	226.643	Surface	2006
283.574	233.036	Surface	2006	5570.532	226.633	Surface	2006
286.497	233.022	Surface	2006	5573.523	226.645	Surface	2006
289.419	233.012	Surface	2006	5576.514	226.637	Surface	2006
292.341	233.012	Surface	2006	5579.506	226.637	Surface	2006
295.264	233.009	Surface	2006	5582.497	226.635	Surface	2006
298.186	232.985	Surface	2006	5585.496	226.632	Surface	2006
301.108	232.985	Surface	2006	5588.495	226.629	Surface	2006
304.030	232.959	Surface	2006	5591.494	226.628	Surface	2006
306.953	232.960	Surface	2006	5594.493	226.621	Surface	2006
309.875	232.966	Surface	2006	5597.493	226.641	Surface	2006
312.797	232.954	Surface	2006	5600.492	226.638	Surface	2006
315.719	232.942	Surface	2006	5603.491	226.634	Surface	2006
318.642	232.943	Surface	2006	5606.490	226.625	Surface	2006
321.564	232.920	Surface	2006	5609.489	226.614	Surface	2006
324.487	232.897	Surface	2006	5612.489	226.598	Surface	2006
327.409	232.868	Surface	2006	5615.488	226.588	Surface	2006
330.345	232.868	Surface	2006	5618.487	226.600	Surface	2006
333.282	232.873	Surface	2006	5621.486	226.617	Surface	2006
336.218	232.859	Surface	2006	5624.485	226.617	Surface	2006
339.155	232.842	Surface	2006	5627.485	226.579	Surface	2006
342.091	232.842	Surface	2006	5630.484	226.582	Surface	2006
345.028	232.828	Surface	2006	5633.483	226.601	Surface	2006
347.965	232.810	Surface	2006	5636.482	226.602	Surface	2006
350.901	232.803	Surface	2006	5639.481	226.580	Surface	2006
353.838	232.792	Surface	2006	5642.480	226.581	Surface	2006
356.774	232.783	Surface	2006	5645.480	226.582	Surface	2006
359.710	232.787	Surface	2006	5648.479	226.555	Surface	2006
362.647	232.768	Surface	2006	5651.478	226.570	Surface	2006
365.584	232.777	Surface	2006	5654.477	226.568	Surface	2006
368.520	232.744	Surface	2006	5657.477	226.570	Surface	2006
371.457	232.726	Surface	2006	5660.476	226.582	Surface	2006
374.393	232.711	Surface	2006	5663.475	226.558	Surface	2006
377.330	232.705	Surface	2006	5666.474	226.556	Surface	2006
380.266	232.703	Surface	2006	5669.473	226.539	Surface	2006
383.203	232.700	Surface	2006	5672.472	226.568	Surface	2006
386.139	232.639	Surface	2006	5675.472	226.567	Surface	2006
389.076	232.598	Surface	2006	5678.471	226.559	Surface	2006
392.013	232.552	Surface	2006	5681.470	226.553	Surface	2006
394.949	232.527	Surface	2006	5684.437	226.550	Surface	2006
397.885	232.526	Surface	2006	5687.403	226.521	Surface	2006
400.822	232.505	Surface	2006	5690.370	226.518	Surface	2006
403.758	232.474	Surface	2006	5693.336	226.519	Surface	2006
406.695	232.450	Surface	2006	5696.303	226.514	Surface	2006
409.632	232.432	Surface	2006	5699.269	226.512	Surface	2006
412.568	232.430	Surface	2006	5702.236	226.508	Surface	2006

415.505	232.443	Surface	2006	5705.202	226.497	Surface	2006
418.441	232.407	Surface	2006	5708.169	226.487	Surface	2006
421.378	232.404	Surface	2006	5711.135	226.493	Surface	2006
424.314	232.413	Surface	2006	5714.102	226.508	Surface	2006
427.251	232.356	Surface	2006	5717.068	226.494	Surface	2006
430.187	232.333	Surface	2006	5720.035	226.502	Surface	2006
433.124	232.331	Surface	2006	5723.001	226.494	Surface	2006
436.060	232.236	Surface	2006	5725.968	226.481	Surface	2006
438.997	232.168	Surface	2006	5728.935	226.464	Surface	2006
441.956	232.144	Surface	2006	5731.901	226.444	Surface	2006
444.915	232.080	Surface	2006	5734.868	226.454	Surface	2006
447.874	232.006	Surface	2006	5737.834	226.433	Surface	2006
450.834	231.947	Surface	2006	5740.801	226.426	Surface	2006
453.793	231.863	Surface	2006	5743.767	226.426	Surface	2006
456.752	231.788	Surface	2006	5746.734	226.423	Surface	2006
459.711	231.714	Surface	2006	5749.700	226.407	Surface	2006
462.671	231.639	Surface	2006	5752.667	226.424	Surface	2006
465.630	231.566	Surface	2006	5755.633	226.412	Surface	2006
468.589	231.448	Surface	2006	5758.600	226.408	Surface	2006
471.548	231.347	Surface	2006	5761.566	226.419	Surface	2006
474.508	231.306	Surface	2006	5764.533	226.401	Surface	2006
477.467	231.321	Surface	2006	5767.495	226.434	Surface	2006
480.426	231.326	Surface	2006	5770.457	226.423	Surface	2006
483.385	231.309	Surface	2006	5773.419	226.419	Surface	2006
486.344	231.285	Surface	2006	5776.381	226.416	Surface	2006
489.304	231.260	Surface	2006	5779.343	226.409	Surface	2006
492.263	231.251	Surface	2006	5782.304	226.405	Surface	2006
495.222	231.230	Surface	2006	5785.266	226.411	Surface	2006
498.181	231.239	Surface	2006	5788.228	226.422	Surface	2006
501.140	231.260	Surface	2006	5791.190	226.409	Surface	2006
504.093	231.257	Surface	2006	5794.152	226.395	Surface	2006
507.046	231.249	Surface	2006	5797.114	226.384	Surface	2006
509.998	231.262	Surface	2006	5800.076	226.378	Surface	2006
512.951	231.248	Surface	2006	5803.038	226.386	Surface	2006
515.904	231.269	Surface	2006	5806.000	226.396	Surface	2006
518.856	231.263	Surface	2006	5808.962	226.393	Surface	2006
521.809	231.257	Surface	2006	5811.924	226.386	Surface	2006
524.761	231.260	Surface	2006	5814.886	226.401	Surface	2006
527.714	231.284	Surface	2006	5817.848	226.408	Surface	2006
530.667	231.275	Surface	2006	5820.810	226.402	Surface	2006
533.620	231.252	Surface	2006	5823.772	226.394	Surface	2006
536.572	231.249	Surface	2006	5826.734	226.384	Surface	2006
539.525	231.233	Surface	2006	5829.695	226.367	Surface	2006
542.477	231.244	Surface	2006	5832.657	226.361	Surface	2006
545.430	231.254	Surface	2006	5835.619	226.383	Surface	2006
548.383	231.258	Surface	2006	5838.534	226.366	Surface	2006
551.336	231.229	Surface	2006	5841.448	226.357	Surface	2006
554.288	231.224	Surface	2006	5844.363	226.353	Surface	2006
557.241	231.247	Surface	2006	5847.278	226.361	Surface	2006

560.193	231.247	Surface	2006	5850.192	226.364	Surface	2006
563.146	231.201	Surface	2006	5853.107	226.338	Surface	2006
566.099	231.202	Surface	2006	5856.022	226.322	Surface	2006
569.051	231.233	Surface	2006	5858.936	226.356	Surface	2006
572.004	231.244	Surface	2006	5861.851	226.368	Surface	2006
574.957	231.215	Surface	2006	5864.765	226.312	Surface	2006
577.854	231.214	Surface	2006	5867.680	226.342	Surface	2006
580.751	231.225	Surface	2006	5870.595	226.334	Surface	2006
583.648	231.214	Surface	2006	5873.509	226.325	Surface	2006
586.545	231.190	Surface	2006	5876.424	226.338	Surface	2006
589.442	231.179	Surface	2006	5879.339	226.354	Surface	2006
592.340	231.183	Surface	2006	5882.253	226.365	Surface	2006
595.237	231.184	Surface	2006	5885.168	226.339	Surface	2006
598.134	231.179	Surface	2006	5888.083	226.316	Surface	2006
601.031	231.168	Surface	2006	5890.997	226.316	Surface	2006
603.928	231.163	Surface	2006	5893.912	226.318	Surface	2006
606.825	231.166	Surface	2006	5896.826	226.325	Surface	2006
609.723	231.156	Surface	2006	5899.741	226.307	Surface	2006
612.620	231.158	Surface	2006	5902.656	226.312	Surface	2006
615.517	231.148	Surface	2006	5905.570	226.327	Surface	2006
618.414	231.121	Surface	2006	5908.485	226.329	Surface	2006
621.396	231.124	Surface	2006	5911.400	226.317	Surface	2006
624.377	231.117	Surface	2006	5914.314	226.317	Surface	2006
627.359	231.100	Surface	2006	5917.229	226.304	Surface	2006
630.341	231.036	Surface	2006	5920.143	226.306	Surface	2006
633.322	231.082	Surface	2006	5923.096	226.317	Surface	2006
636.304	231.087	Surface	2006	5926.048	226.238	Surface	2006
639.285	231.037	Surface	2006	5929.000	226.208	Surface	2006
642.267	231.050	Surface	2006	5931.952	226.208	Surface	2006
645.249	231.033	Surface	2006	5934.905	226.193	Surface	2006
648.230	231.048	Surface	2006	5937.857	226.180	Surface	2006
651.212	231.007	Surface	2006	5940.809	226.172	Surface	2006
654.194	231.019	Surface	2006	5943.762	226.179	Surface	2006
657.176	230.999	Surface	2006	5946.714	226.167	Surface	2006
660.157	230.968	Surface	2006	5949.666	226.155	Surface	2006
662.902	230.947	Surface	2006	5952.618	226.165	Surface	2006
665.647	230.945	Surface	2006	5955.570	226.183	Surface	2006
668.392	230.945	Surface	2006	5958.523	226.185	Surface	2006
671.137	230.923	Surface	2006	5961.475	226.164	Surface	2006
673.882	230.909	Surface	2006	5964.427	226.140	Surface	2006
676.627	230.937	Surface	2006	5967.380	226.149	Surface	2006
679.372	230.937	Surface	2006	5970.332	226.128	Surface	2006
682.117	230.896	Surface	2006	5973.284	226.102	Surface	2006
684.862	230.874	Surface	2006	5976.236	226.101	Surface	2006
687.608	230.867	Surface	2006	5979.188	226.095	Surface	2006
690.491	230.858	Surface	2006	5982.141	226.092	Surface	2006
693.375	230.851	Surface	2006	5985.093	226.081	Surface	2006
696.258	230.862	Surface	2006	5988.045	226.062	Surface	2006
699.142	230.851	Surface	2006	5990.998	226.043	Surface	2006

702.026	230.847	Surface	2006	5993.960	226.020	Surface	2006
704.909	230.850	Surface	2006	5996.922	225.990	Surface	2006
707.793	230.843	Surface	2006	5999.885	225.956	Surface	2006
710.677	230.840	Surface	2006	6002.847	225.942	Surface	2006
713.609	230.845	Surface	2006	6005.809	225.925	Surface	2006
716.542	230.839	Surface	2006	6008.772	225.904	Surface	2006
719.475	230.839	Surface	2006	6011.734	225.880	Surface	2006
722.408	230.855	Surface	2006	6014.696	225.861	Surface	2006
725.341	230.863	Surface	2006	6017.658	225.857	Surface	2006
728.274	230.869	Surface	2006	6020.621	225.841	Surface	2006
731.207	230.858	Surface	2006	6023.583	225.809	Surface	2006
734.139	230.884	Surface	2006	6026.545	225.764	Surface	2006
737.072	230.902	Surface	2006	6029.507	225.727	Surface	2006
740.005	230.866	Surface	2006	6032.470	225.701	Surface	2006
742.938	230.867	Surface	2006	6035.432	225.703	Surface	2006
745.890	230.890	Surface	2006	6038.394	225.717	Surface	2006
748.841	230.894	Surface	2006	6041.328	225.729	Surface	2006
751.793	230.916	Surface	2006	6044.261	225.729	Surface	2006
754.745	230.976	Surface	2006	6047.194	225.735	Surface	2006
757.696	230.861	Surface	2006	6050.128	225.720	Surface	2006
760.648	230.824	Surface	2006	6053.061	225.714	Surface	2006
763.600	230.866	Surface	2006	6055.995	225.717	Surface	2006
766.552	230.868	Surface	2006	6058.928	225.706	Surface	2006
769.503	230.827	Surface	2006	6061.862	225.727	Surface	2006
772.455	230.831	Surface	2006	6064.795	225.748	Surface	2006
775.417	230.833	Surface	2006	6067.728	225.706	Surface	2006
778.380	230.852	Surface	2006	6070.662	225.724	Surface	2006
781.342	230.866	Surface	2006	6073.595	225.722	Surface	2006
784.304	230.882	Surface	2006	6076.529	225.735	Surface	2006
787.266	230.890	Surface	2006	6079.462	225.700	Surface	2006
790.229	230.855	Surface	2006	6082.396	225.692	Surface	2006
793.191	230.825	Surface	2006	6085.329	225.685	Surface	2006
796.153	230.881	Surface	2006	6088.263	225.695	Surface	2006
799.116	230.942	Surface	2006	6091.196	225.724	Surface	2006
802.078	230.984	Surface	2006	6094.048	225.729	Surface	2006
805.040	230.951	Surface	2006	6096.899	225.692	Surface	2006
808.002	230.908	Surface	2006	6099.751	225.667	Surface	2006
810.965	230.874	Surface	2006	6102.602	225.687	Surface	2006
813.927	230.850	Surface	2006	6105.454	225.690	Surface	2006
816.889	230.855	Surface	2006	6108.305	225.687	Surface	2006
819.852	230.878	Surface	2006	6111.157	225.712	Surface	2006
822.765	230.896	Surface	2006	6114.008	225.734	Surface	2006
825.679	230.896	Surface	2006	6116.860	225.755	Surface	2006
828.592	230.880	Surface	2006	6119.711	225.770	Surface	2006
831.506	230.888	Surface	2006	6122.563	225.748	Surface	2006
834.419	230.893	Surface	2006	6125.414	225.737	Surface	2006
837.333	230.890	Surface	2006	6128.266	225.713	Surface	2006
840.246	230.916	Surface	2006	6131.118	225.722	Surface	2006
843.160	230.932	Surface	2006	6133.969	225.722	Surface	2006

846.073	230.913	Surface	2006	6136.821	225.719	Surface	2006
848.987	230.914	Surface	2006	6139.817	225.693	Surface	2006
851.900	230.918	Surface	2006	6142.813	225.717	Surface	2006
854.814	230.909	Surface	2006	6145.809	225.744	Surface	2006
857.727	230.917	Surface	2006	6148.805	225.707	Surface	2006
860.641	230.907	Surface	2006	6151.802	225.714	Surface	2006
863.555	230.927	Surface	2006	6154.798	225.708	Surface	2006
866.468	230.912	Surface	2006	6157.794	225.707	Surface	2006
869.382	230.908	Surface	2006	6160.790	225.707	Surface	2006
872.295	230.892	Surface	2006	6163.787	225.707	Surface	2006
875.228	230.884	Surface	2006	6166.783	225.716	Surface	2006
878.161	230.885	Surface	2006	6169.779	225.712	Surface	2006
881.094	230.888	Surface	2006	6172.776	225.709	Surface	2006
884.027	230.887	Surface	2006	6175.772	225.732	Surface	2006
886.960	230.878	Surface	2006	6178.768	225.727	Surface	2006
889.892	230.870	Surface	2006	6181.764	225.725	Surface	2006
892.825	230.851	Surface	2006	6184.761	225.737	Surface	2006
895.758	230.808	Surface	2006	6187.656	225.735	Surface	2006
898.691	230.800	Surface	2006	6190.553	225.742	Surface	2006
901.624	230.772	Surface	2006	6193.448	225.753	Surface	2006
904.557	230.724	Surface	2006	6196.345	225.762	Surface	2006
907.347	230.714	Surface	2006	6199.241	225.762	Surface	2006
910.137	230.729	Surface	2006	6202.137	225.757	Surface	2006
912.927	230.704	Surface	2006	6205.033	225.764	Surface	2006
915.717	230.638	Surface	2006	6207.929	225.772	Surface	2006
918.507	230.594	Surface	2006	6210.825	225.774	Surface	2006
921.297	230.537	Surface	2006	6213.721	225.787	Surface	2006
924.087	230.513	Surface	2006	6216.617	225.795	Surface	2006
926.877	230.514	Surface	2006	6219.513	225.785	Surface	2006
929.667	230.452	Surface	2006	6222.409	225.776	Surface	2006
932.457	230.355	Surface	2006	6225.305	225.772	Surface	2006
935.247	230.299	Surface	2006	6228.201	225.770	Surface	2006
938.096	230.273	Surface	2006	6231.097	225.750	Surface	2006
940.944	230.264	Surface	2006	6233.993	225.769	Surface	2006
943.792	230.226	Surface	2006	6236.889	225.793	Surface	2006
946.640	230.178	Surface	2006	6239.781	225.817	Surface	2006
949.489	230.140	Surface	2006	6242.673	225.813	Surface	2006
952.337	230.114	Surface	2006	6245.564	225.816	Surface	2006
955.185	230.106	Surface	2006	6248.456	225.810	Surface	2006
958.033	230.096	Surface	2006	6251.348	225.803	Surface	2006
960.882	230.082	Surface	2006	6254.240	225.799	Surface	2006
963.730	230.105	Surface	2006	6257.131	225.793	Surface	2006
966.579	230.150	Surface	2006	6260.023	225.790	Surface	2006
969.427	230.169	Surface	2006	6262.915	225.792	Surface	2006
972.275	230.181	Surface	2006	6265.807	225.795	Surface	2006
975.124	230.193	Surface	2006	6268.699	225.798	Surface	2006
977.972	230.169	Surface	2006	6271.590	225.799	Surface	2006
980.820	230.139	Surface	2006	6274.482	225.795	Surface	2006
983.746	230.139	Surface	2006	6277.374	225.792	Surface	2006

986.672	230.121	Surface	2006	6280.265	225.795	Surface	2006
989.598	230.109	Surface	2006	6283.157	225.793	Surface	2006
992.524	230.125	Surface	2006	6286.049	225.792	Surface	2006
995.450	230.152	Surface	2006	6288.941	225.789	Surface	2006
998.375	230.154	Surface	2006	6291.833	225.785	Surface	2006
1001.301	230.148	Surface	2006	6294.726	225.788	Surface	2006
1004.227	230.140	Surface	2006	6297.620	225.788	Surface	2006
1007.153	230.128	Surface	2006	6300.513	225.798	Surface	2006
1010.079	230.128	Surface	2006	6303.407	225.810	Surface	2006
1013.005	230.125	Surface	2006	6306.300	225.820	Surface	2006
1015.931	230.131	Surface	2006	6309.194	225.832	Surface	2006
1018.857	230.160	Surface	2006	6312.087	225.841	Surface	2006
1021.783	230.166	Surface	2006	6314.981	225.840	Surface	2006
1024.708	230.152	Surface	2006	6317.874	225.840	Surface	2006
1027.669	230.141	Surface	2006	6320.768	225.841	Surface	2006
1030.630	230.146	Surface	2006	6323.661	225.843	Surface	2006
1033.591	230.154	Surface	2006	6326.555	225.845	Surface	2006
1036.552	230.155	Surface	2006	6329.448	225.848	Surface	2006
1039.513	230.155	Surface	2006	6332.342	225.849	Surface	2006
1042.474	230.140	Surface	2006	6335.236	225.852	Surface	2006
1045.435	230.138	Surface	2006	6338.129	225.854	Surface	2006
1048.396	230.158	Surface	2006	6341.023	225.856	Surface	2006
1051.357	230.151	Surface	2006	6343.916	225.859	Surface	2006
1054.318	230.150	Surface	2006	6346.782	225.868	Surface	2006
1057.279	230.151	Surface	2006	6349.648	225.915	Surface	2006
1060.240	230.146	Surface	2006	6352.513	226.014	Surface	2006
1063.201	230.163	Surface	2006	6355.379	226.102	Surface	2006
1066.161	230.137	Surface	2006	6358.245	226.150	Surface	2006
1069.123	230.135	Surface	2006	6361.111	226.158	Surface	2006
1072.084	230.143	Surface	2006	6363.976	226.169	Surface	2006
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1083.594	230.138	Surface	2006	6375.439	226.203	Surface	2006
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1089.294	230.123	Surface	2006	6381.171	226.212	Surface	2006
1092.143	230.136	Surface	2006	6384.036	226.212	Surface	2006
1094.993	230.146	Surface	2006	6386.902	226.212	Surface	2006
1097.843	230.170	Surface	2006	6389.768	226.195	Surface	2006
1100.693	230.169	Surface	2006	6392.634	226.109	Surface	2006
1103.543	230.159	Surface	2006	6395.499	225.992	Surface	2006
1106.393	230.154	Surface	2006	6398.466	225.881	Surface	2006
1109.242	230.164	Surface	2006	6401.432	225.796	Surface	2006
1112.092	230.166	Surface	2006	6404.397	225.763	Surface	2006
1114.942	230.165	Surface	2006	6407.364	225.761	Surface	2006
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1120.768	230.139	Surface	2006	6413.296	225.859	Surface	2006
1123.681	230.130	Surface	2006	6416.262	225.939	Surface	2006
1126.594	230.144	Surface	2006	6419.228	226.017	Surface	2006

1129.506	230.145	Surface	2006	6422.194	226.090	Surface	2006
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1135.332	230.180	Surface	2006	6428.126	226.114	Surface	2006
1138.245	230.186	Surface	2006	6431.093	226.106	Surface	2006
1141.158	230.179	Surface	2006	6434.084	226.099	Surface	2006
1144.071	230.190	Surface	2006	6437.077	226.087	Surface	2006
1146.984	230.196	Surface	2006	6440.069	226.072	Surface	2006
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1167.374	230.178	Surface	2006	6461.013	225.898	Surface	2006
1170.287	230.191	Surface	2006	6464.005	225.861	Surface	2006
1173.200	230.186	Surface	2006	6466.997	225.806	Surface	2006
1176.113	230.196	Surface	2006	6469.989	225.779	Surface	2006
1179.026	230.202	Surface	2006	6472.981	225.786	Surface	2006
1181.847	230.186	Surface	2006	6475.973	225.792	Surface	2006
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1187.489	230.140	Surface	2006	6481.957	225.797	Surface	2006
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1193.131	230.146	Surface	2006	6487.941	225.792	Surface	2006
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1224.394	230.118	Surface	2006	6520.830	225.775	Surface	2006
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1244.533	230.105	Surface	2006	6541.733	225.738	Surface	2006
1247.515	230.105	Surface	2006	6544.719	225.737	Surface	2006
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1253.481	230.089	Surface	2006	6550.617	225.739	Surface	2006
1256.463	230.085	Surface	2006	6553.529	225.741	Surface	2006
1259.445	230.097	Surface	2006	6556.440	225.742	Surface	2006
1262.428	230.104	Surface	2006	6559.352	225.743	Surface	2006
1265.411	230.101	Surface	2006	6562.264	225.744	Surface	2006
1268.393	230.109	Surface	2006	6565.175	225.743	Surface	2006

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1298.219	230.106	Surface	2006	6594.365	225.754	Surface	2006
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1447.714	230.035	Surface	2006	6744.065	225.784	Surface	2006
1450.657	230.036	Surface	2006	6747.031	225.778	Surface	2006
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1524.181	229.943	Surface	2006	6821.785	225.793	Surface	2006
1527.117	229.951	Surface	2006	6824.780	225.801	Surface	2006
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1532.988	229.958	Surface	2006	6830.770	225.769	Surface	2006
1535.923	229.952	Surface	2006	6833.714	225.766	Surface	2006
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1550.601	229.916	Surface	2006	6848.436	225.761	Surface	2006
1553.537	229.924	Surface	2006	6851.380	225.754	Surface	2006
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1562.344	229.909	Surface	2006	6860.213	225.709	Surface	2006
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1597.412	229.860	Surface	2006	6895.546	225.714	Surface	2006
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1861.768	229.807	Surface	2006	7161.091	225.658	Surface	2006
1864.738	229.816	Surface	2006	7164.006	225.665	Surface	2006
1867.707	229.801	Surface	2006	7166.920	225.671	Surface	2006
1870.678	229.780	Surface	2006	7169.835	225.670	Surface	2006
1873.647	229.813	Surface	2006	7172.749	225.663	Surface	2006
1876.617	229.803	Surface	2006	7175.664	225.659	Surface	2006
1879.587	229.794	Surface	2006	7178.578	225.677	Surface	2006
1882.557	229.792	Surface	2006	7181.493	225.683	Surface	2006
1885.527	229.792	Surface	2006	7184.407	225.668	Surface	2006
1888.496	229.796	Surface	2006	7187.322	225.686	Surface	2006
1891.467	229.778	Surface	2006	7190.237	225.703	Surface	2006
1894.436	229.787	Surface	2006	7193.151	225.687	Surface	2006
1897.406	229.826	Surface	2006	7196.070	225.665	Surface	2006
1900.376	229.810	Surface	2006	7198.988	225.652	Surface	2006
1903.308	229.795	Surface	2006	7201.907	225.647	Surface	2006
1906.239	229.794	Surface	2006	7204.825	225.663	Surface	2006
1909.171	229.792	Surface	2006	7207.743	225.665	Surface	2006
1912.103	229.797	Surface	2006	7210.662	225.672	Surface	2006
1915.034	229.818	Surface	2006	7213.580	225.669	Surface	2006
1917.966	229.846	Surface	2006	7216.499	225.663	Surface	2006
1920.898	229.851	Surface	2006	7219.417	225.673	Surface	2006
1923.830	229.822	Surface	2006	7222.336	225.660	Surface	2006
1926.761	229.813	Surface	2006	7225.254	225.647	Surface	2006
1929.693	229.802	Surface	2006	7228.173	225.656	Surface	2006
1932.625	229.803	Surface	2006	7231.091	225.679	Surface	2006
1935.556	229.812	Surface	2006	7234.010	225.680	Surface	2006
1938.488	229.818	Surface	2006	7236.928	225.653	Surface	2006
1941.420	229.828	Surface	2006	7239.847	225.662	Surface	2006
1944.351	229.833	Surface	2006	7242.765	225.647	Surface	2006
1947.283	229.813	Surface	2006	7245.684	225.647	Surface	2006
1950.215	229.793	Surface	2006	7248.602	225.641	Surface	2006
1953.147	229.804	Surface	2006	7251.520	225.663	Surface	2006
1956.078	229.816	Surface	2006	7254.439	225.675	Surface	2006
1959.010	229.810	Surface	2006	7257.358	225.629	Surface	2006
1961.864	229.808	Surface	2006	7260.276	225.611	Surface	2006
1964.719	229.819	Surface	2006	7263.194	225.597	Surface	2006
1967.573	229.813	Surface	2006	7266.113	225.623	Surface	2006
1970.428	229.810	Surface	2006	7269.031	225.629	Surface	2006
1973.282	229.818	Surface	2006	7271.950	225.625	Surface	2006
1976.136	229.827	Surface	2006	7274.868	225.648	Surface	2006
1978.991	229.818	Surface	2006	7277.787	225.647	Surface	2006
1981.845	229.808	Surface	2006	7280.649	225.633	Surface	2006
1984.700	229.811	Surface	2006	7283.511	225.621	Surface	2006
1987.554	229.826	Surface	2006	7286.373	225.595	Surface	2006

1990.408	229.825	Surface	2006	7289.236	225.593	Surface	2006
1993.262	229.832	Surface	2006	7292.098	225.598	Surface	2006
1996.117	229.836	Surface	2006	7294.960	225.616	Surface	2006
1998.971	229.820	Surface	2006	7297.823	225.625	Surface	2006
2001.826	229.794	Surface	2006	7300.685	225.617	Surface	2006
2004.680	229.800	Surface	2006	7303.547	225.615	Surface	2006
2007.534	229.827	Surface	2006	7306.409	225.596	Surface	2006
2010.389	229.837	Surface	2006	7309.272	225.596	Surface	2006
2013.243	229.829	Surface	2006	7312.134	225.606	Surface	2006
2016.097	229.835	Surface	2006	7314.996	225.614	Surface	2006
2019.058	229.841	Surface	2006	7317.859	225.630	Surface	2006
2022.019	229.844	Surface	2006	7320.721	225.631	Surface	2006
2024.980	229.844	Surface	2006	7323.583	225.604	Surface	2006
2027.941	229.841	Surface	2006	7326.446	225.616	Surface	2006
2030.902	229.828	Surface	2006	7329.308	225.599	Surface	2006
2033.863	229.822	Surface	2006	7332.170	225.576	Surface	2006
2036.824	229.816	Surface	2006	7335.092	225.579	Surface	2006
2039.785	229.813	Surface	2006	7338.013	225.603	Surface	2006
2042.746	229.811	Surface	2006	7340.935	225.629	Surface	2006
2045.707	229.828	Surface	2006	7343.857	225.583	Surface	2006
2048.668	229.828	Surface	2006	7346.778	225.575	Surface	2006
2051.629	229.833	Surface	2006	7349.700	225.561	Surface	2006
2054.590	229.848	Surface	2006	7352.622	225.564	Surface	2006
2057.551	229.847	Surface	2006	7355.543	225.595	Surface	2006
2060.512	229.830	Surface	2006	7358.465	225.587	Surface	2006
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2066.434	229.848	Surface	2006	7364.308	225.559	Surface	2006
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2075.114	229.821	Surface	2006	7373.073	225.579	Surface	2006
2078.008	229.807	Surface	2006	7375.995	225.560	Surface	2006
2080.901	229.826	Surface	2006	7378.917	225.545	Surface	2006
2083.795	229.850	Surface	2006	7381.838	225.548	Surface	2006
2086.688	229.860	Surface	2006	7384.760	225.534	Surface	2006
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2092.475	229.876	Surface	2006	7390.603	225.512	Surface	2006
2095.369	229.885	Surface	2006	7393.596	225.520	Surface	2006
2098.262	229.892	Surface	2006	7396.590	225.516	Surface	2006
2101.156	229.886	Surface	2006	7399.584	225.503	Surface	2006
2104.049	229.864	Surface	2006	7402.577	225.492	Surface	2006
2106.943	229.849	Surface	2006	7405.571	225.497	Surface	2006
2109.836	229.852	Surface	2006	7408.564	225.515	Surface	2006
2112.823	229.853	Surface	2006	7411.557	225.544	Surface	2006
2115.810	229.859	Surface	2006	7414.551	225.526	Surface	2006
2118.797	229.853	Surface	2006	7417.545	225.511	Surface	2006
2121.784	229.836	Surface	2006	7420.538	225.500	Surface	2006
2124.771	229.825	Surface	2006	7423.532	225.497	Surface	2006
2127.758	229.828	Surface	2006	7426.525	225.489	Surface	2006
2130.745	229.831	Surface	2006	7429.519	225.475	Surface	2006

2133.732	229.830	Surface	2006	7432.512	225.463	Surface	2006
2136.720	229.833	Surface	2006	7435.506	225.446	Surface	2006
2139.707	229.832	Surface	2006	7438.499	225.461	Surface	2006
2142.694	229.827	Surface	2006	7441.493	225.463	Surface	2006
2145.681	229.838	Surface	2006	7444.486	225.452	Surface	2006
2148.668	229.858	Surface	2006	7447.480	225.439	Surface	2006
2151.655	229.861	Surface	2006	7450.473	225.447	Surface	2006
2154.642	229.858	Surface	2006	7453.467	225.437	Surface	2006
2157.629	229.882	Surface	2006	7456.460	225.403	Surface	2006
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2163.568	229.984	Surface	2006	7462.447	225.404	Surface	2006
2166.538	230.027	Surface	2006	7465.358	225.389	Surface	2006
2169.507	230.025	Surface	2006	7468.269	225.353	Surface	2006
2172.477	230.008	Surface	2006	7471.180	225.326	Surface	2006
2175.447	229.991	Surface	2006	7474.091	225.318	Surface	2006
2178.416	229.973	Surface	2006	7477.002	225.322	Surface	2006
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2184.356	229.937	Surface	2006	7482.824	225.332	Surface	2006
2187.325	229.919	Surface	2006	7485.735	225.303	Surface	2006
2190.295	229.902	Surface	2006	7488.646	225.325	Surface	2006
2193.264	229.892	Surface	2006	7491.557	225.335	Surface	2006
2196.234	229.885	Surface	2006	7494.468	225.342	Surface	2006
2199.204	229.879	Surface	2006	7497.379	225.350	Surface	2006
2202.174	229.872	Surface	2006	7500.290	225.334	Surface	2006
2205.143	229.868	Surface	2006	7503.201	225.320	Surface	2006
2208.113	229.862	Surface	2006	7506.112	225.302	Surface	2006
2211.082	229.862	Surface	2006	7509.023	225.271	Surface	2006
2214.052	229.870	Surface	2006	7511.934	225.310	Surface	2006
2216.975	230.105	Surface	2006	7514.801	225.311	Surface	2006
2219.897	230.263	Surface	2006	7517.667	225.306	Surface	2006
2222.820	230.348	Surface	2006	7520.534	225.309	Surface	2006
2225.742	230.361	Surface	2006	7523.401	225.304	Surface	2006
2228.665	230.299	Surface	2006	7526.268	225.286	Surface	2006
2231.588	230.165	Surface	2006	7529.134	225.295	Surface	2006
2234.510	229.957	Surface	2006	7532.001	225.302	Surface	2006
2237.432	229.882	Surface	2006	7534.868	225.295	Surface	2006
2240.355	229.868	Surface	2006	7537.735	225.272	Surface	2006
2243.278	229.864	Surface	2006	7540.601	225.237	Surface	2006
2246.200	229.862	Surface	2006	7543.468	225.263	Surface	2006
2249.123	229.861	Surface	2006	7546.335	225.265	Surface	2006
2252.045	229.861	Surface	2006	7549.201	225.262	Surface	2006
2254.968	229.863	Surface	2006	7552.068	225.263	Surface	2006
2257.890	229.865	Surface	2006	7554.935	225.238	Surface	2006
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2263.736	229.867	Surface	2006	7560.668	225.212	Surface	2006
2266.658	229.866	Surface	2006	7563.535	225.164	Surface	2006
2269.580	229.865	Surface	2006	7566.402	225.217	Surface	2006
2272.503	229.865	Surface	2006	7569.268	225.253	Surface	2006
2275.426	229.864	Surface	2006	7572.253	225.238	Surface	2006

2278.348	229.862	Surface	2006	7575.238	225.236	Surface	2006
2281.271	229.862	Surface	2006	7578.223	225.204	Surface	2006
2284.193	229.861	Surface	2006	7581.207	225.158	Surface	2006
2287.116	229.859	Surface	2006	7584.192	225.158	Surface	2006
2290.038	229.859	Surface	2006	7587.177	225.191	Surface	2006
2292.959	229.859	Surface	2006	7590.162	225.205	Surface	2006
2295.881	229.858	Surface	2006	7593.146	225.214	Surface	2006
2298.802	229.856	Surface	2006	7596.131	225.201	Surface	2006
2301.724	229.856	Surface	2006	7599.115	225.182	Surface	2006
2304.645	229.855	Surface	2006	7602.100	225.132	Surface	2006
2307.566	229.853	Surface	2006	7605.085	225.141	Surface	2006
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2313.409	229.852	Surface	2006	7611.054	225.174	Surface	2006
2316.330	229.850	Surface	2006	7614.039	225.185	Surface	2006
2319.251	229.850	Surface	2006	7617.024	225.190	Surface	2006
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2328.016	229.859	Surface	2006	7625.978	225.176	Surface	2006
2330.937	229.856	Surface	2006	7628.963	225.178	Surface	2006
2333.858	229.845	Surface	2006	7631.947	225.179	Surface	2006
2336.780	229.839	Surface	2006	7634.932	225.134	Surface	2006
2339.701	229.846	Surface	2006	7637.917	225.142	Surface	2006
2342.622	229.841	Surface	2006	7640.901	225.145	Surface	2006
2345.543	229.838	Surface	2006	7643.886	225.163	Surface	2006
2348.465	229.833	Surface	2006	7646.871	225.169	Surface	2006
2351.386	229.829	Surface	2006	7649.856	225.159	Surface	2006
2354.308	229.836	Surface	2006	7652.840	225.125	Surface	2006
2357.229	229.831	Surface	2006	7655.825	225.095	Surface	2006
2360.150	229.824	Surface	2006	7658.810	225.075	Surface	2006
2363.072	229.816	Surface	2006	7661.794	225.061	Surface	2006
2365.993	229.809	Surface	2006	7664.779	225.085	Surface	2006
2368.912	229.805	Surface	2006	7667.768	225.125	Surface	2006
2371.832	229.802	Surface	2006	7670.756	225.127	Surface	2006
2374.751	229.799	Surface	2006	7673.744	225.093	Surface	2006
2377.671	229.796	Surface	2006	7676.732	225.086	Surface	2006
2380.590	229.793	Surface	2006	7679.721	225.118	Surface	2006
2383.510	229.790	Surface	2006	7682.709	225.139	Surface	2006
2386.429	229.787	Surface	2006	7685.697	225.161	Surface	2006
2389.348	229.784	Surface	2006	7688.686	225.164	Surface	2006
2392.268	229.781	Surface	2006	7691.674	225.153	Surface	2006
2395.187	229.778	Surface	2006	7694.663	225.088	Surface	2006
2398.107	229.775	Surface	2006	7697.651	225.053	Surface	2006
2401.026	229.775	Surface	2006	7700.639	225.090	Surface	2006
2403.945	229.783	Surface	2006	7703.628	225.115	Surface	2006
2406.865	229.788	Surface	2006	7706.616	225.124	Surface	2006
2409.784	229.785	Surface	2006	7709.604	225.119	Surface	2006
2412.704	229.782	Surface	2006	7712.593	225.092	Surface	2006
2415.623	229.777	Surface	2006	7715.581	225.038	Surface	2006
2418.543	229.771	Surface	2006	7718.496	225.043	Surface	2006

2421.462	229.757	Surface	2006	7721.412	225.042	Surface	2006
2424.382	229.734	Surface	2006	7724.327	225.054	Surface	2006
2427.301	229.732	Surface	2006	7727.242	225.095	Surface	2006
2430.220	229.728	Surface	2006	7730.158	225.124	Surface	2006
2433.140	229.719	Surface	2006	7733.073	225.093	Surface	2006
2436.059	229.710	Surface	2006	7735.989	225.097	Surface	2006
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2441.898	229.695	Surface	2006	7741.819	225.128	Surface	2006
2444.817	229.686	Surface	2006	7744.734	225.127	Surface	2006
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2453.597	229.729	Surface	2006	7753.481	225.066	Surface	2006
2456.537	229.738	Surface	2006	7756.392	225.099	Surface	2006
2459.477	229.713	Surface	2006	7759.303	225.068	Surface	2006
2462.418	229.701	Surface	2006	7762.214	225.024	Surface	2006
2465.358	229.706	Surface	2006	7765.125	225.010	Surface	2006
2468.298	229.708	Surface	2006	7768.036	225.050	Surface	2006
2471.239	229.715	Surface	2006	7770.947	225.110	Surface	2006
2474.179	229.715	Surface	2006	7773.858	225.080	Surface	2006
2477.119	229.721	Surface	2006	7776.769	225.070	Surface	2006
2480.060	229.720	Surface	2006	7779.680	225.109	Surface	2006
2483.000	229.713	Surface	2006	7782.591	225.106	Surface	2006
2485.941	229.716	Surface	2006	7785.502	225.125	Surface	2006
2488.881	229.708	Surface	2006	7788.413	225.147	Surface	2006
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2500.642	229.689	Surface	2006	7800.057	225.103	Surface	2006
2503.583	229.674	Surface	2006	7802.968	225.130	Surface	2006
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2509.463	229.704	Surface	2006	7808.907	225.110	Surface	2006
2512.404	229.690	Surface	2006	7811.877	225.089	Surface	2006
2515.344	229.686	Surface	2006	7814.846	225.105	Surface	2006
2518.284	229.672	Surface	2006	7817.816	225.106	Surface	2006
2521.225	229.674	Surface	2006	7820.786	225.105	Surface	2006
2524.165	229.670	Surface	2006	7823.755	225.089	Surface	2006
2527.105	229.657	Surface	2006	7826.725	225.106	Surface	2006
2530.089	229.633	Surface	2006	7829.694	225.077	Surface	2006
2533.072	229.662	Surface	2006	7832.664	225.083	Surface	2006
2536.055	229.646	Surface	2006	7835.634	225.119	Surface	2006
2539.038	229.658	Surface	2006	7838.604	225.149	Surface	2006
2542.021	229.634	Surface	2006	7841.573	225.080	Surface	2006
2545.004	229.640	Surface	2006	7844.543	225.049	Surface	2006
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2553.954	229.642	Surface	2006	7853.452	225.128	Surface	2006
2556.937	229.646	Surface	2006	7856.422	225.104	Surface	2006
2559.920	229.642	Surface	2006	7859.391	225.083	Surface	2006
2562.903	229.610	Surface	2006	7862.374	225.042	Surface	2006

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2568.869	229.623	Surface	2006	7868.339	225.098	Surface	2006
2571.853	229.643	Surface	2006	7871.322	225.062	Surface	2006
2574.835	229.639	Surface	2006	7874.304	225.005	Surface	2006
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2645.357	229.555	Surface	2006	7944.292	224.963	Surface	2006
2648.269	229.557	Surface	2006	7947.160	224.933	Surface	2006
2651.180	229.524	Surface	2006	7950.029	224.924	Surface	2006
2654.091	229.544	Surface	2006	7952.898	224.907	Surface	2006
2657.003	229.536	Surface	2006	7955.867	224.885	Surface	2006
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2691.969	229.422	Surface	2006	7991.497	224.836	Surface	2006
2694.885	229.424	Surface	2006	7994.466	224.879	Surface	2006
2697.801	229.420	Surface	2006	7997.436	224.879	Surface	2006
2700.717	229.402	Surface	2006	8000.405	224.860	Surface	2006
2703.633	229.387	Surface	2006	8003.374	224.855	Surface	2006
2706.549	229.403	Surface	2006	8006.343	224.857	Surface	2006

2709.465	229.396	Surface	2006	8009.313	224.854	Surface	2006
2712.381	229.357	Surface	2006	8012.282	224.804	Surface	2006
2715.297	229.356	Surface	2006	8015.251	224.751	Surface	2006
2718.213	229.360	Surface	2006	8018.220	224.732	Surface	2006
2721.129	229.303	Surface	2006	8021.189	224.737	Surface	2006
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2729.768	229.278	Surface	2006	8030.080	224.681	Surface	2006
2732.576	229.274	Surface	2006	8033.031	224.677	Surface	2006
2735.383	229.249	Surface	2006	8035.983	224.652	Surface	2006
2738.190	229.235	Surface	2006	8038.935	224.615	Surface	2006
2740.998	229.219	Surface	2006	8041.886	224.550	Surface	2006
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2746.612	229.244	Surface	2006	8047.790	224.550	Surface	2006
2749.420	229.229	Surface	2006	8050.741	224.465	Surface	2006
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2766.264	229.193	Surface	2006	8068.455	224.265	Surface	2006
2769.223	229.186	Surface	2006	8071.408	224.255	Surface	2006
2772.183	229.170	Surface	2006	8074.361	224.269	Surface	2006
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2778.101	229.150	Surface	2006	8080.266	224.330	Surface	2006
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2786.979	229.160	Surface	2006	8089.124	224.302	Surface	2006
2789.938	229.151	Surface	2006	8092.077	224.332	Surface	2006
2792.898	229.147	Surface	2006	8095.030	224.307	Surface	2006
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2798.816	229.179	Surface	2006	8100.935	224.274	Surface	2006
2801.676	229.164	Surface	2006	8103.887	224.319	Surface	2006
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2835.907	229.052	Surface	2006	8139.064	224.300	Surface	2006
2838.686	229.014	Surface	2006	8141.931	224.303	Surface	2006
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2844.242	228.940	Surface	2006	8147.666	224.284	Surface	2006
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3598.605	227.744	Surface	2006	8889.838	224.100	Surface	2006
3601.587	227.743	Surface	2006	8892.810	224.095	Surface	2006
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3610.535	227.733	Surface	2006	8901.726	224.096	Surface	2006
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3619.483	227.737	Surface	2006	8910.641	224.107	Surface	2006
3622.465	227.716	Surface	2006	8913.613	224.102	Surface	2006
3625.378	227.711	Surface	2006	8916.585	224.106	Surface	2006
3628.292	227.708	Surface	2006	8919.557	224.111	Surface	2006
3631.205	227.708	Surface	2006	8922.452	224.114	Surface	2006
3634.119	227.701	Surface	2006	8925.348	224.114	Surface	2006
3637.032	227.695	Surface	2006	8928.243	224.113	Surface	2006
3639.946	227.701	Surface	2006	8931.138	224.110	Surface	2006
3642.859	227.704	Surface	2006	8934.034	224.109	Surface	2006
3645.773	227.674	Surface	2006	8936.929	224.111	Surface	2006
3648.686	227.674	Surface	2006	8939.824	224.162	Surface	2006
3651.600	227.675	Surface	2006	8942.720	224.174	Surface	2006
3654.513	227.690	Surface	2006	8945.615	224.173	Surface	2006
3657.427	227.703	Surface	2006	8948.510	224.172	Surface	2006
3660.340	227.701	Surface	2006	8951.406	224.174	Surface	2006
3663.254	227.690	Surface	2006	8954.301	224.174	Surface	2006
3666.167	227.705	Surface	2006	8957.196	224.174	Surface	2006
3669.081	227.716	Surface	2006	8960.092	224.174	Surface	2006
3671.994	227.707	Surface	2006	8962.987	224.174	Surface	2006
3674.908	227.678	Surface	2006	8965.882	224.174	Surface	2006
3677.821	227.722	Surface	2006	8968.778	224.174	Surface	2006
3680.734	227.707	Surface	2006	8971.673	224.174	Surface	2006
3683.648	227.694	Surface	2006	8974.568	224.175	Surface	2006
3686.561	227.693	Surface	2006	8977.464	224.177	Surface	2006
3689.475	227.676	Surface	2006	8980.357	224.177	Surface	2006
3692.388	227.677	Surface	2006	8983.251	224.175	Surface	2006
3695.302	227.686	Surface	2006	8986.144	224.175	Surface	2006
3698.215	227.689	Surface	2006	8989.038	224.172	Surface	2006
3701.129	227.668	Surface	2006	8991.931	224.172	Surface	2006
3704.105	227.681	Surface	2006	8994.825	224.169	Surface	2006
3707.082	227.692	Surface	2006	8997.718	224.169	Surface	2006
3710.058	227.675	Surface	2006	9000.612	224.166	Surface	2006

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3716.012	227.676	Surface	2006	9006.504	224.163	Surface	2006
3718.988	227.694	Surface	2006	9009.503	224.162	Surface	2006
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3724.941	227.709	Surface	2006	9015.500	224.159	Surface	2006
3727.918	227.694	Surface	2006	9018.499	224.158	Surface	2006
3730.895	227.682	Surface	2006	9021.497	224.156	Surface	2006
3733.871	227.678	Surface	2006	9024.496	224.155	Surface	2006
3736.848	227.689	Surface	2006	9027.494	224.153	Surface	2006
3739.825	227.685	Surface	2006	9030.493	224.152	Surface	2006
3742.801	227.676	Surface	2006	9033.492	224.150	Surface	2006
3745.778	227.666	Surface	2006	9036.491	224.149	Surface	2006
3748.754	227.620	Surface	2006	9039.489	224.147	Surface	2006
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3816.979	227.710	Surface	2006	9107.804	224.332	Surface	2006
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3831.969	227.708	Surface	2006	9122.563	224.298	Surface	2006
3834.967	227.695	Surface	2006	9125.515	224.289	Surface	2006
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3840.963	227.696	Surface	2006	9131.419	224.277	Surface	2006
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3849.958	227.713	Surface	2006	9140.274	224.279	Surface	2006
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4083.844	227.680	Surface	2006	9373.524	224.227	Surface	2006
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4089.838	227.684	Surface	2006	9379.235	224.242	Surface	2006
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4098.828	227.680	Surface	2006	9388.080	224.209	Surface	2006
4101.825	227.675	Surface	2006	9391.075	224.213	Surface	2006
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4206.609	227.584	Surface	2006	9498.998	224.603	Surface	2006
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4457.875	227.585	Surface	2006	9750.614	224.132	Surface	2006
4460.739	227.592	Surface	2006	9753.575	224.122	Surface	2006
4463.604	227.580	Surface	2006	9756.571	224.117	Surface	2006
4466.469	227.589	Surface	2006	9759.567	224.246	Surface	2006
4469.333	227.599	Surface	2006	9762.563	224.597	Surface	2006
4472.198	227.591	Surface	2006	9765.560	225.025	Surface	2006
4475.063	227.592	Surface	2006	9768.556	225.403	Surface	2006
4477.927	227.597	Surface	2006	9771.552	225.561	Surface	2006
4480.792	227.603	Surface	2006	9774.548	225.863	Surface	2006
4483.744	227.586	Surface	2006	9777.545	225.988	Surface	2006
4486.696	227.607	Surface	2006	9780.541	225.953	Surface	2006
4489.647	227.596	Surface	2006	9783.537	225.950	Surface	2006
4492.599	227.585	Surface	2006	9786.534	225.938	Surface	2006
4495.551	227.598	Surface	2006	9789.530	225.901	Surface	2006
4498.502	227.597	Surface	2006	9792.526	225.722	Surface	2006
4501.454	227.572	Surface	2006	9795.522	225.438	Surface	2006
4504.406	227.555	Surface	2006	9798.518	225.191	Surface	2006
4507.358	227.571	Surface	2006	9801.515	225.014	Surface	2006
4510.309	227.557	Surface	2006	9804.511	224.831	Surface	2006
4513.261	227.546	Surface	2006	9807.507	224.684	Surface	2006
4516.212	227.565	Surface	2006	9810.503	224.562	Surface	2006
4519.164	227.577	Surface	2006	9813.500	224.371	Surface	2006
4522.116	227.575	Surface	2006	9816.496	224.144	Surface	2006
4525.068	227.577	Surface	2006	9819.492	223.868	Surface	2006
4528.019	227.576	Surface	2006	9822.488	223.635	Surface	2006
4530.971	227.572	Surface	2006	9825.485	223.509	Surface	2006
4533.923	227.574	Surface	2006	9828.481	223.410	Surface	2006
4536.874	227.587	Surface	2006	9831.477	223.288	Surface	2006
4539.826	227.597	Surface	2006	9834.473	223.102	Surface	2006
4542.733	227.606	Surface	2006	9837.469	222.888	Surface	2006
4545.641	227.615	Surface	2006	9840.466	222.675	Surface	2006
4548.549	227.615	Surface	2006	9843.462	222.442	Surface	2006
4551.456	227.618	Surface	2006	9846.458	222.267	Surface	2006
4554.364	227.620	Surface	2006	9849.455	222.070	Surface	2006
4557.271	227.624	Surface	2006	9852.451	221.881	Surface	2006
4560.179	227.626	Surface	2006	9855.447	221.708	Surface	2006
4563.086	227.626	Surface	2006	9858.443	221.504	Surface	2006
4565.994	227.622	Surface	2006	9861.440	221.275	Surface	2006
4568.902	227.614	Surface	2006	9864.436	221.051	Surface	2006

4571.809	227.581	Surface	2006	9867.432	220.863	Surface	2006
4574.717	227.548	Surface	2006	9870.428	220.708	Surface	2006
4577.624	227.564	Surface	2006	9873.425	220.524	Surface	2006
4580.532	227.575	Surface	2006	9876.419	220.331	Surface	2006
4583.439	227.573	Surface	2006	9879.413	220.125	Surface	2006
4586.347	227.567	Surface	2006	9882.407	219.896	Surface	2006
4589.254	227.585	Surface	2006	9885.401	219.637	Surface	2006
4592.162	227.583	Surface	2006	9888.396	219.386	Surface	2006
4595.069	227.576	Surface	2006	9891.390	219.187	Surface	2006
4598.003	227.564	Surface	2006	9894.384	218.997	Surface	2006
4600.938	227.553	Surface	2006	9897.378	218.738	Surface	2006
4603.872	227.565	Surface	2006	9900.372	218.462	Surface	2006
4606.806	227.579	Surface	2006	9903.367	218.196	Surface	2006
4609.740	227.590	Surface	2006	9906.361	217.921	Surface	2006
4612.674	227.588	Surface	2006	9909.355	217.619	Surface	2006
4615.609	227.565	Surface	2006	9912.349	217.271	Surface	2006
4618.543	227.550	Surface	2006	9915.343	216.922	Surface	2006
4621.477	227.543	Surface	2006	9918.337	216.584	Surface	2006
4624.411	227.541	Surface	2006	9921.332	216.243	Surface	2006
4627.345	227.537	Surface	2006	9924.326	215.878	Surface	2006
4630.279	227.535	Surface	2006	9927.320	215.493	Surface	2006
4633.214	227.523	Surface	2006	9930.314	215.103	Surface	2006
4636.148	227.520	Surface	2006	9933.308	214.732	Surface	2006
4639.082	227.532	Surface	2006	9936.303	214.340	Surface	2006
4642.016	227.559	Surface	2006	9939.297	213.948	Surface	2006
4644.946	227.565	Surface	2006	9942.291	213.614	Surface	2006
4647.875	227.573	Surface	2006	9945.285	213.259	Surface	2006
4650.805	227.576	Surface	2006	9948.279	212.839	Surface	2006
4653.734	227.580	Surface	2006	9951.274	212.396	Surface	2006
4656.664	227.573	Surface	2006	9954.268	212.044	Surface	2006
4659.593	227.569	Surface	2006	9957.262	211.920	Surface	2006
4662.523	227.567	Surface	2006	9960.256	211.871	Surface	2006
4665.452	227.570	Surface	2006	9963.250	211.877	Surface	2006
4668.381	227.553	Surface	2006	9966.244	211.882	Surface	2006
4671.311	227.531	Surface	2006	9969.239	211.888	Surface	2006
4674.240	227.533	Surface	2006	9972.233	211.892	Surface	2006
4677.170	227.524	Surface	2006	9975.227	211.898	Surface	2006
4680.099	227.526	Surface	2006	9978.221	211.904	Surface	2006
4683.029	227.521	Surface	2006	9981.215	211.905	Surface	2006
4685.958	227.533	Surface	2006	9984.210	211.904	Surface	2006
4688.874	227.544	Surface	2006	9987.204	211.901	Surface	2006
4691.789	227.532	Surface	2006	9990.198	211.898	Surface	2006
4694.704	227.518	Surface	2006	9993.192	211.894	Surface	2006
4697.620	227.521	Surface	2006	9996.186	211.894	Surface	2006
4700.535	227.526	Surface	2006	9999.160	211.890	Surface	2006
4703.450	227.527	Surface	2006	10002.134	211.886	Surface	2006
4706.366	227.515	Surface	2006	10005.108	211.882	Surface	2006
4709.281	227.508	Surface	2006	10008.082	211.879	Surface	2006
4712.196	227.482	Surface	2006	10011.056	211.877	Surface	2006

4715.112	227.469	Surface	2006	10014.030	211.874	Surface	2006
4718.027	227.506	Surface	2006	10017.003	211.870	Surface	2006
4720.943	227.506	Surface	2006	10019.978	211.866	Surface	2006
4723.858	227.479	Surface	2006	10022.951	211.864	Surface	2006
4726.732	227.440	Surface	2006	10025.925	211.861	Surface	2006
4729.606	227.457	Surface	2006	10028.899	211.856	Surface	2006
4732.480	227.468	Surface	2006	10031.873	211.853	Surface	2006
4735.354	227.464	Surface	2006	10034.847	211.853	Surface	2006
4738.228	227.474	Surface	2006	10037.821	211.852	Surface	2006
4741.102	227.475	Surface	2006	10040.795	211.853	Surface	2006
4743.976	227.467	Surface	2006	10043.768	211.853	Surface	2006
4746.850	227.450	Surface	2006	10046.743	211.852	Surface	2006
4749.724	227.440	Surface	2006	10049.716	211.853	Surface	2006
4752.598	227.457	Surface	2006	10052.690	211.853	Surface	2006
4755.472	227.454	Surface	2006	10055.664	211.852	Surface	2006
4758.346	227.457	Surface	2006	10058.638	211.852	Surface	2006
4761.220	227.436	Surface	2006	10061.612	211.856	Surface	2006
4764.094	227.428	Surface	2006	10064.586	211.856	Surface	2006
4766.968	227.446	Surface	2006	10067.560	211.858	Surface	2006
4769.842	227.443	Surface	2006	10070.533	211.860	Surface	2006
4772.760	227.438	Surface	2006	10073.507	211.862	Surface	2006
4775.677	227.441	Surface	2006	10076.481	211.864	Surface	2006
4778.594	227.408	Surface	2006	10079.470	211.868	Surface	2006
4781.512	227.458	Surface	2006	10082.459	211.870	Surface	2006
4784.429	227.432	Surface	2006	10085.448	211.865	Surface	2006
4787.347	227.444	Surface	2006	10088.437	211.849	Surface	2006
4790.264	227.435	Surface	2006	10091.426	211.852	Surface	2006
4793.182	227.423	Surface	2006	10094.415	211.862	Surface	2006
4796.099	227.405	Surface	2006	10097.404	211.853	Surface	2006
4799.017	227.401	Surface	2006	10100.393	211.837	Surface	2006
4801.934	227.408	Surface	2006	10103.382	211.880	Surface	2006
4804.851	227.390	Surface	2006	10106.371	211.927	Surface	2006
4807.769	227.345	Surface	2006	10109.360	211.976	Surface	2006
4810.686	227.367	Surface	2006	10112.349	212.029	Surface	2006
4813.604	227.370	Surface	2006	10115.338	212.069	Surface	2006
4816.521	227.351	Surface	2006	10118.327	212.176	Surface	2006
4819.438	227.339	Surface	2006	10121.316	212.261	Surface	2006
4822.356	227.341	Surface	2006	10124.305	212.349	Surface	2006
4825.273	227.331	Surface	2006	10127.294	212.440	Surface	2006
4828.191	227.324	Surface	2006	10130.283	212.505	Surface	2006
4831.108	227.348	Surface	2006	10133.272	212.569	Surface	2006
4834.094	227.349	Surface	2006	10136.261	212.651	Surface	2006
4837.080	227.340	Surface	2006	10139.250	212.704	Surface	2006
4840.067	227.328	Surface	2006	10142.239	212.770	Surface	2006
4843.053	227.330	Surface	2006	10145.228	212.839	Surface	2006
4846.039	227.325	Surface	2006	10148.217	212.875	Surface	2006
4849.025	227.323	Surface	2006	10151.206	212.878	Surface	2006
4852.012	227.314	Surface	2006	10154.194	212.880	Surface	2006
4854.998	227.305	Surface	2006	10157.183	212.878	Surface	2006

4857.984	227.303	Surface	2006	10160.172	212.882	Surface	2006
4860.970	227.310	Surface	2006	10163.161	212.862	Surface	2006
4863.956	227.328	Surface	2006	10166.150	212.770	Surface	2006
4866.943	227.306	Surface	2006	10169.139	212.649	Surface	2006
4869.929	227.288	Surface	2006	10172.128	212.508	Surface	2006
4872.788	227.284	Surface	2006	10175.117	212.288	Surface	2006
4875.647	227.287	Surface	2006	10178.106	212.044	Surface	2006
4878.507	227.288	Surface	2006	10181.095	211.789	Surface	2006
4881.366	227.283	Surface	2006	10184.084	211.652	Surface	2006
4884.226	227.272	Surface	2006	10187.073	211.622	Surface	2006
4887.085	227.269	Surface	2006	10190.062	211.613	Surface	2006
4889.944	227.276	Surface	2006	10193.051	211.619	Surface	2006
4892.804	227.252	Surface	2006	10196.040	211.602	Surface	2006
4895.663	227.197	Surface	2006	10199.029	211.613	Surface	2006
4898.523	227.182	Surface	2006	10202.018	211.633	Surface	2006
4901.382	227.170	Surface	2006	10205.007	211.618	Surface	2006
4904.241	227.178	Surface	2006	10207.996	211.639	Surface	2006
4907.219	227.180	Surface	2006	10210.985	211.648	Surface	2006
4910.197	227.179	Surface	2006	10213.974	211.647	Surface	2006
4913.175	227.168	Surface	2006	10216.963	211.635	Surface	2006
4916.152	227.139	Surface	2006	10219.952	211.641	Surface	2006
4919.130	227.097	Surface	2006	10222.941	211.645	Surface	2006
4922.108	227.124	Surface	2006	10225.930	211.608	Surface	2006
4925.085	227.136	Surface	2006	10228.919	211.637	Surface	2006
4928.063	227.115	Surface	2006	10231.908	211.677	Surface	2006
4931.041	227.109	Surface	2006	10234.897	211.658	Surface	2006
4934.018	227.095	Surface	2006	10237.886	211.642	Surface	2006
4936.996	227.075	Surface	2006	10240.875	211.617	Surface	2006
4939.974	227.072	Surface	2006	10243.864	211.609	Surface	2006
4942.952	227.068	Surface	2006	10246.827	211.647	Surface	2006
4945.929	227.060	Surface	2006	10249.790	211.660	Surface	2006
4948.907	227.034	Surface	2006	10252.753	211.631	Surface	2006
4951.885	227.014	Surface	2006	10255.716	211.615	Surface	2006
4954.863	226.988	Surface	2006	10258.680	211.614	Surface	2006
4957.840	226.993	Surface	2006	10261.643	211.615	Surface	2006
4960.742	226.972	Surface	2006	10264.606	211.602	Surface	2006
4963.642	226.931	Surface	2006	10267.569	211.587	Surface	2006
4966.544	226.933	Surface	2006	10270.532	211.599	Surface	2006
4969.445	226.928	Surface	2006	10273.495	211.613	Surface	2006
4972.346	226.917	Surface	2006	10276.459	211.613	Surface	2006
4975.247	226.942	Surface	2006	10279.422	211.596	Surface	2006
4978.148	226.957	Surface	2006	10282.385	211.579	Surface	2006
4981.049	226.975	Surface	2006	10285.348	211.588	Surface	2006
4983.951	226.970	Surface	2006	10288.311	211.600	Surface	2006
4986.852	226.955	Surface	2006	10291.274	211.605	Surface	2006
4989.753	226.947	Surface	2006	10294.237	211.594	Surface	2006
4992.654	226.936	Surface	2006	10297.201	211.576	Surface	2006
4995.555	226.930	Surface	2006	10300.164	211.577	Surface	2006
4998.457	226.929	Surface	2006	10303.127	211.566	Surface	2006

5001.358	226.952	Surface	2006	10306.090	211.550	Surface	2006
5004.259	226.927	Surface	2006	10309.053	211.539	Surface	2006
5007.160	226.935	Surface	2006	10312.016	211.555	Surface	2006
5010.061	226.937	Surface	2006	10314.980	211.543	Surface	2006
5012.962	226.922	Surface	2006	10317.943	211.493	Surface	2006
5015.863	226.926	Surface	2006	10320.906	211.468	Surface	2006
5018.764	226.926	Surface	2006	10323.869	211.462	Surface	2006
5021.666	226.920	Surface	2006	10326.832	211.455	Surface	2006
5024.617	226.908	Surface	2006	10329.795	211.440	Surface	2006
5027.568	226.906	Surface	2006	10332.759	211.442	Surface	2006
5030.520	226.905	Surface	2006	10335.722	211.431	Surface	2006
5033.471	226.892	Surface	2006	10338.685	211.426	Surface	2006
5036.422	226.901	Surface	2006	10341.648	211.417	Surface	2006
5039.373	226.898	Surface	2006	10344.611	211.387	Surface	2006
5042.325	226.894	Surface	2006	10347.574	211.377	Surface	2006
5045.276	226.881	Surface	2006	10350.538	211.398	Surface	2006
5048.227	226.885	Surface	2006	10353.501	211.395	Surface	2006
5051.179	226.872	Surface	2006	10356.464	211.373	Surface	2006
5054.130	226.879	Surface	2006	10359.427	211.367	Surface	2006
5057.081	226.874	Surface	2006	10362.390	211.368	Surface	2006
5060.033	226.887	Surface	2006	10365.353	211.353	Surface	2006
5062.984	226.885	Surface	2006	10368.316	211.325	Surface	2006
5065.935	226.882	Surface	2006	10371.280	211.290	Surface	2006
5068.886	226.876	Surface	2006	10374.243	211.289	Surface	2006
5071.838	226.879	Surface	2006	10377.206	211.284	Surface	2006
5074.789	226.857	Surface	2006	10380.169	211.271	Surface	2006
5077.740	226.856	Surface	2006	10383.132	211.289	Surface	2006
5080.692	226.841	Surface	2006	10386.096	211.286	Surface	2006
5083.643	226.836	Surface	2006	10389.059	211.260	Surface	2006
5086.594	226.828	Surface	2006	10392.022	211.254	Surface	2006
5089.546	226.823	Surface	2006	10394.985	211.258	Surface	2006
5092.497	226.850	Surface	2006	10397.948	211.265	Surface	2006
5095.448	226.844	Surface	2006	10400.912	211.249	Surface	2006
5098.399	226.849	Surface	2006	10403.875	211.203	Surface	2006
5101.351	226.845	Surface	2006	10406.838	211.179	Surface	2006
5104.302	226.836	Surface	2006	10409.801	211.174	Surface	2006
5107.282	226.813	Surface	2006	10412.764	211.155	Surface	2006
5110.262	226.827	Surface	2006	10415.727	211.160	Surface	2006
5113.242	226.825	Surface	2006	10418.691	211.140	Surface	2006
5116.223	226.822	Surface	2006	10421.654	211.132	Surface	2006
5119.203	226.809	Surface	2006	10424.617	211.121	Surface	2006
5122.183	226.806	Surface	2006	10427.580	211.130	Surface	2006
5125.163	226.830	Surface	2006	10430.543	211.124	Surface	2006
5128.143	226.841	Surface	2006	10433.506	211.106	Surface	2006
5131.123	226.844	Surface	2006	10436.470	211.087	Surface	2006
5134.104	226.818	Surface	2006	10439.433	211.083	Surface	2006
5137.083	226.820	Surface	2006	10442.396	211.069	Surface	2006
5140.064	226.828	Surface	2006	10445.359	211.069	Surface	2006
5143.044	226.830	Surface	2006	10448.322	211.060	Surface	2006

5146.024	226.837	Surface	2006	10451.285	211.056	Surface	2006
5149.004	226.832	Surface	2006	10454.249	211.001	Surface	2006
5151.984	226.830	Surface	2006	10457.212	210.930	Surface	2006
5154.964	226.830	Surface	2006	10460.184	210.908	Surface	2006
5157.926	226.847	Surface	2006	10463.157	210.919	Surface	2006
5160.887	226.856	Surface	2006	10466.130	210.897	Surface	2006
5163.849	226.846	Surface	2006	10469.102	210.887	Surface	2006
5166.810	226.835	Surface	2006	10472.075	210.877	Surface	2006
5169.772	226.849	Surface	2006	10475.047	210.859	Surface	2006
5172.733	226.848	Surface	2006	10478.020	210.858	Surface	2006
5175.695	226.849	Surface	2006	10480.993	210.863	Surface	2006
5178.656	226.855	Surface	2006	10483.965	210.842	Surface	2006
5181.618	226.850	Surface	2006	10486.938	210.817	Surface	2006
5184.579	226.844	Surface	2006	10489.910	210.794	Surface	2006
5187.541	226.848	Surface	2006	10492.883	210.784	Surface	2006
5190.502	226.845	Surface	2006	10495.856	210.782	Surface	2006
5193.463	226.838	Surface	2006	10498.828	210.785	Surface	2006
5196.425	226.838	Surface	2006	10501.801	210.782	Surface	2006
5199.386	226.845	Surface	2006	10504.773	210.754	Surface	2006
5202.348	226.857	Surface	2006	10507.746	210.702	Surface	2006
5205.309	226.860	Surface	2006	10510.719	210.685	Surface	2006
5208.271	226.858	Surface	2006	10513.691	210.697	Surface	2006
5211.232	226.861	Surface	2006	10516.664	210.697	Surface	2006
5214.194	226.859	Surface	2006	10519.637	210.683	Surface	2006
5217.155	226.852	Surface	2006	10522.609	210.672	Surface	2006
5220.117	226.848	Surface	2006	10525.581	210.664	Surface	2006
5223.078	226.839	Surface	2006	10528.554	210.659	Surface	2006
5226.040	226.824	Surface	2006	10531.527	210.665	Surface	2006
5229.001	226.822	Surface	2006	10534.499	210.661	Surface	2006
5231.963	226.821	Surface	2006	10537.472	210.647	Surface	2006
5234.924	226.830	Surface	2006	10540.445	210.666	Surface	2006
5237.885	226.838	Surface	2006	10543.417	210.658	Surface	2006
5240.797	226.847	Surface	2006	10546.390	210.635	Surface	2006
5243.708	226.846	Surface	2006	10549.362	210.626	Surface	2006
5246.620	226.840	Surface	2006	10552.335	210.632	Surface	2006
5249.532	226.840	Surface	2006	10555.308	210.643	Surface	2006
5252.443	226.880	Surface	2006	10558.280	210.634	Surface	2006
5255.382	226.840	Surface	2006	10561.253	210.624	Surface	2006
5258.321	226.806	Surface	2006	10564.225	210.627	Surface	2006
5261.259	226.803	Surface	2006	10567.198	210.608	Surface	2006
5264.198	226.816	Surface	2006	10570.171	210.602	Surface	2006
5267.137	226.819	Surface	2006	10573.143	210.604	Surface	2006
5270.076	226.818	Surface	2006	10576.116	210.598	Surface	2006
5273.015	226.813	Surface	2006	10579.088	210.599	Surface	2006
5275.953	226.813	Surface	2006	10582.061	210.602	Surface	2006
5278.892	226.809	Surface	2006	10585.034	210.613	Surface	2006
5281.831	226.796	Surface	2006	10588.006	210.608	Surface	2006

11.2 Stream Gradient - 2008 Lidar:

Distance	Z	DEM	Year	Distance	Z	DEM	Year
0.000	233.253	Surface	2008	5345.667	224.435	Surface	2008
3.142	233.220	Surface	2008	5348.815	224.424	Surface	2008
6.285	233.216	Surface	2008	5351.963	224.428	Surface	2008
9.427	233.235	Surface	2008	5355.112	224.445	Surface	2008
12.570	233.226	Surface	2008	5358.259	224.452	Surface	2008
15.712	233.190	Surface	2008	5361.408	224.432	Surface	2008
18.854	233.198	Surface	2008	5364.556	224.429	Surface	2008
21.997	233.232	Surface	2008	5367.704	224.440	Surface	2008
25.139	233.320	Surface	2008	5370.852	224.421	Surface	2008
28.281	233.310	Surface	2008	5374.000	224.419	Surface	2008
31.424	233.286	Surface	2008	5377.148	224.452	Surface	2008
34.566	233.277	Surface	2008	5380.296	224.471	Surface	2008
37.708	233.263	Surface	2008	5383.444	224.467	Surface	2008
40.851	233.264	Surface	2008	5386.592	224.469	Surface	2008
43.993	233.250	Surface	2008	5389.740	224.487	Surface	2008
47.135	233.245	Surface	2008	5392.888	224.492	Surface	2008
50.278	233.249	Surface	2008	5396.036	224.488	Surface	2008
53.420	233.241	Surface	2008	5399.184	224.475	Surface	2008
56.563	233.231	Surface	2008	5402.332	224.456	Surface	2008
59.705	233.240	Surface	2008	5405.480	224.427	Surface	2008
62.847	233.246	Surface	2008	5408.629	224.405	Surface	2008
65.990	233.242	Surface	2008	5411.776	224.430	Surface	2008
69.132	233.291	Surface	2008	5414.925	224.437	Surface	2008
72.395	233.317	Surface	2008	5418.073	224.443	Surface	2008
75.658	233.297	Surface	2008	5421.221	224.446	Surface	2008
78.922	233.283	Surface	2008	5424.369	224.453	Surface	2008
82.185	233.293	Surface	2008	5427.517	224.468	Surface	2008
85.448	233.323	Surface	2008	5430.665	224.458	Surface	2008
88.711	233.325	Surface	2008	5433.813	224.456	Surface	2008
91.975	233.267	Surface	2008	5436.961	224.491	Surface	2008
95.238	233.203	Surface	2008	5440.109	224.476	Surface	2008
98.501	233.194	Surface	2008	5443.257	224.460	Surface	2008
101.764	233.170	Surface	2008	5446.405	224.487	Surface	2008
105.027	233.192	Surface	2008	5449.553	224.495	Surface	2008
108.290	233.315	Surface	2008	5452.701	224.497	Surface	2008
111.554	233.342	Surface	2008	5455.849	224.522	Surface	2008
114.817	233.323	Surface	2008	5458.997	224.529	Surface	2008
118.080	233.254	Surface	2008	5462.145	224.514	Surface	2008
121.343	233.226	Surface	2008	5465.294	224.500	Surface	2008
124.606	233.199	Surface	2008	5468.441	224.491	Surface	2008
127.869	233.153	Surface	2008	5471.631	224.477	Surface	2008
131.132	233.152	Surface	2008	5474.822	224.472	Surface	2008
134.396	233.118	Surface	2008	5478.012	224.446	Surface	2008
137.659	233.092	Surface	2008	5481.202	224.407	Surface	2008
140.922	233.058	Surface	2008	5484.392	224.389	Surface	2008

144.185	233.208	Surface	2008	5487.582	224.411	Surface	2008
147.449	233.280	Surface	2008	5490.772	224.448	Surface	2008
150.712	233.270	Surface	2008	5493.962	224.472	Surface	2008
153.975	233.178	Surface	2008	5497.152	224.490	Surface	2008
157.238	233.151	Surface	2008	5500.343	224.472	Surface	2008
160.501	233.161	Surface	2008	5503.533	224.471	Surface	2008
163.764	233.138	Surface	2008	5506.723	224.478	Surface	2008
167.028	233.097	Surface	2008	5509.913	224.485	Surface	2008
170.291	233.095	Surface	2008	5513.103	224.455	Surface	2008
173.554	233.105	Surface	2008	5516.293	224.458	Surface	2008
176.817	233.127	Surface	2008	5519.483	224.469	Surface	2008
180.080	233.192	Surface	2008	5522.673	224.488	Surface	2008
183.206	233.151	Surface	2008	5525.863	224.487	Surface	2008
186.331	233.185	Surface	2008	5529.054	224.477	Surface	2008
189.457	233.161	Surface	2008	5532.244	224.456	Surface	2008
192.582	233.048	Surface	2008	5535.434	224.436	Surface	2008
195.708	233.053	Surface	2008	5538.699	224.413	Surface	2008
198.833	233.058	Surface	2008	5541.965	224.398	Surface	2008
201.959	233.049	Surface	2008	5545.230	224.406	Surface	2008
205.084	233.071	Surface	2008	5548.496	224.437	Surface	2008
208.210	233.130	Surface	2008	5551.762	224.456	Surface	2008
211.335	233.145	Surface	2008	5555.027	224.473	Surface	2008
214.461	233.114	Surface	2008	5558.293	224.470	Surface	2008
217.586	233.037	Surface	2008	5561.558	224.459	Surface	2008
220.712	233.001	Surface	2008	5564.823	224.429	Surface	2008
223.837	232.984	Surface	2008	5568.089	224.420	Surface	2008
226.963	232.971	Surface	2008	5571.355	224.437	Surface	2008
230.088	232.998	Surface	2008	5574.620	224.446	Surface	2008
233.213	233.016	Surface	2008	5577.886	224.457	Surface	2008
236.339	232.993	Surface	2008	5581.151	224.431	Surface	2008
239.464	232.985	Surface	2008	5584.417	224.408	Surface	2008
242.690	232.997	Surface	2008	5587.682	224.428	Surface	2008
245.917	232.999	Surface	2008	5590.948	224.459	Surface	2008
249.143	232.958	Surface	2008	5594.213	224.467	Surface	2008
252.369	232.917	Surface	2008	5597.479	224.455	Surface	2008
255.595	232.930	Surface	2008	5600.745	224.429	Surface	2008
258.821	232.916	Surface	2008	5604.010	224.423	Surface	2008
262.047	232.887	Surface	2008	5607.276	224.405	Surface	2008
265.273	232.853	Surface	2008	5610.541	224.385	Surface	2008
268.500	232.841	Surface	2008	5613.806	224.408	Surface	2008
271.726	232.860	Surface	2008	5617.072	224.439	Surface	2008
274.952	232.872	Surface	2008	5620.338	224.432	Surface	2008
278.178	232.876	Surface	2008	5623.603	224.417	Surface	2008
281.404	232.896	Surface	2008	5626.869	224.399	Surface	2008
284.630	232.899	Surface	2008	5630.134	224.366	Surface	2008
287.857	232.835	Surface	2008	5633.400	224.350	Surface	2008
291.083	232.800	Surface	2008	5636.665	224.337	Surface	2008
294.328	232.852	Surface	2008	5639.812	224.326	Surface	2008
297.574	232.891	Surface	2008	5642.959	224.331	Surface	2008

300.819	232.900	Surface	2008	5646.106	224.330	Surface	2008
304.065	232.855	Surface	2008	5649.253	224.329	Surface	2008
307.311	232.736	Surface	2008	5652.399	224.336	Surface	2008
310.556	232.701	Surface	2008	5655.546	224.360	Surface	2008
313.802	232.699	Surface	2008	5658.693	224.396	Surface	2008
317.047	232.708	Surface	2008	5661.840	224.398	Surface	2008
320.293	232.679	Surface	2008	5664.986	224.379	Surface	2008
323.538	232.668	Surface	2008	5668.133	224.358	Surface	2008
326.784	232.680	Surface	2008	5671.280	224.344	Surface	2008
330.029	232.671	Surface	2008	5674.427	224.363	Surface	2008
333.275	232.644	Surface	2008	5677.573	224.372	Surface	2008
336.520	232.655	Surface	2008	5680.720	224.330	Surface	2008
339.766	232.653	Surface	2008	5683.867	224.315	Surface	2008
343.011	232.641	Surface	2008	5687.014	224.353	Surface	2008
346.257	232.618	Surface	2008	5690.161	224.381	Surface	2008
349.506	232.588	Surface	2008	5693.307	224.415	Surface	2008
352.754	232.546	Surface	2008	5696.454	224.402	Surface	2008
356.003	232.519	Surface	2008	5699.696	224.403	Surface	2008
359.251	232.522	Surface	2008	5702.936	224.396	Surface	2008
362.500	232.536	Surface	2008	5706.178	224.359	Surface	2008
365.748	232.498	Surface	2008	5709.419	224.373	Surface	2008
368.997	232.499	Surface	2008	5712.660	224.372	Surface	2008
372.245	232.494	Surface	2008	5715.901	224.352	Surface	2008
375.493	232.466	Surface	2008	5719.142	224.311	Surface	2008
378.742	232.433	Surface	2008	5722.383	224.246	Surface	2008
381.990	232.382	Surface	2008	5725.625	224.310	Surface	2008
385.239	232.356	Surface	2008	5728.865	224.359	Surface	2008
388.488	232.377	Surface	2008	5732.107	224.364	Surface	2008
391.736	232.346	Surface	2008	5735.348	224.374	Surface	2008
394.985	232.293	Surface	2008	5738.589	224.395	Surface	2008
398.233	232.260	Surface	2008	5741.830	224.346	Surface	2008
401.481	232.228	Surface	2008	5745.071	224.345	Surface	2008
404.730	232.208	Surface	2008	5748.312	224.356	Surface	2008
407.978	232.174	Surface	2008	5751.554	224.327	Surface	2008
411.227	232.141	Surface	2008	5754.794	224.316	Surface	2008
414.475	232.153	Surface	2008	5758.036	224.323	Surface	2008
417.744	232.126	Surface	2008	5761.277	224.337	Surface	2008
421.013	232.094	Surface	2008	5764.518	224.373	Surface	2008
424.282	232.082	Surface	2008	5767.708	224.358	Surface	2008
427.550	232.061	Surface	2008	5770.898	224.305	Surface	2008
430.819	232.004	Surface	2008	5774.089	224.377	Surface	2008
434.088	231.988	Surface	2008	5777.279	224.364	Surface	2008
437.357	231.970	Surface	2008	5780.469	224.329	Surface	2008
440.626	231.927	Surface	2008	5783.660	224.305	Surface	2008
443.894	231.866	Surface	2008	5786.850	224.298	Surface	2008
447.163	231.799	Surface	2008	5790.040	224.286	Surface	2008
450.432	231.702	Surface	2008	5793.230	224.334	Surface	2008
453.701	231.648	Surface	2008	5796.421	224.357	Surface	2008
456.970	231.519	Surface	2008	5799.611	224.393	Surface	2008

460.238	231.438	Surface	2008	5802.801	224.375	Surface	2008
463.507	231.325	Surface	2008	5805.991	224.348	Surface	2008
466.776	231.197	Surface	2008	5809.181	224.338	Surface	2008
470.045	231.168	Surface	2008	5812.372	224.349	Surface	2008
473.314	231.097	Surface	2008	5815.562	224.355	Surface	2008
476.582	231.011	Surface	2008	5818.752	224.367	Surface	2008
479.851	231.006	Surface	2008	5821.942	224.394	Surface	2008
483.120	231.039	Surface	2008	5825.133	224.381	Surface	2008
486.389	231.027	Surface	2008	5828.323	224.322	Surface	2008
489.658	231.027	Surface	2008	5831.513	224.278	Surface	2008
492.927	231.024	Surface	2008	5834.704	224.331	Surface	2008
496.196	231.025	Surface	2008	5837.894	224.357	Surface	2008
499.465	231.037	Surface	2008	5841.084	224.310	Surface	2008
502.735	231.049	Surface	2008	5844.326	224.248	Surface	2008
506.003	231.045	Surface	2008	5847.569	224.295	Surface	2008
509.273	231.049	Surface	2008	5850.811	224.333	Surface	2008
512.542	231.069	Surface	2008	5854.053	224.330	Surface	2008
515.811	231.109	Surface	2008	5857.296	224.327	Surface	2008
519.080	231.145	Surface	2008	5860.538	224.315	Surface	2008
522.349	231.176	Surface	2008	5863.780	224.360	Surface	2008
525.618	231.164	Surface	2008	5867.023	224.369	Surface	2008
528.887	231.127	Surface	2008	5870.265	224.298	Surface	2008
532.156	231.125	Surface	2008	5873.507	224.251	Surface	2008
535.425	231.133	Surface	2008	5876.750	224.284	Surface	2008
538.694	231.080	Surface	2008	5879.992	224.312	Surface	2008
541.963	231.089	Surface	2008	5883.234	224.311	Surface	2008
545.232	231.157	Surface	2008	5886.477	224.273	Surface	2008
548.501	231.195	Surface	2008	5889.719	224.298	Surface	2008
551.770	231.172	Surface	2008	5892.961	224.342	Surface	2008
555.040	231.137	Surface	2008	5896.204	224.332	Surface	2008
558.308	231.109	Surface	2008	5899.446	224.313	Surface	2008
561.578	231.111	Surface	2008	5902.688	224.286	Surface	2008
564.704	231.124	Surface	2008	5905.931	224.249	Surface	2008
567.830	231.163	Surface	2008	5909.173	224.264	Surface	2008
570.956	231.185	Surface	2008	5912.415	224.316	Surface	2008
574.082	231.192	Surface	2008	5915.658	224.330	Surface	2008
577.209	231.139	Surface	2008	5918.900	224.331	Surface	2008
580.335	231.143	Surface	2008	5922.054	224.334	Surface	2008
583.461	231.166	Surface	2008	5925.207	224.327	Surface	2008
586.587	231.143	Surface	2008	5928.361	224.314	Surface	2008
589.713	231.099	Surface	2008	5931.514	224.315	Surface	2008
592.840	231.073	Surface	2008	5934.668	224.306	Surface	2008
595.966	231.059	Surface	2008	5937.822	224.299	Surface	2008
599.092	231.052	Surface	2008	5940.975	224.290	Surface	2008
602.218	231.074	Surface	2008	5944.129	224.243	Surface	2008
605.345	231.113	Surface	2008	5947.282	224.279	Surface	2008
608.471	231.120	Surface	2008	5950.436	224.288	Surface	2008
611.597	231.087	Surface	2008	5953.589	224.254	Surface	2008
614.723	231.034	Surface	2008	5956.743	224.215	Surface	2008

617.849	231.025	Surface	2008	5959.897	224.165	Surface	2008
620.976	230.963	Surface	2008	5963.050	224.203	Surface	2008
624.102	230.993	Surface	2008	5966.204	224.163	Surface	2008
627.203	230.952	Surface	2008	5969.357	224.151	Surface	2008
630.304	230.917	Surface	2008	5972.511	224.140	Surface	2008
633.405	230.927	Surface	2008	5975.665	224.118	Surface	2008
636.506	230.962	Surface	2008	5978.818	224.159	Surface	2008
639.606	230.971	Surface	2008	5981.972	224.125	Surface	2008
642.708	230.941	Surface	2008	5985.126	224.115	Surface	2008
645.808	230.903	Surface	2008	5988.279	224.104	Surface	2008
648.909	230.898	Surface	2008	5991.432	224.088	Surface	2008
652.010	230.898	Surface	2008	5994.584	224.044	Surface	2008
655.111	230.889	Surface	2008	5997.737	224.067	Surface	2008
658.212	230.897	Surface	2008	6000.890	224.078	Surface	2008
661.313	230.929	Surface	2008	6004.043	224.029	Surface	2008
664.414	230.902	Surface	2008	6007.195	224.002	Surface	2008
667.515	230.886	Surface	2008	6010.348	224.044	Surface	2008
670.616	230.864	Surface	2008	6013.500	224.039	Surface	2008
673.717	230.846	Surface	2008	6016.653	223.999	Surface	2008
676.818	230.813	Surface	2008	6019.805	223.981	Surface	2008
680.023	230.769	Surface	2008	6022.958	223.934	Surface	2008
683.228	230.770	Surface	2008	6026.111	223.888	Surface	2008
686.433	230.814	Surface	2008	6029.263	223.849	Surface	2008
689.638	230.744	Surface	2008	6032.416	223.839	Surface	2008
692.843	230.748	Surface	2008	6035.569	223.872	Surface	2008
696.049	230.785	Surface	2008	6038.721	223.875	Surface	2008
699.254	230.761	Surface	2008	6041.874	223.828	Surface	2008
702.459	230.685	Surface	2008	6045.120	223.733	Surface	2008
705.664	230.657	Surface	2008	6048.365	223.683	Surface	2008
708.869	230.666	Surface	2008	6051.611	223.643	Surface	2008
712.074	230.698	Surface	2008	6054.856	223.535	Surface	2008
715.279	230.757	Surface	2008	6058.102	223.457	Surface	2008
718.484	230.783	Surface	2008	6061.347	223.455	Surface	2008
721.689	230.760	Surface	2008	6064.593	223.446	Surface	2008
724.895	230.748	Surface	2008	6067.839	223.439	Surface	2008
728.100	230.809	Surface	2008	6071.084	223.406	Surface	2008
731.305	230.822	Surface	2008	6074.330	223.335	Surface	2008
734.434	230.831	Surface	2008	6077.575	223.317	Surface	2008
737.563	230.840	Surface	2008	6080.821	223.348	Surface	2008
740.692	230.848	Surface	2008	6084.066	223.338	Surface	2008
743.821	230.806	Surface	2008	6087.312	223.314	Surface	2008
746.951	230.804	Surface	2008	6090.558	223.271	Surface	2008
750.080	230.817	Surface	2008	6093.803	223.206	Surface	2008
753.208	230.803	Surface	2008	6097.049	223.160	Surface	2008
756.338	230.773	Surface	2008	6100.286	223.199	Surface	2008
759.467	230.760	Surface	2008	6103.523	223.164	Surface	2008
762.596	230.750	Surface	2008	6106.760	223.096	Surface	2008
765.725	230.748	Surface	2008	6109.997	223.102	Surface	2008
768.854	230.773	Surface	2008	6113.234	223.056	Surface	2008

771.983	230.812	Surface	2008	6116.471	223.095	Surface	2008
775.084	230.811	Surface	2008	6119.708	223.122	Surface	2008
778.185	230.797	Surface	2008	6122.945	223.111	Surface	2008
781.286	230.792	Surface	2008	6126.182	223.076	Surface	2008
784.387	230.812	Surface	2008	6129.419	223.008	Surface	2008
787.488	230.813	Surface	2008	6132.656	222.958	Surface	2008
790.589	230.816	Surface	2008	6135.893	222.963	Surface	2008
793.690	230.854	Surface	2008	6139.131	222.975	Surface	2008
796.791	230.852	Surface	2008	6142.368	222.972	Surface	2008
799.892	230.840	Surface	2008	6145.605	222.973	Surface	2008
802.993	230.828	Surface	2008	6148.842	222.929	Surface	2008
806.094	230.816	Surface	2008	6152.058	222.860	Surface	2008
809.195	230.803	Surface	2008	6155.275	222.821	Surface	2008
812.295	230.808	Surface	2008	6158.491	222.785	Surface	2008
815.396	230.820	Surface	2008	6161.708	222.772	Surface	2008
818.497	230.836	Surface	2008	6164.924	222.768	Surface	2008
821.598	230.853	Surface	2008	6168.141	222.752	Surface	2008
824.699	230.853	Surface	2008	6171.357	222.756	Surface	2008
827.871	230.840	Surface	2008	6174.574	222.815	Surface	2008
831.043	230.838	Surface	2008	6177.790	222.799	Surface	2008
834.215	230.831	Surface	2008	6181.007	222.782	Surface	2008
837.387	230.830	Surface	2008	6184.223	222.770	Surface	2008
840.559	230.821	Surface	2008	6187.440	222.749	Surface	2008
843.731	230.818	Surface	2008	6190.656	222.732	Surface	2008
846.902	230.820	Surface	2008	6193.873	222.766	Surface	2008
850.075	230.841	Surface	2008	6197.089	222.818	Surface	2008
853.246	230.838	Surface	2008	6200.306	222.859	Surface	2008
856.418	230.837	Surface	2008	6203.522	222.891	Surface	2008
859.590	230.834	Surface	2008	6206.739	222.901	Surface	2008
862.762	230.825	Surface	2008	6209.955	222.847	Surface	2008
865.934	230.819	Surface	2008	6213.172	222.840	Surface	2008
869.106	230.811	Surface	2008	6216.343	222.888	Surface	2008
872.278	230.799	Surface	2008	6219.514	222.909	Surface	2008
875.450	230.790	Surface	2008	6222.685	222.946	Surface	2008
878.621	230.788	Surface	2008	6225.856	222.953	Surface	2008
881.793	230.779	Surface	2008	6229.028	222.930	Surface	2008
884.965	230.776	Surface	2008	6232.199	222.890	Surface	2008
888.112	230.770	Surface	2008	6235.370	222.891	Surface	2008
891.259	230.760	Surface	2008	6238.541	222.879	Surface	2008
894.405	230.751	Surface	2008	6241.712	222.790	Surface	2008
897.552	230.743	Surface	2008	6244.883	222.767	Surface	2008
900.699	230.740	Surface	2008	6248.055	222.818	Surface	2008
903.845	230.740	Surface	2008	6251.226	222.867	Surface	2008
906.992	230.688	Surface	2008	6254.397	222.878	Surface	2008
910.139	230.692	Surface	2008	6257.569	222.840	Surface	2008
913.285	230.670	Surface	2008	6260.740	222.818	Surface	2008
916.432	230.600	Surface	2008	6263.911	222.856	Surface	2008
919.579	230.594	Surface	2008	6267.082	222.921	Surface	2008
922.725	230.605	Surface	2008	6270.253	222.942	Surface	2008

925.872	230.570	Surface	2008	6273.424	222.924	Surface	2008
929.019	230.531	Surface	2008	6276.596	222.938	Surface	2008
932.166	230.498	Surface	2008	6279.767	222.950	Surface	2008
935.312	230.455	Surface	2008	6282.938	222.947	Surface	2008
938.593	230.379	Surface	2008	6286.109	222.946	Surface	2008
941.874	230.270	Surface	2008	6289.378	222.890	Surface	2008
945.155	230.179	Surface	2008	6292.648	222.833	Surface	2008
948.435	230.113	Surface	2008	6295.918	222.876	Surface	2008
951.716	230.064	Surface	2008	6299.187	222.868	Surface	2008
954.997	230.039	Surface	2008	6302.457	222.832	Surface	2008
958.278	230.025	Surface	2008	6305.726	222.907	Surface	2008
961.558	229.997	Surface	2008	6308.996	222.931	Surface	2008
964.839	229.971	Surface	2008	6312.266	222.952	Surface	2008
968.120	229.930	Surface	2008	6315.535	222.965	Surface	2008
971.400	229.883	Surface	2008	6318.805	222.950	Surface	2008
974.681	229.830	Surface	2008	6322.074	222.940	Surface	2008
977.962	229.832	Surface	2008	6325.344	222.931	Surface	2008
981.243	229.928	Surface	2008	6328.613	222.921	Surface	2008
984.524	229.940	Surface	2008	6331.883	222.943	Surface	2008
987.804	229.874	Surface	2008	6335.152	222.967	Surface	2008
991.085	229.869	Surface	2008	6338.422	222.961	Surface	2008
994.366	229.901	Surface	2008	6341.692	222.943	Surface	2008
997.364	229.910	Surface	2008	6344.914	222.929	Surface	2008
1000.363	229.875	Surface	2008	6348.137	222.906	Surface	2008
1003.362	229.830	Surface	2008	6351.360	222.890	Surface	2008
1006.361	229.851	Surface	2008	6354.583	222.881	Surface	2008
1009.360	229.875	Surface	2008	6357.806	222.866	Surface	2008
1012.358	229.877	Surface	2008	6361.029	222.854	Surface	2008
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1958.982	229.692	Surface	2008	7316.235	220.383	Surface	2008
1962.260	229.679	Surface	2008	7319.465	220.371	Surface	2008
1965.538	229.732	Surface	2008	7322.694	220.381	Surface	2008
1968.816	229.740	Surface	2008	7325.923	220.415	Surface	2008
1972.094	229.735	Surface	2008	7329.152	220.381	Surface	2008
1975.372	229.704	Surface	2008	7332.381	220.364	Surface	2008
1978.650	229.654	Surface	2008	7335.610	220.357	Surface	2008
1981.928	229.658	Surface	2008	7338.839	220.359	Surface	2008
1985.206	229.695	Surface	2008	7342.068	220.337	Surface	2008
1988.484	229.683	Surface	2008	7345.298	220.284	Surface	2008
1991.762	229.691	Surface	2008	7348.527	220.345	Surface	2008
1995.040	229.704	Surface	2008	7351.693	220.378	Surface	2008
1998.318	229.713	Surface	2008	7354.860	220.393	Surface	2008
2001.596	229.710	Surface	2008	7358.027	220.407	Surface	2008
2004.874	229.705	Surface	2008	7361.193	220.380	Surface	2008
2008.152	229.672	Surface	2008	7364.360	220.366	Surface	2008
2011.430	229.605	Surface	2008	7367.526	220.337	Surface	2008
2014.708	229.607	Surface	2008	7370.693	220.342	Surface	2008
2017.987	229.597	Surface	2008	7373.860	220.315	Surface	2008
2021.264	229.642	Surface	2008	7377.026	220.307	Surface	2008
2024.542	229.686	Surface	2008	7380.193	220.310	Surface	2008

2027.821	229.704	Surface	2008	7383.360	220.314	Surface	2008
2031.099	229.687	Surface	2008	7386.526	220.348	Surface	2008
2034.376	229.679	Surface	2008	7389.693	220.354	Surface	2008
2037.655	229.679	Surface	2008	7392.860	220.351	Surface	2008
2040.933	229.700	Surface	2008	7396.026	220.323	Surface	2008
2044.211	229.717	Surface	2008	7399.193	220.308	Surface	2008
2047.489	229.716	Surface	2008	7402.360	220.319	Surface	2008
2050.767	229.664	Surface	2008	7405.526	220.342	Surface	2008
2054.045	229.681	Surface	2008	7408.693	220.295	Surface	2008
2057.323	229.720	Surface	2008	7411.860	220.279	Surface	2008
2060.601	229.738	Surface	2008	7415.026	220.282	Surface	2008
2063.879	229.728	Surface	2008	7418.193	220.272	Surface	2008
2067.157	229.709	Surface	2008	7421.359	220.286	Surface	2008
2070.435	229.714	Surface	2008	7424.526	220.321	Surface	2008
2073.713	229.723	Surface	2008	7427.693	220.328	Surface	2008
2076.991	229.712	Surface	2008	7430.859	220.330	Surface	2008
2080.269	229.674	Surface	2008	7434.098	220.313	Surface	2008
2083.547	229.670	Surface	2008	7437.336	220.301	Surface	2008
2086.825	229.692	Surface	2008	7440.574	220.279	Surface	2008
2090.103	229.704	Surface	2008	7443.813	220.266	Surface	2008
2093.381	229.672	Surface	2008	7447.051	220.250	Surface	2008
2096.659	229.640	Surface	2008	7450.290	220.255	Surface	2008
2099.937	229.618	Surface	2008	7453.528	220.291	Surface	2008
2103.158	229.599	Surface	2008	7456.766	220.313	Surface	2008
2106.379	229.667	Surface	2008	7460.005	220.279	Surface	2008
2109.599	229.706	Surface	2008	7463.243	220.260	Surface	2008
2112.820	229.667	Surface	2008	7466.481	220.280	Surface	2008
2116.041	229.646	Surface	2008	7469.720	220.306	Surface	2008
2119.262	229.655	Surface	2008	7472.958	220.293	Surface	2008
2122.483	229.661	Surface	2008	7476.196	220.266	Surface	2008
2125.703	229.625	Surface	2008	7479.435	220.278	Surface	2008
2128.924	229.641	Surface	2008	7482.673	220.299	Surface	2008
2132.145	229.666	Surface	2008	7485.911	220.296	Surface	2008
2135.366	229.676	Surface	2008	7489.150	220.249	Surface	2008
2138.587	229.682	Surface	2008	7492.388	220.247	Surface	2008
2141.807	229.694	Surface	2008	7495.626	220.265	Surface	2008
2145.028	229.714	Surface	2008	7498.865	220.308	Surface	2008
2148.249	229.727	Surface	2008	7502.103	220.283	Surface	2008
2151.470	229.723	Surface	2008	7505.333	220.250	Surface	2008
2154.691	229.696	Surface	2008	7508.562	220.220	Surface	2008
2157.911	229.653	Surface	2008	7511.791	220.211	Surface	2008
2161.132	229.627	Surface	2008	7515.021	220.238	Surface	2008
2164.353	229.626	Surface	2008	7518.250	220.242	Surface	2008
2167.574	229.622	Surface	2008	7521.479	220.243	Surface	2008
2170.795	229.682	Surface	2008	7524.709	220.241	Surface	2008
2174.015	229.737	Surface	2008	7527.938	220.255	Surface	2008
2177.236	229.746	Surface	2008	7531.168	220.256	Surface	2008
2180.457	229.744	Surface	2008	7534.397	220.259	Surface	2008
2183.678	229.726	Surface	2008	7537.626	220.247	Surface	2008

2186.899	229.730	Surface	2008	7540.856	220.229	Surface	2008
2190.084	229.733	Surface	2008	7544.085	220.233	Surface	2008
2193.269	229.710	Surface	2008	7547.314	220.234	Surface	2008
2196.454	229.710	Surface	2008	7550.544	220.241	Surface	2008
2199.639	229.711	Surface	2008	7553.773	220.245	Surface	2008
2202.824	229.715	Surface	2008	7557.002	220.264	Surface	2008
2206.009	229.723	Surface	2008	7560.232	220.229	Surface	2008
2209.194	229.723	Surface	2008	7563.461	220.183	Surface	2008
2212.379	229.692	Surface	2008	7566.690	220.206	Surface	2008
2215.563	229.653	Surface	2008	7569.920	220.241	Surface	2008
2218.749	229.625	Surface	2008	7573.149	220.258	Surface	2008
2221.933	229.675	Surface	2008	7576.379	220.266	Surface	2008
2225.118	229.696	Surface	2008	7579.608	220.230	Surface	2008
2228.303	229.741	Surface	2008	7582.837	220.210	Surface	2008
2231.488	229.750	Surface	2008	7586.067	220.185	Surface	2008
2234.673	229.750	Surface	2008	7589.296	220.145	Surface	2008
2237.858	229.755	Surface	2008	7592.525	220.142	Surface	2008
2241.043	229.751	Surface	2008	7595.755	220.170	Surface	2008
2244.228	229.706	Surface	2008	7598.984	220.164	Surface	2008
2247.413	229.698	Surface	2008	7602.204	220.204	Surface	2008
2250.598	229.698	Surface	2008	7605.424	220.236	Surface	2008
2253.783	229.698	Surface	2008	7608.644	220.258	Surface	2008
2256.968	229.685	Surface	2008	7611.864	220.260	Surface	2008
2260.153	229.673	Surface	2008	7615.084	220.217	Surface	2008
2263.338	229.657	Surface	2008	7618.304	220.223	Surface	2008
2266.523	229.664	Surface	2008	7621.524	220.226	Surface	2008
2269.708	229.678	Surface	2008	7624.744	220.197	Surface	2008
2272.893	229.693	Surface	2008	7627.964	220.178	Surface	2008
2276.078	229.689	Surface	2008	7631.184	220.162	Surface	2008
2279.263	229.678	Surface	2008	7634.404	220.178	Surface	2008
2282.448	229.694	Surface	2008	7637.624	220.201	Surface	2008
2285.720	229.715	Surface	2008	7640.843	220.201	Surface	2008
2288.992	229.669	Surface	2008	7644.064	220.185	Surface	2008
2292.263	229.588	Surface	2008	7647.284	220.182	Surface	2008
2295.535	229.572	Surface	2008	7650.504	220.168	Surface	2008
2298.807	229.600	Surface	2008	7653.723	220.152	Surface	2008
2302.079	229.616	Surface	2008	7656.944	220.165	Surface	2008
2305.351	229.618	Surface	2008	7660.163	220.232	Surface	2008
2308.623	229.610	Surface	2008	7663.383	220.221	Surface	2008
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2315.167	229.609	Surface	2008	7669.855	220.167	Surface	2008
2318.439	229.614	Surface	2008	7673.106	220.168	Surface	2008
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2324.983	229.653	Surface	2008	7679.609	220.140	Surface	2008
2328.255	229.659	Surface	2008	7682.861	220.123	Surface	2008
2331.527	229.653	Surface	2008	7686.112	220.132	Surface	2008
2334.798	229.647	Surface	2008	7689.364	220.130	Surface	2008
2338.070	229.654	Surface	2008	7692.615	220.102	Surface	2008
2341.342	229.668	Surface	2008	7695.867	220.078	Surface	2008

2344.614	229.663	Surface	2008	7699.118	220.024	Surface	2008
2347.886	229.624	Surface	2008	7702.369	220.056	Surface	2008
2351.158	229.577	Surface	2008	7705.621	220.098	Surface	2008
2354.430	229.550	Surface	2008	7708.873	220.077	Surface	2008
2357.702	229.615	Surface	2008	7712.124	220.044	Surface	2008
2360.973	229.706	Surface	2008	7715.375	220.063	Surface	2008
2364.245	229.719	Surface	2008	7718.627	220.041	Surface	2008
2367.517	229.709	Surface	2008	7721.878	220.011	Surface	2008
2370.714	229.701	Surface	2008	7725.130	220.008	Surface	2008
2373.910	229.676	Surface	2008	7728.381	219.939	Surface	2008
2377.106	229.665	Surface	2008	7731.633	219.981	Surface	2008
2380.302	229.667	Surface	2008	7734.884	220.031	Surface	2008
2383.498	229.678	Surface	2008	7738.136	220.013	Surface	2008
2386.694	229.689	Surface	2008	7741.387	220.025	Surface	2008
2389.891	229.676	Surface	2008	7744.639	220.026	Surface	2008
2393.087	229.666	Surface	2008	7747.890	220.029	Surface	2008
2396.283	229.689	Surface	2008	7751.142	220.046	Surface	2008
2399.479	229.687	Surface	2008	7754.393	220.015	Surface	2008
2402.675	229.686	Surface	2008	7757.599	219.996	Surface	2008
2405.872	229.684	Surface	2008	7760.805	219.992	Surface	2008
2409.068	229.682	Surface	2008	7764.011	220.014	Surface	2008
2412.264	229.666	Surface	2008	7767.218	220.028	Surface	2008
2415.460	229.598	Surface	2008	7770.424	219.979	Surface	2008
2418.656	229.572	Surface	2008	7773.630	219.948	Surface	2008
2421.853	229.601	Surface	2008	7776.836	219.841	Surface	2008
2425.049	229.652	Surface	2008	7780.042	219.913	Surface	2008
2428.245	229.717	Surface	2008	7783.248	219.946	Surface	2008
2431.441	229.729	Surface	2008	7786.455	219.950	Surface	2008
2434.638	229.709	Surface	2008	7789.661	219.909	Surface	2008
2437.834	229.697	Surface	2008	7792.867	219.899	Surface	2008
2441.030	229.681	Surface	2008	7796.073	219.867	Surface	2008
2444.226	229.661	Surface	2008	7799.279	219.842	Surface	2008
2447.422	229.626	Surface	2008	7802.485	219.848	Surface	2008
2450.619	229.587	Surface	2008	7805.691	219.818	Surface	2008
2453.815	229.551	Surface	2008	7808.898	219.761	Surface	2008
2457.011	229.537	Surface	2008	7812.104	219.730	Surface	2008
2460.207	229.508	Surface	2008	7815.243	219.725	Surface	2008
2463.403	229.491	Surface	2008	7818.383	219.730	Surface	2008
2466.600	229.497	Surface	2008	7821.523	219.763	Surface	2008
2469.796	229.527	Surface	2008	7824.663	219.777	Surface	2008
2472.992	229.548	Surface	2008	7827.802	219.761	Surface	2008
2476.188	229.541	Surface	2008	7830.942	219.746	Surface	2008
2479.385	229.570	Surface	2008	7834.081	219.735	Surface	2008
2482.581	229.608	Surface	2008	7837.221	219.711	Surface	2008
2485.777	229.567	Surface	2008	7840.361	219.620	Surface	2008
2489.037	229.505	Surface	2008	7843.500	219.630	Surface	2008
2492.297	229.480	Surface	2008	7846.640	219.617	Surface	2008
2495.557	229.524	Surface	2008	7849.780	219.588	Surface	2008
2498.818	229.577	Surface	2008	7852.919	219.559	Surface	2008

2502.078	229.556	Surface	2008	7856.059	219.545	Surface	2008
2505.337	229.550	Surface	2008	7859.285	219.492	Surface	2008
2508.598	229.590	Surface	2008	7862.512	219.396	Surface	2008
2511.858	229.556	Surface	2008	7865.739	219.364	Surface	2008
2515.118	229.493	Surface	2008	7868.965	219.372	Surface	2008
2518.378	229.508	Surface	2008	7872.192	219.338	Surface	2008
2521.638	229.529	Surface	2008	7875.418	219.249	Surface	2008
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2528.158	229.566	Surface	2008	7881.872	219.192	Surface	2008
2531.418	229.596	Surface	2008	7885.098	219.254	Surface	2008
2534.679	229.501	Surface	2008	7888.325	219.244	Surface	2008
2537.939	229.446	Surface	2008	7891.551	219.181	Surface	2008
2541.199	229.479	Surface	2008	7894.778	219.121	Surface	2008
2544.459	229.531	Surface	2008	7898.005	219.079	Surface	2008
2547.719	229.553	Surface	2008	7901.231	219.072	Surface	2008
2550.979	229.555	Surface	2008	7904.295	219.077	Surface	2008
2554.239	229.518	Surface	2008	7907.360	219.095	Surface	2008
2557.500	229.544	Surface	2008	7910.424	219.062	Surface	2008
2560.760	229.562	Surface	2008	7913.489	219.092	Surface	2008
2564.020	229.550	Surface	2008	7916.553	219.108	Surface	2008
2567.280	229.554	Surface	2008	7919.617	219.010	Surface	2008
2570.540	229.578	Surface	2008	7922.682	218.999	Surface	2008
2573.800	229.556	Surface	2008	7925.746	219.004	Surface	2008
2577.060	229.523	Surface	2008	7928.811	219.033	Surface	2008
2580.320	229.511	Surface	2008	7931.875	219.026	Surface	2008
2583.581	229.496	Surface	2008	7934.939	218.973	Surface	2008
2586.841	229.493	Surface	2008	7938.004	218.922	Surface	2008
2590.101	229.449	Surface	2008	7941.068	218.930	Surface	2008
2593.361	229.534	Surface	2008	7944.132	218.971	Surface	2008
2596.621	229.497	Surface	2008	7947.197	218.924	Surface	2008
2599.881	229.550	Surface	2008	7950.361	218.873	Surface	2008
2603.141	229.570	Surface	2008	7953.524	218.872	Surface	2008
2606.360	229.535	Surface	2008	7956.688	218.869	Surface	2008
2609.579	229.473	Surface	2008	7959.852	218.831	Surface	2008
2612.798	229.474	Surface	2008	7963.016	218.768	Surface	2008
2616.017	229.441	Surface	2008	7966.180	218.705	Surface	2008
2619.236	229.377	Surface	2008	7969.344	218.687	Surface	2008
2622.455	229.362	Surface	2008	7972.507	218.673	Surface	2008
2625.674	229.441	Surface	2008	7975.671	218.564	Surface	2008
2628.893	229.443	Surface	2008	7978.789	218.539	Surface	2008
2632.111	229.446	Surface	2008	7981.907	218.483	Surface	2008
2635.330	229.463	Surface	2008	7985.024	218.459	Surface	2008
2638.549	229.427	Surface	2008	7988.142	218.476	Surface	2008
2641.768	229.369	Surface	2008	7991.260	218.493	Surface	2008
2644.987	229.341	Surface	2008	7994.377	218.514	Surface	2008
2648.206	229.346	Surface	2008	7997.495	218.550	Surface	2008
2651.425	229.376	Surface	2008	8000.613	218.585	Surface	2008
2654.644	229.410	Surface	2008	8003.730	218.562	Surface	2008
2657.863	229.387	Surface	2008	8006.848	218.476	Surface	2008

2661.082	229.364	Surface	2008	8009.966	218.438	Surface	2008
2664.300	229.360	Surface	2008	8013.084	218.479	Surface	2008
2667.520	229.374	Surface	2008	8016.201	218.519	Surface	2008
2670.738	229.369	Surface	2008	8019.216	218.515	Surface	2008
2673.957	229.340	Surface	2008	8022.232	218.506	Surface	2008
2677.176	229.298	Surface	2008	8025.247	218.475	Surface	2008
2680.395	229.266	Surface	2008	8028.262	218.446	Surface	2008
2683.614	229.277	Surface	2008	8031.278	218.439	Surface	2008
2686.833	229.294	Surface	2008	8034.293	218.463	Surface	2008
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2712.585	229.291	Surface	2008	8058.710	218.325	Surface	2008
2715.804	229.220	Surface	2008	8061.823	218.338	Surface	2008
2719.022	229.153	Surface	2008	8064.937	218.372	Surface	2008
2722.241	229.173	Surface	2008	8068.050	218.424	Surface	2008
2725.460	229.202	Surface	2008	8071.164	218.470	Surface	2008
2728.679	229.172	Surface	2008	8074.277	218.471	Surface	2008
2731.898	229.179	Surface	2008	8077.390	218.441	Surface	2008
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2747.993	229.137	Surface	2008	8092.957	218.485	Surface	2008
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2795.988	229.095	Surface	2008	8141.312	218.317	Surface	2008
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2802.233	228.980	Surface	2008	8147.839	218.322	Surface	2008
2805.356	229.012	Surface	2008	8151.103	218.320	Surface	2008
2808.479	229.020	Surface	2008	8154.366	218.257	Surface	2008
2811.602	229.016	Surface	2008	8157.630	218.278	Surface	2008
2814.725	229.003	Surface	2008	8160.894	218.318	Surface	2008

2817.848	229.012	Surface	2008	8164.158	218.355	Surface	2008
2820.970	228.989	Surface	2008	8167.414	218.333	Surface	2008
2824.093	228.976	Surface	2008	8170.671	218.290	Surface	2008
2827.216	228.970	Surface	2008	8173.928	218.286	Surface	2008
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2839.707	228.865	Surface	2008	8186.955	218.270	Surface	2008
2842.830	228.817	Surface	2008	8190.212	218.223	Surface	2008
2845.953	228.809	Surface	2008	8193.469	218.160	Surface	2008
2849.060	228.847	Surface	2008	8196.725	218.167	Surface	2008
2852.167	228.888	Surface	2008	8199.982	218.223	Surface	2008
2855.274	228.878	Surface	2008	8203.239	218.238	Surface	2008
2858.381	228.835	Surface	2008	8206.496	218.235	Surface	2008
2861.489	228.835	Surface	2008	8209.753	218.255	Surface	2008
2864.596	228.841	Surface	2008	8213.009	218.265	Surface	2008
2867.703	228.840	Surface	2008	8216.266	218.204	Surface	2008
2870.810	228.867	Surface	2008	8219.523	218.216	Surface	2008
2873.917	228.900	Surface	2008	8222.758	218.246	Surface	2008
2877.024	228.900	Surface	2008	8225.993	218.273	Surface	2008
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2886.346	228.838	Surface	2008	8235.698	218.191	Surface	2008
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2898.889	228.779	Surface	2008	8248.638	218.173	Surface	2008
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2905.331	228.817	Surface	2008	8255.108	218.146	Surface	2008
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2911.773	228.861	Surface	2008	8261.579	218.220	Surface	2008
2914.995	228.863	Surface	2008	8264.814	218.174	Surface	2008
2918.216	228.860	Surface	2008	8268.048	218.182	Surface	2008
2921.437	228.864	Surface	2008	8271.284	218.215	Surface	2008
2924.658	228.820	Surface	2008	8274.519	218.218	Surface	2008
2927.879	228.809	Surface	2008	8277.754	218.192	Surface	2008
2931.100	228.848	Surface	2008	8280.989	218.187	Surface	2008
2934.322	228.884	Surface	2008	8284.224	218.177	Surface	2008
2937.543	228.899	Surface	2008	8287.459	218.163	Surface	2008
2940.764	228.884	Surface	2008	8290.694	218.147	Surface	2008
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2947.206	228.875	Surface	2008	8297.164	218.149	Surface	2008
2950.427	228.818	Surface	2008	8300.399	218.132	Surface	2008
2953.649	228.802	Surface	2008	8303.634	218.189	Surface	2008
2956.870	228.851	Surface	2008	8306.869	218.157	Surface	2008
2960.091	228.873	Surface	2008	8310.104	218.125	Surface	2008
2963.285	228.860	Surface	2008	8313.339	218.118	Surface	2008
2966.478	228.869	Surface	2008	8316.574	218.137	Surface	2008
2969.672	228.872	Surface	2008	8319.823	218.133	Surface	2008

2972.865	228.854	Surface	2008	8323.071	218.123	Surface	2008
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2982.446	228.786	Surface	2008	8332.817	218.010	Surface	2008
2985.639	228.812	Surface	2008	8336.066	218.049	Surface	2008
2988.833	228.823	Surface	2008	8339.314	218.081	Surface	2008
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2995.220	228.861	Surface	2008	8345.811	218.104	Surface	2008
2998.414	228.852	Surface	2008	8349.060	218.104	Surface	2008
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3864.016	227.742	Surface	2008	9215.074	216.485	Surface	2008
3867.146	227.755	Surface	2008	9218.150	216.487	Surface	2008
3870.407	227.737	Surface	2008	9221.226	216.490	Surface	2008
3873.669	227.724	Surface	2008	9224.302	216.471	Surface	2008
3876.930	227.703	Surface	2008	9227.378	216.462	Surface	2008
3880.192	227.721	Surface	2008	9230.454	216.462	Surface	2008
3883.453	227.762	Surface	2008	9233.529	216.446	Surface	2008
3886.714	227.757	Surface	2008	9236.605	216.457	Surface	2008
3889.976	227.715	Surface	2008	9239.681	216.469	Surface	2008
3893.237	227.688	Surface	2008	9242.757	216.438	Surface	2008
3896.498	227.685	Surface	2008	9245.833	216.392	Surface	2008
3899.760	227.646	Surface	2008	9248.865	216.372	Surface	2008
3903.021	227.593	Surface	2008	9251.897	216.330	Surface	2008
3906.283	227.563	Surface	2008	9254.929	216.308	Surface	2008
3909.544	227.555	Surface	2008	9257.961	216.277	Surface	2008
3912.805	227.557	Surface	2008	9260.993	216.218	Surface	2008

3916.066	227.555	Surface	2008	9264.025	216.160	Surface	2008
3919.320	227.556	Surface	2008	9267.057	216.145	Surface	2008
3922.574	227.554	Surface	2008	9270.089	216.132	Surface	2008
3925.828	227.496	Surface	2008	9273.120	216.126	Surface	2008
3929.082	227.492	Surface	2008	9276.153	216.059	Surface	2008
3932.335	227.519	Surface	2008	9279.346	215.983	Surface	2008
3935.589	227.540	Surface	2008	9282.539	215.900	Surface	2008
3938.843	227.544	Surface	2008	9285.732	215.869	Surface	2008
3942.096	227.545	Surface	2008	9288.925	215.839	Surface	2008
3945.350	227.537	Surface	2008	9292.118	215.769	Surface	2008
3948.604	227.525	Surface	2008	9295.311	215.776	Surface	2008
3951.858	227.555	Surface	2008	9298.504	215.795	Surface	2008
3955.112	227.584	Surface	2008	9301.697	215.826	Surface	2008
3958.365	227.600	Surface	2008	9304.890	215.816	Surface	2008
3961.619	227.600	Surface	2008	9308.000	215.798	Surface	2008
3964.873	227.577	Surface	2008	9311.109	215.848	Surface	2008
3968.126	227.503	Surface	2008	9314.219	215.857	Surface	2008
3971.380	227.479	Surface	2008	9317.328	215.837	Surface	2008
3974.634	227.449	Surface	2008	9320.438	215.797	Surface	2008
3977.888	227.428	Surface	2008	9323.547	215.792	Surface	2008
3981.142	227.437	Surface	2008	9326.657	215.798	Surface	2008
3984.254	227.478	Surface	2008	9329.767	215.804	Surface	2008
3987.367	227.491	Surface	2008	9332.876	215.842	Surface	2008
3990.480	227.467	Surface	2008	9335.986	215.856	Surface	2008
3993.592	227.535	Surface	2008	9339.095	215.861	Surface	2008
3996.705	227.565	Surface	2008	9342.205	215.841	Surface	2008
3999.818	227.568	Surface	2008	9345.314	215.803	Surface	2008
4002.930	227.559	Surface	2008	9348.424	215.832	Surface	2008
4006.043	227.526	Surface	2008	9351.534	215.842	Surface	2008
4009.156	227.527	Surface	2008	9354.643	215.799	Surface	2008
4012.269	227.533	Surface	2008	9357.824	215.826	Surface	2008
4015.381	227.534	Surface	2008	9361.005	215.817	Surface	2008
4018.494	227.535	Surface	2008	9364.186	215.798	Surface	2008
4021.607	227.570	Surface	2008	9367.367	215.810	Surface	2008
4024.719	227.621	Surface	2008	9370.549	215.817	Surface	2008
4027.832	227.606	Surface	2008	9373.730	215.796	Surface	2008
4030.945	227.566	Surface	2008	9376.911	215.782	Surface	2008
4034.057	227.557	Surface	2008	9380.092	215.780	Surface	2008
4037.303	227.549	Surface	2008	9383.273	215.774	Surface	2008
4040.548	227.531	Surface	2008	9386.454	215.826	Surface	2008
4043.794	227.531	Surface	2008	9389.635	215.837	Surface	2008
4047.040	227.529	Surface	2008	9392.794	215.830	Surface	2008
4050.285	227.527	Surface	2008	9395.952	215.848	Surface	2008
4053.531	227.520	Surface	2008	9399.111	215.859	Surface	2008
4056.776	227.526	Surface	2008	9402.269	215.827	Surface	2008
4060.022	227.526	Surface	2008	9405.427	215.839	Surface	2008
4063.268	227.519	Surface	2008	9408.586	215.865	Surface	2008
4066.513	227.512	Surface	2008	9411.744	215.886	Surface	2008
4069.759	227.512	Surface	2008	9414.903	215.893	Surface	2008

4073.005	227.511	Surface	2008	9418.061	215.864	Surface	2008
4076.250	227.511	Surface	2008	9421.220	215.831	Surface	2008
4079.496	227.504	Surface	2008	9424.378	215.804	Surface	2008
4082.676	227.480	Surface	2008	9427.536	215.796	Surface	2008
4085.857	227.453	Surface	2008	9430.695	215.831	Surface	2008
4089.038	227.429	Surface	2008	9433.853	215.862	Surface	2008
4092.218	227.413	Surface	2008	9437.012	215.872	Surface	2008
4095.399	227.395	Surface	2008	9440.170	215.878	Surface	2008
4098.580	227.383	Surface	2008	9443.329	215.868	Surface	2008
4101.760	227.363	Surface	2008	9446.440	215.833	Surface	2008
4104.941	227.388	Surface	2008	9449.551	215.804	Surface	2008
4108.122	227.421	Surface	2008	9452.662	215.810	Surface	2008
4111.302	227.455	Surface	2008	9455.773	215.836	Surface	2008
4114.483	227.471	Surface	2008	9458.884	215.859	Surface	2008
4117.663	227.482	Surface	2008	9461.995	215.853	Surface	2008
4120.844	227.496	Surface	2008	9465.106	215.832	Surface	2008
4124.025	227.505	Surface	2008	9468.217	215.828	Surface	2008
4127.205	227.484	Surface	2008	9471.328	215.836	Surface	2008
4130.386	227.433	Surface	2008	9474.440	215.830	Surface	2008
4133.567	227.402	Surface	2008	9477.551	215.858	Surface	2008
4136.735	227.419	Surface	2008	9480.662	215.867	Surface	2008
4139.902	227.435	Surface	2008	9483.773	215.860	Surface	2008
4143.070	227.431	Surface	2008	9486.884	215.807	Surface	2008
4146.239	227.404	Surface	2008	9489.995	215.853	Surface	2008
4149.406	227.390	Surface	2008	9493.106	215.850	Surface	2008
4152.574	227.429	Surface	2008	9496.217	215.800	Surface	2008
4155.742	227.405	Surface	2008	9499.328	215.803	Surface	2008
4158.910	227.350	Surface	2008	9502.439	215.839	Surface	2008
4162.078	227.303	Surface	2008	9505.689	215.868	Surface	2008
4165.246	227.282	Surface	2008	9508.938	215.841	Surface	2008
4168.414	227.291	Surface	2008	9512.187	215.839	Surface	2008
4171.582	227.303	Surface	2008	9515.436	215.857	Surface	2008
4174.750	227.310	Surface	2008	9518.685	215.827	Surface	2008
4177.918	227.292	Surface	2008	9521.934	215.802	Surface	2008
4181.086	227.276	Surface	2008	9525.183	215.801	Surface	2008
4184.254	227.260	Surface	2008	9528.433	215.794	Surface	2008
4187.422	227.280	Surface	2008	9531.682	215.770	Surface	2008
4190.589	227.287	Surface	2008	9534.931	215.795	Surface	2008
4193.757	227.255	Surface	2008	9538.180	215.761	Surface	2008
4196.858	227.192	Surface	2008	9541.429	215.751	Surface	2008
4199.958	227.146	Surface	2008	9544.679	215.757	Surface	2008
4203.058	227.093	Surface	2008	9547.928	215.748	Surface	2008
4206.158	227.067	Surface	2008	9551.177	215.722	Surface	2008
4209.258	227.066	Surface	2008	9554.426	215.647	Surface	2008
4212.359	227.071	Surface	2008	9557.675	215.590	Surface	2008
4215.459	227.073	Surface	2008	9560.912	215.567	Surface	2008
4218.559	227.037	Surface	2008	9564.149	215.636	Surface	2008
4221.659	226.990	Surface	2008	9567.387	215.677	Surface	2008
4224.759	226.947	Surface	2008	9570.623	215.654	Surface	2008

4227.860	226.881	Surface	2008	9573.861	215.612	Surface	2008
4230.960	226.798	Surface	2008	9577.098	215.600	Surface	2008
4234.060	226.820	Surface	2008	9580.335	215.551	Surface	2008
4237.160	226.853	Surface	2008	9583.572	215.528	Surface	2008
4240.328	226.860	Surface	2008	9586.809	215.520	Surface	2008
4243.496	226.858	Surface	2008	9590.046	215.522	Surface	2008
4246.664	226.851	Surface	2008	9593.283	215.517	Surface	2008
4249.832	226.838	Surface	2008	9596.520	215.423	Surface	2008
4253.000	226.794	Surface	2008	9599.757	215.395	Surface	2008
4256.168	226.827	Surface	2008	9602.994	215.402	Surface	2008
4259.336	226.832	Surface	2008	9606.231	215.414	Surface	2008
4262.504	226.737	Surface	2008	9609.468	215.404	Surface	2008
4265.672	226.685	Surface	2008	9612.706	215.386	Surface	2008
4268.839	226.709	Surface	2008	9615.943	215.316	Surface	2008
4272.008	226.724	Surface	2008	9619.180	215.276	Surface	2008
4275.175	226.759	Surface	2008	9622.417	215.257	Surface	2008
4278.343	226.769	Surface	2008	9625.654	215.246	Surface	2008
4281.511	226.757	Surface	2008	9628.891	215.223	Surface	2008
4284.679	226.699	Surface	2008	9632.128	215.172	Surface	2008
4287.847	226.699	Surface	2008	9635.365	215.232	Surface	2008
4291.015	226.722	Surface	2008	9638.474	215.232	Surface	2008
4294.183	226.739	Surface	2008	9641.583	215.183	Surface	2008
4297.351	226.748	Surface	2008	9644.692	215.147	Surface	2008
4300.500	226.744	Surface	2008	9647.801	215.078	Surface	2008
4303.649	226.719	Surface	2008	9650.910	215.057	Surface	2008
4306.798	226.685	Surface	2008	9654.019	215.034	Surface	2008
4309.947	226.698	Surface	2008	9657.128	215.005	Surface	2008
4313.096	226.714	Surface	2008	9660.238	215.004	Surface	2008
4316.245	226.730	Surface	2008	9663.347	215.031	Surface	2008
4319.394	226.768	Surface	2008	9666.456	215.024	Surface	2008
4322.544	226.743	Surface	2008	9669.565	215.041	Surface	2008
4325.693	226.674	Surface	2008	9672.674	214.997	Surface	2008
4328.842	226.638	Surface	2008	9675.783	214.944	Surface	2008
4331.991	226.643	Surface	2008	9678.892	214.938	Surface	2008
4335.140	226.667	Surface	2008	9682.001	214.954	Surface	2008
4338.289	226.684	Surface	2008	9685.110	214.910	Surface	2008
4341.438	226.703	Surface	2008	9688.360	214.916	Surface	2008
4344.587	226.719	Surface	2008	9691.611	214.923	Surface	2008
4347.736	226.686	Surface	2008	9694.861	214.942	Surface	2008
4350.885	226.633	Surface	2008	9698.111	214.952	Surface	2008
4354.034	226.689	Surface	2008	9701.361	214.961	Surface	2008
4357.188	226.706	Surface	2008	9704.612	214.972	Surface	2008
4360.341	226.659	Surface	2008	9707.862	215.006	Surface	2008
4363.495	226.624	Surface	2008	9711.112	214.992	Surface	2008
4366.649	226.625	Surface	2008	9714.363	214.950	Surface	2008
4369.802	226.611	Surface	2008	9717.613	214.944	Surface	2008
4372.956	226.616	Surface	2008	9720.773	214.930	Surface	2008
4376.109	226.625	Surface	2008	9723.933	214.921	Surface	2008
4379.263	226.634	Surface	2008	9727.092	214.938	Surface	2008

4382.417	226.636	Surface	2008	9730.252	214.951	Surface	2008
4385.570	226.618	Surface	2008	9733.412	214.915	Surface	2008
4388.724	226.615	Surface	2008	9736.571	214.903	Surface	2008
4391.878	226.624	Surface	2008	9739.731	214.910	Surface	2008
4395.031	226.683	Surface	2008	9742.891	214.906	Surface	2008
4398.185	226.718	Surface	2008	9746.051	214.935	Surface	2008
4401.338	226.644	Surface	2008	9749.211	214.969	Surface	2008
4404.492	226.622	Surface	2008	9752.432	214.967	Surface	2008
4407.646	226.607	Surface	2008	9755.653	214.958	Surface	2008
4410.799	226.579	Surface	2008	9758.874	214.927	Surface	2008
4413.953	226.578	Surface	2008	9762.095	214.912	Surface	2008
4417.107	226.585	Surface	2008	9765.316	214.904	Surface	2008
4420.260	226.604	Surface	2008	9768.538	214.861	Surface	2008
4423.414	226.599	Surface	2008	9771.759	214.860	Surface	2008
4426.605	226.582	Surface	2008	9774.980	214.814	Surface	2008
4429.797	226.552	Surface	2008	9778.201	214.769	Surface	2008
4432.988	226.555	Surface	2008	9781.422	214.705	Surface	2008
4436.180	226.561	Surface	2008	9784.667	214.702	Surface	2008
4439.371	226.554	Surface	2008	9787.910	214.738	Surface	2008
4442.563	226.542	Surface	2008	9791.155	214.766	Surface	2008
4445.755	226.551	Surface	2008	9794.399	214.735	Surface	2008
4448.946	226.583	Surface	2008	9797.643	214.704	Surface	2008
4452.138	226.599	Surface	2008	9800.887	214.685	Surface	2008
4455.329	226.584	Surface	2008	9804.131	214.647	Surface	2008
4458.521	226.585	Surface	2008	9807.375	214.573	Surface	2008
4461.712	226.627	Surface	2008	9810.620	214.555	Surface	2008
4464.904	226.600	Surface	2008	9813.863	214.599	Surface	2008
4468.096	226.551	Surface	2008	9817.108	214.578	Surface	2008
4471.287	226.542	Surface	2008	9820.244	214.532	Surface	2008
4474.479	226.556	Surface	2008	9823.379	214.508	Surface	2008
4477.670	226.589	Surface	2008	9826.515	214.517	Surface	2008
4480.862	226.568	Surface	2008	9829.651	214.557	Surface	2008
4484.053	226.475	Surface	2008	9832.787	214.588	Surface	2008
4487.201	226.510	Surface	2008	9835.923	214.584	Surface	2008
4490.349	226.563	Surface	2008	9839.059	214.560	Surface	2008
4493.497	226.601	Surface	2008	9842.194	214.576	Surface	2008
4496.646	226.581	Surface	2008	9845.330	214.645	Surface	2008
4499.793	226.533	Surface	2008	9848.466	214.678	Surface	2008
4502.942	226.503	Surface	2008	9851.723	214.615	Surface	2008
4506.090	226.504	Surface	2008	9854.980	214.554	Surface	2008
4509.238	226.524	Surface	2008	9858.237	214.531	Surface	2008
4512.386	226.533	Surface	2008	9861.494	214.519	Surface	2008
4515.534	226.532	Surface	2008	9864.751	214.528	Surface	2008
4518.682	226.502	Surface	2008	9868.008	214.579	Surface	2008
4521.830	226.479	Surface	2008	9871.265	214.602	Surface	2008
4524.978	226.459	Surface	2008	9874.522	214.602	Surface	2008
4528.126	226.448	Surface	2008	9877.543	214.591	Surface	2008
4531.274	226.464	Surface	2008	9880.563	214.671	Surface	2008
4534.422	226.453	Surface	2008	9883.583	214.711	Surface	2008

4537.570	226.448	Surface	2008	9886.604	214.691	Surface	2008
4540.718	226.453	Surface	2008	9889.624	214.677	Surface	2008
4543.866	226.457	Surface	2008	9892.645	214.670	Surface	2008
4547.014	226.437	Surface	2008	9895.665	214.678	Surface	2008
4550.162	226.406	Surface	2008	9898.686	214.669	Surface	2008
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4556.557	226.332	Surface	2008	9904.727	214.681	Surface	2008
4559.755	226.308	Surface	2008	9907.747	214.683	Surface	2008
4562.952	226.258	Surface	2008	9910.907	214.683	Surface	2008
4566.150	226.218	Surface	2008	9914.066	214.689	Surface	2008
4569.347	226.220	Surface	2008	9917.226	214.703	Surface	2008
4572.545	226.231	Surface	2008	9920.385	214.683	Surface	2008
4575.742	226.213	Surface	2008	9923.544	214.668	Surface	2008
4578.940	226.192	Surface	2008	9926.704	214.650	Surface	2008
4582.137	226.185	Surface	2008	9929.863	214.647	Surface	2008
4585.335	226.190	Surface	2008	9933.022	214.661	Surface	2008
4588.532	226.189	Surface	2008	9936.182	214.660	Surface	2008
4591.730	226.167	Surface	2008	9939.190	214.629	Surface	2008
4594.927	226.153	Surface	2008	9942.199	214.628	Surface	2008
4598.125	226.144	Surface	2008	9945.207	214.620	Surface	2008
4601.322	226.152	Surface	2008	9948.215	214.568	Surface	2008
4604.519	226.117	Surface	2008	9951.223	214.533	Surface	2008
4607.717	226.071	Surface	2008	9954.232	214.554	Surface	2008
4610.914	226.064	Surface	2008	9957.240	214.535	Surface	2008
4614.112	226.076	Surface	2008	9960.248	214.504	Surface	2008
4617.309	226.084	Surface	2008	9963.257	214.449	Surface	2008
4620.507	226.131	Surface	2008	9966.265	214.338	Surface	2008
4623.704	226.218	Surface	2008	9969.244	214.295	Surface	2008
4626.902	226.168	Surface	2008	9972.223	214.244	Surface	2008
4630.099	226.185	Surface	2008	9975.202	214.234	Surface	2008
4633.297	226.159	Surface	2008	9978.181	214.123	Surface	2008
4636.385	226.175	Surface	2008	9981.160	214.011	Surface	2008
4639.473	226.214	Surface	2008	9984.139	213.938	Surface	2008
4642.561	226.234	Surface	2008	9987.118	213.934	Surface	2008
4645.649	226.227	Surface	2008	9990.097	213.944	Surface	2008
4648.737	226.168	Surface	2008	9993.076	213.939	Surface	2008
4651.826	226.149	Surface	2008	9996.227	213.900	Surface	2008
4654.914	226.098	Surface	2008	9999.378	213.852	Surface	2008
4658.002	226.049	Surface	2008	10002.528	213.871	Surface	2008
4661.090	226.065	Surface	2008	10005.679	213.921	Surface	2008
4664.178	226.074	Surface	2008	10008.830	213.930	Surface	2008
4667.267	226.057	Surface	2008	10011.980	213.927	Surface	2008
4670.355	226.068	Surface	2008	10015.131	213.908	Surface	2008
4673.443	226.081	Surface	2008	10018.282	213.853	Surface	2008
4676.531	226.088	Surface	2008	10021.432	213.828	Surface	2008
4679.619	226.090	Surface	2008	10024.583	213.842	Surface	2008
4682.707	226.101	Surface	2008	10027.733	213.853	Surface	2008
4685.923	226.097	Surface	2008	10030.863	213.868	Surface	2008
4689.139	226.065	Surface	2008	10033.993	213.859	Surface	2008

4692.354	226.045	Surface	2008	10037.123	213.851	Surface	2008
4695.570	226.044	Surface	2008	10040.253	213.873	Surface	2008
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4702.002	226.069	Surface	2008	10046.513	213.872	Surface	2008
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4708.433	226.062	Surface	2008	10052.772	213.893	Surface	2008
4711.649	226.034	Surface	2008	10056.023	213.899	Surface	2008
4714.864	225.969	Surface	2008	10059.274	213.870	Surface	2008
4718.080	225.958	Surface	2008	10062.526	213.858	Surface	2008
4721.296	225.950	Surface	2008	10065.777	213.845	Surface	2008
4724.512	225.914	Surface	2008	10069.028	213.847	Surface	2008
4727.727	225.970	Surface	2008	10072.279	213.876	Surface	2008
4730.943	226.027	Surface	2008	10075.262	213.891	Surface	2008
4734.159	226.005	Surface	2008	10078.245	213.895	Surface	2008
4737.374	225.923	Surface	2008	10081.227	213.885	Surface	2008
4740.590	225.951	Surface	2008	10084.209	213.866	Surface	2008
4743.806	225.989	Surface	2008	10087.192	213.858	Surface	2008
4747.022	225.970	Surface	2008	10090.175	213.907	Surface	2008
4750.237	225.954	Surface	2008	10093.372	213.900	Surface	2008
4753.450	225.935	Surface	2008	10096.570	213.909	Surface	2008
4756.662	225.881	Surface	2008	10099.768	213.911	Surface	2008
4759.874	225.836	Surface	2008	10102.965	213.911	Surface	2008
4763.087	225.804	Surface	2008	10106.163	213.921	Surface	2008
4766.299	225.772	Surface	2008	10109.361	213.914	Surface	2008
4769.511	225.752	Surface	2008	10112.559	213.867	Surface	2008
4772.723	225.749	Surface	2008	10115.757	213.861	Surface	2008
4775.936	225.734	Surface	2008	10118.954	213.921	Surface	2008
4779.148	225.681	Surface	2008	10122.152	213.934	Surface	2008
4782.360	225.626	Surface	2008	10125.350	213.943	Surface	2008
4785.573	225.626	Surface	2008	10128.400	213.907	Surface	2008
4788.785	225.653	Surface	2008	10131.450	213.853	Surface	2008
4791.944	225.664	Surface	2008	10134.500	213.873	Surface	2008
4795.104	225.640	Surface	2008	10137.550	213.909	Surface	2008
4798.263	225.569	Surface	2008	10140.600	213.953	Surface	2008
4801.423	225.544	Surface	2008	10143.650	213.978	Surface	2008
4804.582	225.556	Surface	2008	10146.700	213.986	Surface	2008
4807.742	225.571	Surface	2008	10149.750	213.978	Surface	2008
4810.901	225.515	Surface	2008	10152.800	213.986	Surface	2008
4814.061	225.517	Surface	2008	10156.054	213.931	Surface	2008
4817.220	225.507	Surface	2008	10159.307	213.904	Surface	2008
4820.379	225.476	Surface	2008	10162.561	213.872	Surface	2008
4823.539	225.517	Surface	2008	10165.815	213.887	Surface	2008
4826.698	225.475	Surface	2008	10169.069	213.906	Surface	2008
4829.858	225.452	Surface	2008	10172.323	213.871	Surface	2008
4833.017	225.458	Surface	2008	10175.576	213.827	Surface	2008
4836.176	225.454	Surface	2008	10178.830	213.878	Surface	2008
4839.336	225.407	Surface	2008	10182.084	213.930	Surface	2008
4842.495	225.341	Surface	2008	10185.338	213.901	Surface	2008
4845.655	225.304	Surface	2008	10188.467	213.915	Surface	2008

4848.816	225.303	Surface	2008	10191.597	213.888	Surface	2008
4851.978	225.287	Surface	2008	10194.727	213.866	Surface	2008
4855.139	225.210	Surface	2008	10197.857	213.883	Surface	2008
4858.301	225.126	Surface	2008	10200.987	213.869	Surface	2008
4861.462	225.068	Surface	2008	10204.117	213.835	Surface	2008
4864.624	225.083	Surface	2008	10207.246	213.837	Surface	2008
4867.786	225.080	Surface	2008	10210.376	213.848	Surface	2008
4870.947	225.064	Surface	2008	10213.506	213.856	Surface	2008
4874.109	225.043	Surface	2008	10216.636	213.898	Surface	2008
4877.270	225.029	Surface	2008	10219.824	213.906	Surface	2008
4880.432	225.040	Surface	2008	10223.013	213.853	Surface	2008
4883.594	225.098	Surface	2008	10226.202	213.853	Surface	2008
4886.755	225.081	Surface	2008	10229.390	213.816	Surface	2008
4889.917	225.020	Surface	2008	10232.579	213.799	Surface	2008
4893.111	224.990	Surface	2008	10235.768	213.766	Surface	2008
4896.306	225.012	Surface	2008	10238.957	213.798	Surface	2008
4899.500	225.002	Surface	2008	10242.145	213.825	Surface	2008
4902.695	224.936	Surface	2008	10245.334	213.830	Surface	2008
4905.889	224.940	Surface	2008	10248.383	213.767	Surface	2008
4909.084	225.012	Surface	2008	10251.432	213.774	Surface	2008
4912.279	224.990	Surface	2008	10254.482	213.846	Surface	2008
4915.473	224.960	Surface	2008	10257.531	213.863	Surface	2008
4918.668	224.957	Surface	2008	10260.580	213.865	Surface	2008
4921.862	224.979	Surface	2008	10263.629	213.880	Surface	2008
4925.057	225.001	Surface	2008	10266.678	213.850	Surface	2008
4928.251	225.000	Surface	2008	10269.728	213.772	Surface	2008
4931.446	224.973	Surface	2008	10272.777	213.765	Surface	2008
4934.640	225.020	Surface	2008	10275.826	213.780	Surface	2008
4937.835	225.021	Surface	2008	10278.875	213.805	Surface	2008
4941.029	224.987	Surface	2008	10281.998	213.740	Surface	2008
4944.224	224.937	Surface	2008	10285.120	213.810	Surface	2008
4947.418	224.917	Surface	2008	10288.243	213.836	Surface	2008
4950.528	224.973	Surface	2008	10291.365	213.809	Surface	2008
4953.639	225.012	Surface	2008	10294.488	213.797	Surface	2008
4956.748	224.978	Surface	2008	10297.610	213.788	Surface	2008
4959.858	224.942	Surface	2008	10300.733	213.806	Surface	2008
4962.968	224.926	Surface	2008	10303.855	213.827	Surface	2008
4966.078	224.958	Surface	2008	10306.978	213.853	Surface	2008
4969.188	224.980	Surface	2008	10310.100	213.849	Surface	2008
4972.298	224.951	Surface	2008	10313.223	213.799	Surface	2008
4975.408	224.921	Surface	2008	10316.345	213.780	Surface	2008
4978.518	224.896	Surface	2008	10319.468	213.804	Surface	2008
4981.628	224.879	Surface	2008	10322.590	213.800	Surface	2008
4984.738	224.853	Surface	2008	10325.713	213.804	Surface	2008
4987.848	224.827	Surface	2008	10328.835	213.813	Surface	2008
4990.958	224.793	Surface	2008	10332.107	213.805	Surface	2008
4994.068	224.796	Surface	2008	10335.378	213.775	Surface	2008
4997.293	224.775	Surface	2008	10338.650	213.780	Surface	2008
5000.517	224.708	Surface	2008	10341.921	213.797	Surface	2008

5003.743	224.652	Surface	2008	10345.193	213.799	Surface	2008
5006.967	224.660	Surface	2008	10348.464	213.796	Surface	2008
5010.192	224.623	Surface	2008	10351.736	213.788	Surface	2008
5013.417	224.582	Surface	2008	10355.007	213.803	Surface	2008
5016.642	224.565	Surface	2008	10358.279	213.820	Surface	2008
5019.866	224.620	Surface	2008	10361.550	213.821	Surface	2008
5023.091	224.654	Surface	2008	10364.821	213.807	Surface	2008
5026.316	224.669	Surface	2008	10368.093	213.791	Surface	2008
5029.541	224.657	Surface	2008	10371.168	213.814	Surface	2008
5032.765	224.588	Surface	2008	10374.243	213.835	Surface	2008
5035.990	224.622	Surface	2008	10377.318	213.788	Surface	2008
5039.215	224.610	Surface	2008	10380.392	213.744	Surface	2008
5042.440	224.575	Surface	2008	10383.467	213.727	Surface	2008
5045.665	224.607	Surface	2008	10386.542	213.709	Surface	2008
5048.890	224.650	Surface	2008	10389.617	213.700	Surface	2008
5052.114	224.622	Surface	2008	10392.692	213.712	Surface	2008
5055.339	224.620	Surface	2008	10395.766	213.724	Surface	2008
5058.564	224.623	Surface	2008	10398.841	213.724	Surface	2008
5061.789	224.628	Surface	2008	10401.916	213.736	Surface	2008
5065.013	224.618	Surface	2008	10404.991	213.764	Surface	2008
5068.238	224.583	Surface	2008	10408.065	213.748	Surface	2008
5071.463	224.572	Surface	2008	10411.140	213.737	Surface	2008
5074.688	224.593	Surface	2008	10414.238	213.738	Surface	2008
5077.913	224.570	Surface	2008	10417.336	213.759	Surface	2008
5081.138	224.548	Surface	2008	10420.434	213.766	Surface	2008
5084.362	224.575	Surface	2008	10423.532	213.768	Surface	2008
5087.519	224.600	Surface	2008	10426.630	213.753	Surface	2008
5090.675	224.557	Surface	2008	10429.728	213.710	Surface	2008
5093.832	224.552	Surface	2008	10432.826	213.696	Surface	2008
5096.989	224.586	Surface	2008	10435.924	213.714	Surface	2008
5100.145	224.572	Surface	2008	10439.022	213.740	Surface	2008
5103.302	224.550	Surface	2008	10442.120	213.746	Surface	2008
5106.458	224.545	Surface	2008	10445.218	213.725	Surface	2008
5109.615	224.518	Surface	2008	10448.316	213.697	Surface	2008
5112.772	224.492	Surface	2008	10451.414	213.717	Surface	2008
5115.928	224.505	Surface	2008	10454.512	213.692	Surface	2008
5119.085	224.508	Surface	2008	10457.610	213.720	Surface	2008
5122.241	224.555	Surface	2008	10460.708	213.777	Surface	2008
5125.398	224.581	Surface	2008	10463.806	213.758	Surface	2008
5128.554	224.524	Surface	2008	10467.039	213.682	Surface	2008
5131.711	224.522	Surface	2008	10470.272	213.669	Surface	2008
5134.868	224.495	Surface	2008	10473.504	213.677	Surface	2008
5138.024	224.461	Surface	2008	10476.737	213.731	Surface	2008
5141.181	224.435	Surface	2008	10479.969	213.740	Surface	2008
5144.337	224.433	Surface	2008	10483.202	213.704	Surface	2008
5147.494	224.408	Surface	2008	10486.434	213.713	Surface	2008
5150.650	224.403	Surface	2008	10489.667	213.751	Surface	2008
5153.807	224.394	Surface	2008	10492.900	213.738	Surface	2008
5157.081	224.379	Surface	2008	10496.132	213.754	Surface	2008

5160.354	224.358	Surface	2008	10499.365	213.714	Surface	2008
5163.628	224.400	Surface	2008	10502.598	213.663	Surface	2008
5166.901	224.480	Surface	2008	10505.830	213.656	Surface	2008
5170.175	224.466	Surface	2008	10509.063	213.682	Surface	2008
5173.449	224.417	Surface	2008	10512.295	213.703	Surface	2008
5176.722	224.413	Surface	2008	10515.528	213.674	Surface	2008
5179.996	224.420	Surface	2008	10518.760	213.647	Surface	2008
5183.270	224.448	Surface	2008	10521.993	213.656	Surface	2008
5186.543	224.435	Surface	2008	10525.226	213.659	Surface	2008
5189.817	224.401	Surface	2008	10528.448	213.667	Surface	2008
5193.091	224.410	Surface	2008	10531.670	213.672	Surface	2008
5196.364	224.407	Surface	2008	10534.893	213.682	Surface	2008
5199.638	224.358	Surface	2008	10538.115	213.727	Surface	2008
5202.912	224.374	Surface	2008	10541.337	213.732	Surface	2008
5206.185	224.436	Surface	2008	10544.560	213.711	Surface	2008
5209.459	224.450	Surface	2008	10547.782	213.696	Surface	2008
5212.732	224.450	Surface	2008	10551.004	213.700	Surface	2008
5216.006	224.419	Surface	2008	10554.227	213.709	Surface	2008
5219.279	224.397	Surface	2008	10557.449	213.673	Surface	2008
5222.553	224.428	Surface	2008	10560.671	213.635	Surface	2008
5225.726	224.465	Surface	2008	10563.894	213.708	Surface	2008
5228.898	224.467	Surface	2008	10567.116	213.709	Surface	2008
5232.071	224.466	Surface	2008	10570.338	213.699	Surface	2008
5235.243	224.429	Surface	2008	10573.561	213.693	Surface	2008
5238.415	224.431	Surface	2008	10576.735	213.681	Surface	2008
5241.588	224.449	Surface	2008	10579.910	213.701	Surface	2008
5244.760	224.438	Surface	2008	10583.084	213.722	Surface	2008
5247.933	224.423	Surface	2008	10586.259	213.702	Surface	2008
5251.105	224.441	Surface	2008	10589.433	213.687	Surface	2008
5254.278	224.457	Surface	2008	10592.608	213.715	Surface	2008
5257.450	224.473	Surface	2008	10595.782	213.745	Surface	2008
5260.623	224.448	Surface	2008	10598.957	213.736	Surface	2008
5263.795	224.416	Surface	2008	10602.131	213.721	Surface	2008
5266.967	224.443	Surface	2008	10605.306	213.717	Surface	2008
5270.140	224.426	Surface	2008	10608.480	213.709	Surface	2008
5273.312	224.435	Surface	2008	10611.655	213.717	Surface	2008
5276.485	224.455	Surface	2008	10614.829	213.728	Surface	2008
5279.629	224.463	Surface	2008	10618.004	213.747	Surface	2008
5282.773	224.472	Surface	2008	10621.204	213.744	Surface	2008
5285.917	224.500	Surface	2008	10624.403	213.728	Surface	2008
5289.061	224.481	Surface	2008	10627.603	213.718	Surface	2008
5292.205	224.430	Surface	2008	10630.803	213.700	Surface	2008
5295.349	224.423	Surface	2008	10634.003	213.700	Surface	2008
5298.493	224.409	Surface	2008	10637.202	213.695	Surface	2008
5301.638	224.458	Surface	2008	10640.402	213.712	Surface	2008
5304.782	224.438	Surface	2008	10643.602	213.744	Surface	2008
5307.926	224.445	Surface	2008	10646.802	213.724	Surface	2008
5311.070	224.477	Surface	2008	10650.002	213.737	Surface	2008
5314.214	224.500	Surface	2008	10653.201	213.756	Surface	2008

5317.358	224.485	Surface	2008	10656.401	213.770	Surface	2008
5320.502	224.462	Surface	2008	10659.601	213.774	Surface	2008
5323.647	224.464	Surface	2008	10662.801	213.749	Surface	2008
5326.791	224.465	Surface	2008	10666.001	213.722	Surface	2008
5329.935	224.489	Surface	2008	10669.200	213.780	Surface	2008
5333.079	224.482	Surface	2008	10671.777	213.789	Surface	2008
5336.223	224.455	Surface	2008	10674.354	213.789	Surface	2008
5339.371	224.439	Surface	2008	10676.931	213.784	Surface	2008

11.3 Stream Gradient - 2011 Lidar:

Distance	Z	DEM	Year	Distance	Z	DEM	Year
0.000	233.306	Surface	2011	5355.962	222.779	Surface	2011
2.980	233.295	Surface	2011	5358.877	222.798	Surface	2011
5.959	233.280	Surface	2011	5361.792	222.815	Surface	2011
8.939	233.255	Surface	2011	5364.706	222.808	Surface	2011
11.919	233.258	Surface	2011	5367.621	222.787	Surface	2011
14.899	233.280	Surface	2011	5370.536	222.766	Surface	2011
17.878	233.291	Surface	2011	5373.450	222.766	Surface	2011
20.858	233.282	Surface	2011	5376.365	222.764	Surface	2011
23.838	233.256	Surface	2011	5379.280	222.752	Surface	2011
26.818	233.252	Surface	2011	5382.194	222.750	Surface	2011
29.797	233.277	Surface	2011	5385.109	222.749	Surface	2011
32.777	233.295	Surface	2011	5388.024	222.779	Surface	2011
35.757	233.302	Surface	2011	5390.938	222.767	Surface	2011
38.737	233.287	Surface	2011	5393.853	222.737	Surface	2011
41.716	233.287	Surface	2011	5396.767	222.705	Surface	2011
44.696	233.278	Surface	2011	5399.682	222.684	Surface	2011
47.676	233.283	Surface	2011	5402.597	222.663	Surface	2011
50.656	233.273	Surface	2011	5405.511	222.645	Surface	2011
53.635	233.248	Surface	2011	5408.426	222.612	Surface	2011
56.615	233.248	Surface	2011	5411.341	222.580	Surface	2011
59.595	233.275	Surface	2011	5414.255	222.556	Surface	2011
62.575	233.283	Surface	2011	5417.170	222.541	Surface	2011
65.555	233.285	Surface	2011	5420.085	222.537	Surface	2011
68.534	233.284	Surface	2011	5422.999	222.531	Surface	2011
71.514	233.277	Surface	2011	5425.914	222.523	Surface	2011
74.494	233.274	Surface	2011	5428.872	222.514	Surface	2011
77.444	233.269	Surface	2011	5431.831	222.488	Surface	2011
80.394	233.258	Surface	2011	5434.789	222.477	Surface	2011
83.345	233.258	Surface	2011	5437.748	222.485	Surface	2011
86.295	233.259	Surface	2011	5440.706	222.489	Surface	2011
89.245	233.252	Surface	2011	5443.664	222.485	Surface	2011
92.196	233.244	Surface	2011	5446.623	222.485	Surface	2011
95.146	233.264	Surface	2011	5449.581	222.476	Surface	2011
98.096	233.248	Surface	2011	5452.540	222.485	Surface	2011
101.047	233.242	Surface	2011	5455.498	222.499	Surface	2011
103.997	233.241	Surface	2011	5458.457	222.502	Surface	2011
106.947	233.232	Surface	2011	5461.415	222.478	Surface	2011
109.898	233.225	Surface	2011	5464.373	222.468	Surface	2011
112.848	233.234	Surface	2011	5467.332	222.473	Surface	2011
115.798	233.240	Surface	2011	5470.290	222.475	Surface	2011
118.749	233.235	Surface	2011	5473.248	222.462	Surface	2011
121.699	233.241	Surface	2011	5476.207	222.468	Surface	2011
124.649	233.257	Surface	2011	5479.165	222.451	Surface	2011
127.600	233.264	Surface	2011	5482.124	222.438	Surface	2011
130.550	233.261	Surface	2011	5485.082	222.430	Surface	2011

133.500	233.230	Surface	2011	5488.041	222.434	Surface	2011
136.451	233.211	Surface	2011	5490.999	222.448	Surface	2011
139.401	233.213	Surface	2011	5493.958	222.447	Surface	2011
142.351	233.213	Surface	2011	5496.916	222.420	Surface	2011
145.302	233.206	Surface	2011	5499.874	222.388	Surface	2011
148.252	233.174	Surface	2011	5502.833	222.391	Surface	2011
151.202	233.154	Surface	2011	5505.791	222.393	Surface	2011
154.153	233.157	Surface	2011	5508.749	222.392	Surface	2011
157.103	233.168	Surface	2011	5511.708	222.392	Surface	2011
160.053	233.166	Surface	2011	5514.674	222.390	Surface	2011
163.003	233.160	Surface	2011	5517.639	222.388	Surface	2011
165.954	233.156	Surface	2011	5520.605	222.391	Surface	2011
168.904	233.145	Surface	2011	5523.570	222.391	Surface	2011
171.854	233.141	Surface	2011	5526.536	222.373	Surface	2011
174.805	233.139	Surface	2011	5529.502	222.367	Surface	2011
177.755	233.140	Surface	2011	5532.468	222.366	Surface	2011
180.705	233.134	Surface	2011	5535.433	222.349	Surface	2011
183.656	233.097	Surface	2011	5538.399	222.329	Surface	2011
186.606	233.076	Surface	2011	5541.364	222.346	Surface	2011
189.556	233.088	Surface	2011	5544.330	222.360	Surface	2011
192.507	233.105	Surface	2011	5547.296	222.346	Surface	2011
195.457	233.093	Surface	2011	5550.261	222.309	Surface	2011
198.407	233.080	Surface	2011	5553.227	222.263	Surface	2011
201.358	233.082	Surface	2011	5556.193	222.255	Surface	2011
204.308	233.087	Surface	2011	5559.158	222.283	Surface	2011
207.258	233.076	Surface	2011	5562.124	222.284	Surface	2011
210.209	233.056	Surface	2011	5565.089	222.265	Surface	2011
213.159	233.056	Surface	2011	5568.055	222.239	Surface	2011
216.109	233.048	Surface	2011	5571.021	222.229	Surface	2011
219.059	233.041	Surface	2011	5573.986	222.248	Surface	2011
222.010	233.048	Surface	2011	5576.952	222.254	Surface	2011
224.960	233.060	Surface	2011	5579.918	222.252	Surface	2011
227.910	233.057	Surface	2011	5582.883	222.256	Surface	2011
230.861	233.039	Surface	2011	5585.849	222.262	Surface	2011
233.811	233.020	Surface	2011	5588.815	222.232	Surface	2011
236.761	233.007	Surface	2011	5591.705	222.164	Surface	2011
239.712	233.015	Surface	2011	5594.595	222.165	Surface	2011
242.662	233.027	Surface	2011	5597.485	222.161	Surface	2011
245.584	233.004	Surface	2011	5600.375	222.157	Surface	2011
248.507	232.980	Surface	2011	5603.265	222.156	Surface	2011
251.429	232.964	Surface	2011	5606.155	222.165	Surface	2011
254.351	232.966	Surface	2011	5609.045	222.159	Surface	2011
257.274	232.957	Surface	2011	5611.935	222.137	Surface	2011
260.196	232.951	Surface	2011	5614.825	222.115	Surface	2011
263.118	232.932	Surface	2011	5617.715	222.080	Surface	2011
266.041	232.904	Surface	2011	5620.605	222.047	Surface	2011
268.963	232.886	Surface	2011	5623.495	222.035	Surface	2011
271.885	232.853	Surface	2011	5626.385	222.039	Surface	2011
274.807	232.874	Surface	2011	5629.275	222.032	Surface	2011

277.730	232.876	Surface	2011	5632.165	222.020	Surface	2011
280.652	232.867	Surface	2011	5635.055	221.999	Surface	2011
283.574	232.849	Surface	2011	5637.945	221.964	Surface	2011
286.497	232.816	Surface	2011	5640.835	221.922	Surface	2011
289.419	232.782	Surface	2011	5643.833	221.876	Surface	2011
292.341	232.778	Surface	2011	5646.832	221.851	Surface	2011
295.264	232.772	Surface	2011	5649.830	221.876	Surface	2011
298.186	232.750	Surface	2011	5652.828	221.861	Surface	2011
301.108	232.731	Surface	2011	5655.826	221.861	Surface	2011
304.030	232.728	Surface	2011	5658.825	221.862	Surface	2011
306.953	232.736	Surface	2011	5661.823	221.827	Surface	2011
309.875	232.729	Surface	2011	5664.822	221.783	Surface	2011
312.797	232.709	Surface	2011	5667.820	221.788	Surface	2011
315.719	232.626	Surface	2011	5670.818	221.795	Surface	2011
318.642	232.553	Surface	2011	5673.816	221.792	Surface	2011
321.564	232.592	Surface	2011	5676.815	221.787	Surface	2011
324.487	232.608	Surface	2011	5679.813	221.795	Surface	2011
327.409	232.588	Surface	2011	5682.811	221.811	Surface	2011
330.345	232.549	Surface	2011	5685.810	221.803	Surface	2011
333.282	232.531	Surface	2011	5688.808	221.794	Surface	2011
336.218	232.523	Surface	2011	5691.806	221.777	Surface	2011
339.155	232.486	Surface	2011	5694.805	221.780	Surface	2011
342.091	232.458	Surface	2011	5697.803	221.807	Surface	2011
345.028	232.454	Surface	2011	5700.801	221.826	Surface	2011
347.965	232.428	Surface	2011	5703.799	221.820	Surface	2011
350.901	232.377	Surface	2011	5706.752	221.806	Surface	2011
353.838	232.343	Surface	2011	5709.705	221.792	Surface	2011
356.774	232.320	Surface	2011	5712.658	221.791	Surface	2011
359.710	232.286	Surface	2011	5715.611	221.781	Surface	2011
362.647	232.255	Surface	2011	5718.564	221.776	Surface	2011
365.584	232.242	Surface	2011	5721.517	221.763	Surface	2011
368.520	232.237	Surface	2011	5724.470	221.736	Surface	2011
371.457	232.196	Surface	2011	5727.423	221.724	Surface	2011
374.393	232.186	Surface	2011	5730.376	221.767	Surface	2011
377.330	232.169	Surface	2011	5733.329	221.801	Surface	2011
380.266	232.110	Surface	2011	5736.282	221.809	Surface	2011
383.203	232.039	Surface	2011	5739.235	221.807	Surface	2011
386.139	232.041	Surface	2011	5742.187	221.804	Surface	2011
389.076	232.063	Surface	2011	5745.140	221.776	Surface	2011
392.013	232.046	Surface	2011	5748.093	221.766	Surface	2011
394.949	231.991	Surface	2011	5751.046	221.752	Surface	2011
397.885	231.978	Surface	2011	5753.999	221.740	Surface	2011
400.822	231.955	Surface	2011	5756.952	221.745	Surface	2011
403.758	231.917	Surface	2011	5759.905	221.750	Surface	2011
406.695	231.895	Surface	2011	5762.858	221.732	Surface	2011
409.632	231.863	Surface	2011	5765.811	221.708	Surface	2011
412.568	231.791	Surface	2011	5768.704	221.721	Surface	2011
415.505	231.681	Surface	2011	5771.597	221.740	Surface	2011
418.441	231.615	Surface	2011	5774.490	221.743	Surface	2011

421.378	231.608	Surface	2011	5777.383	221.741	Surface	2011
424.314	231.583	Surface	2011	5780.277	221.734	Surface	2011
427.251	231.542	Surface	2011	5783.170	221.724	Surface	2011
430.187	231.499	Surface	2011	5786.063	221.719	Surface	2011
433.124	231.453	Surface	2011	5788.956	221.716	Surface	2011
436.060	231.357	Surface	2011	5791.849	221.718	Surface	2011
438.997	231.293	Surface	2011	5794.742	221.716	Surface	2011
441.792	231.201	Surface	2011	5797.636	221.716	Surface	2011
444.586	231.118	Surface	2011	5800.529	221.687	Surface	2011
447.381	231.073	Surface	2011	5803.422	221.661	Surface	2011
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473.085	230.451	Surface	2011	5829.460	221.450	Surface	2011
475.989	230.492	Surface	2011	5832.353	221.435	Surface	2011
478.894	230.514	Surface	2011	5835.247	221.432	Surface	2011
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484.704	230.532	Surface	2011	5841.033	221.405	Surface	2011
487.609	230.542	Surface	2011	5843.926	221.381	Surface	2011
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543.101	230.590	Surface	2011	5898.247	221.175	Surface	2011
546.081	230.599	Surface	2011	5901.089	221.193	Surface	2011
549.060	230.581	Surface	2011	5903.931	221.201	Surface	2011
552.039	230.540	Surface	2011	5906.772	221.193	Surface	2011
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557.998	230.501	Surface	2011	5912.456	221.221	Surface	2011
560.977	230.520	Surface	2011	5915.298	221.220	Surface	2011

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602.632	230.503	Surface	2011	5958.491	221.191	Surface	2011
605.461	230.489	Surface	2011	5961.384	221.199	Surface	2011
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684.149	230.353	Surface	2011	6040.508	221.164	Surface	2011
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1270.230	228.695	Surface	2011	6636.653	221.005	Surface	2011

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2977.179	226.774	Surface	2011	8361.754	216.300	Surface	2011
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2985.365	226.770	Surface	2011	8370.363	216.366	Surface	2011
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3833.087	224.912	Surface	2011	9211.442	215.337	Surface	2011
3835.989	224.909	Surface	2011	9214.423	215.333	Surface	2011
3838.892	224.920	Surface	2011	9217.404	215.265	Surface	2011
3841.795	224.923	Surface	2011	9220.384	215.244	Surface	2011
3844.698	224.913	Surface	2011	9223.365	215.241	Surface	2011
3847.600	224.908	Surface	2011	9226.346	215.221	Surface	2011
3850.503	224.903	Surface	2011	9229.327	215.186	Surface	2011
3853.406	224.886	Surface	2011	9232.307	215.164	Surface	2011
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3859.211	224.880	Surface	2011	9238.269	215.125	Surface	2011
3862.114	224.908	Surface	2011	9241.250	215.089	Surface	2011
3865.017	224.910	Surface	2011	9244.231	215.062	Surface	2011
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3873.725	224.916	Surface	2011	9253.173	214.975	Surface	2011
3876.627	224.910	Surface	2011	9256.154	214.970	Surface	2011
3879.500	224.907	Surface	2011	9259.135	214.965	Surface	2011
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3885.246	224.929	Surface	2011	9265.096	214.986	Surface	2011
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3890.992	224.936	Surface	2011	9271.058	214.941	Surface	2011
3893.865	224.934	Surface	2011	9274.051	214.896	Surface	2011
3896.738	224.925	Surface	2011	9277.044	214.883	Surface	2011
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3919.721	224.930	Surface	2011	9300.989	214.859	Surface	2011
3922.594	224.924	Surface	2011	9303.982	214.853	Surface	2011
3925.467	224.926	Surface	2011	9306.975	214.876	Surface	2011
3928.340	224.912	Surface	2011	9309.968	214.897	Surface	2011
3931.213	224.904	Surface	2011	9312.961	214.865	Surface	2011
3934.086	224.901	Surface	2011	9315.954	214.847	Surface	2011
3937.083	224.887	Surface	2011	9318.947	214.845	Surface	2011
3940.081	224.913	Surface	2011	9321.941	214.836	Surface	2011
3943.078	224.928	Surface	2011	9324.934	214.837	Surface	2011
3946.076	224.917	Surface	2011	9327.927	214.829	Surface	2011
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4701.209	224.114	Surface	2011	10065.304	214.414	Surface	2011
4704.138	224.099	Surface	2011	10068.282	214.410	Surface	2011
4707.066	224.083	Surface	2011	10071.259	214.405	Surface	2011
4709.994	224.074	Surface	2011	10074.236	214.400	Surface	2011
4712.923	224.089	Surface	2011	10077.213	214.395	Surface	2011
4715.851	224.086	Surface	2011	10080.190	214.397	Surface	2011
4718.779	224.060	Surface	2011	10083.167	214.397	Surface	2011
4721.708	224.040	Surface	2011	10086.145	214.398	Surface	2011
4724.636	224.047	Surface	2011	10089.122	214.398	Surface	2011
4727.564	224.056	Surface	2011	10092.099	214.399	Surface	2011
4730.493	224.053	Surface	2011	10095.076	214.399	Surface	2011
4733.421	224.036	Surface	2011	10098.053	214.399	Surface	2011
4736.349	224.009	Surface	2011	10101.030	214.399	Surface	2011
4739.278	223.993	Surface	2011	10104.008	214.399	Surface	2011
4742.206	223.985	Surface	2011	10106.985	214.399	Surface	2011
4745.134	223.978	Surface	2011	10109.962	214.400	Surface	2011
4748.063	223.961	Surface	2011	10112.939	214.400	Surface	2011
4750.991	223.983	Surface	2011	10115.916	214.401	Surface	2011
4753.919	223.988	Surface	2011	10118.893	214.401	Surface	2011
4756.847	223.976	Surface	2011	10121.871	214.401	Surface	2011
4759.776	223.972	Surface	2011	10124.848	214.402	Surface	2011
4762.704	223.960	Surface	2011	10127.825	214.402	Surface	2011
4765.632	223.891	Surface	2011	10130.802	214.401	Surface	2011
4768.561	223.852	Surface	2011	10133.779	214.401	Surface	2011
4771.489	223.847	Surface	2011	10136.756	214.395	Surface	2011
4774.417	223.849	Surface	2011	10139.733	214.390	Surface	2011
4777.346	223.853	Surface	2011	10142.711	214.387	Surface	2011
4780.274	223.858	Surface	2011	10145.688	214.388	Surface	2011
4783.199	223.854	Surface	2011	10148.665	214.389	Surface	2011
4786.123	223.836	Surface	2011	10151.642	214.390	Surface	2011
4789.048	223.835	Surface	2011	10154.642	214.382	Surface	2011
4791.973	223.838	Surface	2011	10157.642	214.375	Surface	2011
4794.898	223.837	Surface	2011	10160.642	214.366	Surface	2011
4797.823	223.838	Surface	2011	10163.642	214.353	Surface	2011
4800.748	223.831	Surface	2011	10166.642	214.344	Surface	2011
4803.672	223.815	Surface	2011	10169.642	214.355	Surface	2011
4806.597	223.829	Surface	2011	10172.642	214.346	Surface	2011
4809.522	223.831	Surface	2011	10175.642	214.329	Surface	2011
4812.447	223.821	Surface	2011	10178.642	214.330	Surface	2011
4815.372	223.766	Surface	2011	10181.642	214.319	Surface	2011
4818.296	223.696	Surface	2011	10184.642	214.306	Surface	2011
4821.221	223.732	Surface	2011	10187.642	214.321	Surface	2011
4824.146	223.748	Surface	2011	10190.642	214.325	Surface	2011
4827.071	223.751	Surface	2011	10193.642	214.314	Surface	2011
4829.995	223.734	Surface	2011	10196.642	214.304	Surface	2011
4832.920	223.717	Surface	2011	10199.642	214.298	Surface	2011
4835.845	223.701	Surface	2011	10202.642	214.292	Surface	2011

4838.770	223.712	Surface	2011	10205.642	214.288	Surface	2011
4841.695	223.670	Surface	2011	10208.642	214.288	Surface	2011
4844.619	223.629	Surface	2011	10211.642	214.295	Surface	2011
4847.544	223.622	Surface	2011	10214.642	214.308	Surface	2011
4850.469	223.644	Surface	2011	10217.642	214.310	Surface	2011
4853.394	223.656	Surface	2011	10220.642	214.303	Surface	2011
4856.319	223.635	Surface	2011	10223.642	214.287	Surface	2011
4859.243	223.590	Surface	2011	10226.642	214.286	Surface	2011
4862.168	223.576	Surface	2011	10229.642	214.289	Surface	2011
4865.093	223.571	Surface	2011	10232.642	214.262	Surface	2011
4868.018	223.549	Surface	2011	10235.642	214.271	Surface	2011
4870.924	223.517	Surface	2011	10238.553	214.271	Surface	2011
4873.830	223.524	Surface	2011	10241.464	214.266	Surface	2011
4876.736	223.545	Surface	2011	10244.375	214.267	Surface	2011
4879.643	223.536	Surface	2011	10247.287	214.274	Surface	2011
4882.549	223.513	Surface	2011	10250.198	214.279	Surface	2011
4885.455	223.484	Surface	2011	10253.110	214.269	Surface	2011
4888.362	223.458	Surface	2011	10256.021	214.259	Surface	2011
4891.268	223.447	Surface	2011	10258.932	214.244	Surface	2011
4894.174	223.426	Surface	2011	10261.843	214.218	Surface	2011
4897.080	223.410	Surface	2011	10264.755	214.220	Surface	2011
4899.986	223.411	Surface	2011	10267.666	214.235	Surface	2011
4902.893	223.416	Surface	2011	10270.577	214.245	Surface	2011
4905.799	223.409	Surface	2011	10273.488	214.227	Surface	2011
4908.705	223.367	Surface	2011	10276.399	214.200	Surface	2011
4911.611	223.350	Surface	2011	10279.311	214.225	Surface	2011
4914.518	223.330	Surface	2011	10282.222	214.203	Surface	2011
4917.424	223.303	Surface	2011	10285.134	214.178	Surface	2011
4920.330	223.276	Surface	2011	10288.045	214.182	Surface	2011
4923.236	223.248	Surface	2011	10290.956	214.205	Surface	2011
4926.142	223.233	Surface	2011	10293.867	214.210	Surface	2011
4929.049	223.219	Surface	2011	10296.779	214.205	Surface	2011
4931.955	223.195	Surface	2011	10299.690	214.194	Surface	2011
4934.861	223.177	Surface	2011	10302.580	214.174	Surface	2011
4937.767	223.172	Surface	2011	10305.471	214.141	Surface	2011
4940.673	223.161	Surface	2011	10308.361	214.131	Surface	2011
4943.580	223.170	Surface	2011	10311.251	214.109	Surface	2011
4946.486	223.171	Surface	2011	10314.142	214.079	Surface	2011
4949.392	223.167	Surface	2011	10317.032	214.052	Surface	2011
4952.298	223.171	Surface	2011	10319.922	214.042	Surface	2011
4955.205	223.176	Surface	2011	10322.812	214.041	Surface	2011
4958.095	223.176	Surface	2011	10325.703	214.038	Surface	2011
4960.984	223.179	Surface	2011	10328.593	214.002	Surface	2011
4963.874	223.153	Surface	2011	10331.483	213.945	Surface	2011
4966.764	223.130	Surface	2011	10334.373	213.914	Surface	2011
4969.654	223.125	Surface	2011	10337.264	213.909	Surface	2011
4972.544	223.122	Surface	2011	10340.154	213.912	Surface	2011
4975.434	223.111	Surface	2011	10343.045	213.917	Surface	2011
4978.324	223.098	Surface	2011	10345.935	213.907	Surface	2011

4981.214	223.072	Surface	2011	10348.825	213.885	Surface	2011
4984.104	223.062	Surface	2011	10351.715	213.859	Surface	2011
4986.994	223.069	Surface	2011	10354.620	213.836	Surface	2011
4989.884	223.081	Surface	2011	10357.525	213.797	Surface	2011
4992.773	223.085	Surface	2011	10360.430	213.770	Surface	2011
4995.663	223.062	Surface	2011	10363.335	213.733	Surface	2011
4998.553	223.032	Surface	2011	10366.240	213.710	Surface	2011
5001.443	223.014	Surface	2011	10369.145	213.693	Surface	2011
5004.333	223.050	Surface	2011	10372.050	213.677	Surface	2011
5007.223	223.058	Surface	2011	10374.954	213.660	Surface	2011
5010.113	223.044	Surface	2011	10377.859	213.626	Surface	2011
5013.003	223.031	Surface	2011	10380.764	213.603	Surface	2011
5015.893	223.019	Surface	2011	10383.669	213.571	Surface	2011
5018.878	223.010	Surface	2011	10386.574	213.562	Surface	2011
5021.864	223.020	Surface	2011	10389.479	213.548	Surface	2011
5024.849	223.056	Surface	2011	10392.383	213.537	Surface	2011
5027.835	223.067	Surface	2011	10395.289	213.538	Surface	2011
5030.820	223.039	Surface	2011	10398.193	213.548	Surface	2011
5033.806	223.011	Surface	2011	10401.098	213.549	Surface	2011
5036.791	222.997	Surface	2011	10404.003	213.537	Surface	2011
5039.777	223.027	Surface	2011	10406.908	213.544	Surface	2011
5042.762	223.013	Surface	2011	10409.813	213.553	Surface	2011
5045.748	222.985	Surface	2011	10412.718	213.537	Surface	2011
5048.733	222.991	Surface	2011	10415.622	213.531	Surface	2011
5051.719	223.001	Surface	2011	10418.527	213.515	Surface	2011
5054.704	223.009	Surface	2011	10421.433	213.499	Surface	2011
5057.690	223.016	Surface	2011	10424.338	213.492	Surface	2011
5060.675	223.036	Surface	2011	10427.243	213.493	Surface	2011
5063.661	223.027	Surface	2011	10430.148	213.485	Surface	2011
5066.646	223.002	Surface	2011	10433.054	213.457	Surface	2011
5069.632	222.962	Surface	2011	10435.959	213.433	Surface	2011
5072.617	222.978	Surface	2011	10438.864	213.389	Surface	2011
5075.603	222.978	Surface	2011	10441.769	213.342	Surface	2011
5078.588	222.951	Surface	2011	10444.675	213.303	Surface	2011
5081.573	222.957	Surface	2011	10447.580	213.251	Surface	2011
5084.559	222.969	Surface	2011	10450.485	213.213	Surface	2011
5087.545	222.967	Surface	2011	10453.390	213.209	Surface	2011
5090.530	222.960	Surface	2011	10456.296	213.215	Surface	2011
5093.516	222.933	Surface	2011	10459.201	213.207	Surface	2011
5096.501	222.911	Surface	2011	10462.106	213.191	Surface	2011
5099.486	222.930	Surface	2011	10465.012	213.114	Surface	2011
5102.472	222.933	Surface	2011	10467.917	213.029	Surface	2011
5105.319	222.928	Surface	2011	10470.822	212.946	Surface	2011
5108.165	222.924	Surface	2011	10473.727	212.938	Surface	2011
5111.011	222.931	Surface	2011	10476.633	212.915	Surface	2011
5113.858	222.933	Surface	2011	10479.538	212.897	Surface	2011
5116.704	222.927	Surface	2011	10482.443	212.878	Surface	2011
5119.550	222.921	Surface	2011	10485.348	212.857	Surface	2011
5122.396	222.904	Surface	2011	10488.254	212.838	Surface	2011

5125.243	222.899	Surface	2011	10491.201	212.803	Surface	2011
5128.089	222.881	Surface	2011	10494.148	212.752	Surface	2011
5130.936	222.900	Surface	2011	10497.096	212.707	Surface	2011
5133.782	222.911	Surface	2011	10500.044	212.643	Surface	2011
5136.628	222.922	Surface	2011	10502.991	212.589	Surface	2011
5139.475	222.911	Surface	2011	10505.938	212.575	Surface	2011
5142.321	222.878	Surface	2011	10508.886	212.547	Surface	2011
5145.167	222.869	Surface	2011	10511.833	212.564	Surface	2011
5148.014	222.893	Surface	2011	10514.781	212.581	Surface	2011
5150.860	222.895	Surface	2011	10517.728	212.579	Surface	2011
5153.706	222.887	Surface	2011	10520.676	212.551	Surface	2011
5156.647	222.879	Surface	2011	10523.623	212.533	Surface	2011
5159.587	222.890	Surface	2011	10526.570	212.510	Surface	2011
5162.528	222.898	Surface	2011	10529.518	212.483	Surface	2011
5165.468	222.905	Surface	2011	10532.466	212.441	Surface	2011
5168.409	222.898	Surface	2011	10535.413	212.398	Surface	2011
5171.349	222.896	Surface	2011	10538.361	212.354	Surface	2011
5174.289	222.900	Surface	2011	10541.249	212.339	Surface	2011
5177.230	222.893	Surface	2011	10544.137	212.321	Surface	2011
5180.170	222.874	Surface	2011	10547.026	212.277	Surface	2011
5183.111	222.861	Surface	2011	10549.915	212.224	Surface	2011
5186.051	222.867	Surface	2011	10552.803	212.183	Surface	2011
5188.992	222.857	Surface	2011	10555.692	212.182	Surface	2011
5191.932	222.896	Surface	2011	10558.580	212.208	Surface	2011
5194.873	222.903	Surface	2011	10561.469	212.208	Surface	2011
5197.813	222.892	Surface	2011	10564.357	212.214	Surface	2011
5200.753	222.891	Surface	2011	10567.246	212.200	Surface	2011
5203.694	222.897	Surface	2011	10570.134	212.160	Surface	2011
5206.634	222.901	Surface	2011	10573.023	212.173	Surface	2011
5209.575	222.905	Surface	2011	10575.911	212.157	Surface	2011
5212.515	222.899	Surface	2011	10578.800	212.141	Surface	2011
5215.456	222.892	Surface	2011	10581.688	212.084	Surface	2011
5218.333	222.901	Surface	2011	10584.577	212.067	Surface	2011
5221.209	222.905	Surface	2011	10587.465	212.037	Surface	2011
5224.086	222.901	Surface	2011	10590.351	212.013	Surface	2011
5226.963	222.895	Surface	2011	10593.237	212.014	Surface	2011
5229.840	222.889	Surface	2011	10596.122	212.027	Surface	2011
5232.718	222.890	Surface	2011	10599.007	212.042	Surface	2011
5235.594	222.923	Surface	2011	10601.893	212.047	Surface	2011
5238.471	222.913	Surface	2011	10604.779	212.019	Surface	2011
5241.348	222.898	Surface	2011	10607.664	211.996	Surface	2011
5244.225	222.892	Surface	2011	10610.550	211.995	Surface	2011
5247.102	222.903	Surface	2011	10613.435	211.991	Surface	2011
5249.979	222.910	Surface	2011	10616.321	211.962	Surface	2011
5252.856	222.920	Surface	2011	10619.206	211.932	Surface	2011
5255.733	222.920	Surface	2011	10622.092	211.943	Surface	2011
5258.610	222.903	Surface	2011	10624.977	211.994	Surface	2011
5261.487	222.893	Surface	2011	10627.863	212.045	Surface	2011
5264.364	222.895	Surface	2011	10630.749	212.040	Surface	2011

5267.241	222.896	Surface	2011	10633.634	212.029	Surface	2011
5270.118	222.890	Surface	2011	10636.520	212.013	Surface	2011
5272.995	222.882	Surface	2011	10639.405	211.995	Surface	2011
5275.872	222.887	Surface	2011	10642.291	211.965	Surface	2011
5278.749	222.894	Surface	2011	10645.176	211.939	Surface	2011
5281.626	222.897	Surface	2011	10648.171	211.961	Surface	2011
5284.602	222.900	Surface	2011	10651.165	211.969	Surface	2011
5287.578	222.881	Surface	2011	10654.160	211.975	Surface	2011
5290.554	222.876	Surface	2011	10657.154	211.970	Surface	2011
5293.530	222.878	Surface	2011	10660.149	211.942	Surface	2011
5296.505	222.875	Surface	2011	10663.143	211.918	Surface	2011
5299.481	222.863	Surface	2011	10666.138	211.911	Surface	2011
5302.457	222.848	Surface	2011	10669.132	211.913	Surface	2011
5305.433	222.834	Surface	2011	10672.127	211.901	Surface	2011
5308.409	222.831	Surface	2011	10675.121	211.922	Surface	2011
5311.385	222.845	Surface	2011	10678.116	211.931	Surface	2011
5314.361	222.869	Surface	2011	10681.110	211.877	Surface	2011
5317.337	222.879	Surface	2011	10684.105	211.815	Surface	2011
5320.313	222.892	Surface	2011	10687.099	211.818	Surface	2011
5323.289	222.900	Surface	2011	10690.094	211.828	Surface	2011
5326.265	222.886	Surface	2011	10693.088	211.836	Surface	2011
5329.240	222.876	Surface	2011	10696.083	211.840	Surface	2011
5332.216	222.887	Surface	2011	10699.077	211.843	Surface	2011
5335.192	222.888	Surface	2011	10702.072	211.859	Surface	2011
5338.168	222.869	Surface	2011	10705.067	211.871	Surface	2011
5341.144	222.846	Surface	2011	10708.061	211.866	Surface	2011
5344.120	222.812	Surface	2011	10710.644	211.862	Surface	2011
5347.096	222.798	Surface	2011	10713.228	211.860	Surface	2011
5350.072	222.782	Surface	2011	10715.811	211.851	Surface	2011
5353.048	222.769	Surface	2011	10718.394	211.829	Surface	2011

11.4 Stream Gradient - 2012 Lidar:

Distance	Z	DEM	Year	Distance	Z	DEM	Year
0.000	233.208	Surface	2012	5336.472	222.577	Surface	2012
3.183	233.195	Surface	2012	5339.502	222.587	Surface	2012
6.366	233.191	Surface	2012	5342.531	222.571	Surface	2012
9.548	233.187	Surface	2012	5345.561	222.565	Surface	2012
12.731	233.179	Surface	2012	5348.590	222.566	Surface	2012
15.914	233.185	Surface	2012	5351.620	222.552	Surface	2012
19.096	233.190	Surface	2012	5354.650	222.519	Surface	2012
22.279	233.150	Surface	2012	5357.680	222.502	Surface	2012
25.462	233.157	Surface	2012	5360.710	222.514	Surface	2012
28.645	233.165	Surface	2012	5363.739	222.510	Surface	2012
31.827	233.163	Surface	2012	5366.769	222.515	Surface	2012
35.010	233.160	Surface	2012	5369.798	222.521	Surface	2012
38.193	233.141	Surface	2012	5372.828	222.510	Surface	2012
41.375	233.117	Surface	2012	5375.963	222.489	Surface	2012
44.558	233.117	Surface	2012	5379.098	222.474	Surface	2012
47.741	233.121	Surface	2012	5382.232	222.461	Surface	2012
50.924	233.116	Surface	2012	5385.367	222.459	Surface	2012
54.107	233.109	Surface	2012	5388.501	222.452	Surface	2012
57.343	233.110	Surface	2012	5391.636	222.446	Surface	2012
60.579	233.110	Surface	2012	5394.771	222.414	Surface	2012
63.815	233.103	Surface	2012	5397.905	222.395	Surface	2012
67.051	233.083	Surface	2012	5401.040	222.402	Surface	2012
70.287	233.087	Surface	2012	5404.175	222.387	Surface	2012
73.523	233.115	Surface	2012	5407.309	222.375	Surface	2012
76.759	233.099	Surface	2012	5410.444	222.386	Surface	2012
79.995	233.073	Surface	2012	5413.579	222.392	Surface	2012
83.231	233.080	Surface	2012	5416.770	222.380	Surface	2012
86.467	233.067	Surface	2012	5419.961	222.395	Surface	2012
89.703	233.079	Surface	2012	5423.152	222.382	Surface	2012
92.940	233.082	Surface	2012	5426.343	222.374	Surface	2012
96.176	233.084	Surface	2012	5429.534	222.393	Surface	2012
99.412	233.068	Surface	2012	5432.725	222.364	Surface	2012
102.648	233.082	Surface	2012	5435.917	222.369	Surface	2012
105.884	233.104	Surface	2012	5439.108	222.400	Surface	2012
109.120	233.076	Surface	2012	5442.299	222.382	Surface	2012
112.356	233.052	Surface	2012	5445.490	222.390	Surface	2012
115.592	233.046	Surface	2012	5448.681	222.393	Surface	2012
118.828	233.065	Surface	2012	5451.872	222.391	Surface	2012
122.064	233.073	Surface	2012	5455.063	222.390	Surface	2012
125.300	233.060	Surface	2012	5458.254	222.369	Surface	2012
128.537	233.047	Surface	2012	5461.445	222.381	Surface	2012
131.773	233.022	Surface	2012	5464.637	222.382	Surface	2012
135.009	233.005	Surface	2012	5467.828	222.374	Surface	2012
138.245	232.996	Surface	2012	5471.029	222.382	Surface	2012
141.481	233.002	Surface	2012	5474.230	222.360	Surface	2012

144.717	232.990	Surface	2012	5477.432	222.368	Surface	2012
147.953	232.970	Surface	2012	5480.634	222.367	Surface	2012
151.189	232.970	Surface	2012	5483.835	222.376	Surface	2012
154.425	232.989	Surface	2012	5487.036	222.363	Surface	2012
157.661	232.970	Surface	2012	5490.238	222.337	Surface	2012
160.735	232.962	Surface	2012	5493.439	222.353	Surface	2012
163.809	232.956	Surface	2012	5496.641	222.350	Surface	2012
166.883	232.938	Surface	2012	5499.842	222.352	Surface	2012
169.956	232.923	Surface	2012	5503.044	222.346	Surface	2012
173.030	232.916	Surface	2012	5506.245	222.341	Surface	2012
176.104	232.910	Surface	2012	5509.446	222.320	Surface	2012
179.177	232.928	Surface	2012	5512.648	222.335	Surface	2012
182.251	232.938	Surface	2012	5515.849	222.341	Surface	2012
185.325	232.929	Surface	2012	5519.051	222.336	Surface	2012
188.398	232.915	Surface	2012	5522.252	222.324	Surface	2012
191.472	232.936	Surface	2012	5525.454	222.314	Surface	2012
194.604	232.927	Surface	2012	5528.655	222.317	Surface	2012
197.734	232.946	Surface	2012	5531.857	222.304	Surface	2012
200.866	232.940	Surface	2012	5535.028	222.298	Surface	2012
203.997	232.927	Surface	2012	5538.199	222.295	Surface	2012
207.128	232.939	Surface	2012	5541.370	222.295	Surface	2012
210.259	232.956	Surface	2012	5544.541	222.288	Surface	2012
213.390	232.932	Surface	2012	5547.712	222.280	Surface	2012
216.522	232.928	Surface	2012	5550.883	222.266	Surface	2012
219.653	232.915	Surface	2012	5554.055	222.273	Surface	2012
222.784	232.917	Surface	2012	5557.226	222.279	Surface	2012
225.915	232.932	Surface	2012	5560.397	222.274	Surface	2012
229.046	232.910	Surface	2012	5563.568	222.267	Surface	2012
232.177	232.906	Surface	2012	5566.739	222.250	Surface	2012
235.406	232.891	Surface	2012	5569.911	222.239	Surface	2012
238.635	232.896	Surface	2012	5573.082	222.231	Surface	2012
241.864	232.896	Surface	2012	5576.253	222.221	Surface	2012
245.093	232.879	Surface	2012	5579.499	222.194	Surface	2012
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251.551	232.855	Surface	2012	5585.991	222.217	Surface	2012
254.780	232.848	Surface	2012	5589.238	222.216	Surface	2012
258.009	232.835	Surface	2012	5592.483	222.209	Surface	2012
261.238	232.832	Surface	2012	5595.730	222.207	Surface	2012
264.468	232.831	Surface	2012	5598.976	222.191	Surface	2012
267.697	232.835	Surface	2012	5602.222	222.197	Surface	2012
270.926	232.820	Surface	2012	5605.468	222.172	Surface	2012
274.155	232.819	Surface	2012	5608.715	222.144	Surface	2012
277.384	232.824	Surface	2012	5611.961	222.103	Surface	2012
280.613	232.794	Surface	2012	5615.207	222.053	Surface	2012
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287.071	232.710	Surface	2012	5621.699	222.060	Surface	2012
290.300	232.693	Surface	2012	5624.945	222.054	Surface	2012
293.529	232.693	Surface	2012	5628.192	222.063	Surface	2012
296.758	232.702	Surface	2012	5631.438	222.081	Surface	2012

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309.674	232.646	Surface	2012	5644.162	221.974	Surface	2012
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4002.342	224.434	Surface	2012	9349.686	214.974	Surface	2012
4005.362	224.441	Surface	2012	9352.802	214.969	Surface	2012

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4014.422	224.390	Surface	2012	9362.152	215.000	Surface	2012
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4029.994	224.406	Surface	2012	9377.734	215.013	Surface	2012
4033.171	224.400	Surface	2012	9380.961	214.999	Surface	2012
4036.348	224.400	Surface	2012	9384.187	214.991	Surface	2012
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4042.703	224.401	Surface	2012	9390.640	214.993	Surface	2012
4045.881	224.410	Surface	2012	9393.866	214.982	Surface	2012
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4052.236	224.400	Surface	2012	9400.319	214.983	Surface	2012
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4058.590	224.400	Surface	2012	9406.772	214.972	Surface	2012
4061.768	224.400	Surface	2012	9409.998	214.984	Surface	2012
4064.945	224.400	Surface	2012	9413.087	214.988	Surface	2012
4068.123	224.400	Surface	2012	9416.175	215.004	Surface	2012
4071.247	224.400	Surface	2012	9419.264	215.002	Surface	2012
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4080.620	224.390	Surface	2012	9428.530	214.975	Surface	2012
4083.744	224.398	Surface	2012	9431.618	214.986	Surface	2012
4086.869	224.400	Surface	2012	9434.707	214.999	Surface	2012
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4093.117	224.400	Surface	2012	9440.884	214.998	Surface	2012
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4941.987	223.017	Surface	2012	10282.543	212.764	Surface	2012
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