DENALI EXPEDITION 2016, THE WEST BUTTRESS

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A

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Denali Expedition 2016, The West Buttress

Abstract

During the summer of 2016 the project team will conduct an expedition to climb the West Buttress of Denali. Denali is the highest peak in North America, with an elevation of 20,320 feet above sea level. The West Buttress is the most commonly climbed route starting at the Kahiltna Glacier and ascending to the summit. The three-week expedition requires robust planning prior to step-off since there will be no external support once started.

Current expedition planning typically consists of ad hoc methods of planning, consisting of subject matter expert opinion and best guesses. The average summit rate for the past ten years on Denali hovers around 52% and the fatality rate hovers at three climbers a year. Unsuccessful attempts are often attributed to bad weather, injury, lack of fitness and lack of mountaineering knowledge. Can following systematic planning guidelines and establishing pre-expedition go/no-go criteria for expeditions on Denali significantly increase safety and increase summit success?

This project encompassed all pre-expedition planning and support. The project produced an itinerary for the three-week expedition, researched and procured equipment for the team, researched high altitude nutrition and procured food items, developed a comprehensive physical fitness training plan for expedition members, and developed an expedition risk management plan. Will these deliverables ensure a more successful and safer expedition? Additionally, the detailed approach to expedition planning will allow the expedition team to establish a balance between unacceptably sparse and excessively burdensome equipment and supplies.

Key Words

Denali
Mount McKinley
The West Buttress
Expedition planning
High altitude nutrition
Training for climbing
Expedition equipment
Mountaineering

Introduction

Humans, by nature, are curious. We are driven to explore our surroundings, whether it is the physical geography of an area, the metaphysical nature of our being, or the scientific laws that govern our existence. Though our exploration of the metaphysical and science has evolved over time, our approach to physical exploration has stayed relatively consistent, minus changes in the mode of transport. Hundreds of years ago, as our ancestors explored the oceans, they thought chiefly about their conveyance, the maximum amount of food and water they could take, navigation, and a way to chart their successful, or unsuccessful, expedition. Fast forward to today, and expeditions to remote areas of the world plan based on their conveyance, how much food and water they can take, navigation, and a way to chart their journey. The only real change has been in equipment and technology. Global Positioning Systems have replaced the sextant like crampons have replaced hobnails. Expeditions share, roughly, the same success rate today as they did in the past. Equipment and technology has helped us reach areas which our ancestors could not go, only our methodology has limited us from seeing our success rates increase.

Project management provides the baseline for a system that expedition planners can use in order to improve an expedition's chances for success. Using project management processes to approach an expedition from a whole systems approach, ensures that each part of the expedition, from procurement to training, is taken into account. Most expedition planning focuses on the objective while missing portions of the pre-planning (Soles & Powers, 2003). Organizations that have used a project management like process have seen a rise in expedition success, while those that do not have remained at a static success rate. For example, the National Air and Space Administration has used a project management approach to expedition planning for all of their missions. They have enjoyed an extremely high mission success rate as a result. Mountaineering, on the other hand, continues to use older methods of planning and continues to maintain a nearly 50% success rate (National Park Service, 2015). Using a process to approach expedition planning from a systems perspective has proven successful in the aerospace world, a similar approach used for terrestrial expeditions may improve expedition success rates.

Mountaineering provides a relatively stable environment to test expedition planning. In Anchorage, mountains are close by, providing training areas to improve skills and knowledge. The Alaska range and the Wrangells provide remote, and hard to access mountains that require a detailed plan and approach for success. Mount Sanford (16,237 feet) provides a great location to test equipment and theories that will be used for a later expedition on Mount Denali (20,310 feet). Whereas Mount Sanford only requires one week to climb, Denali typically requires three weeks. Both expeditions require similar planning and equipment. The process developed to plan the expedition for Denali, was tested on Mount Sanford as part of the team's preparations for Denali. The development of the expedition planning system and execution are detailed in this report.

What is an expedition? Expeditions are endeavors, which last at least several weeks, that utilize a team to achieve a specific objective in a remote location (Soles & Powers, 2003). A project is a "temporary endeavor undertaken to create a unique product, service, or result" (Project Managment Institute, 2013). An expedition will always be

unique, even though the objective may not. Take, for instance, the West Buttress of Denali. This route experiences approximately 1,200 climbers a year (National Park Service, 2015). Even though the route is heavily traveled, the success rate for the summit remains at 52% with a fatality rate of about three climbers annually (National Park Service, 2015). Each team that climbs is their own project, each with different approaches. Teams that are successful have a combination of several factors in their favor that make their results favorable compared to others. Which factors influence their success or make them more successful, planning, equipment, training, food, luck? With the proper approach, all of these factors can be anticipated, and eliminated with only luck (e.g., risk) needing mitigation.

Literature Review

Denali Expedition 2016, undertook research of various expedition planning tools used for mountaineering and remote objectives. There is plenty of material on various aspects of climbing, including expedition planning, but the material is widespread, either being general or specific to a particular system. The only single source style resource that covers, in barest of detail, everything from training, technique, logistics, and planning, is *Mountaineering: the Freedom of the Hills* (Eng, 2010). Though this piece of literature covers most aspects of mountaineering skills, it fails to employ a process to cover the necessary steps to plan an expedition from idea to objective. Other resources, such as: *Climbing: Expedition Planning* (Soles & Powers, 2003) offer more details to consider for planning the objective, but lack pre-expedition considerations such as: knowledge and skills training, physical training, and market research and procurement. Since documents that cover base planning techniques were missing key details, the literature review had to be expanded to encompasses the various aspects of the project system-by-system. *Mountaineering: the Freedom of the Hills* and *Climbing: Expedition Planning* (Eng, 2010; Soles & Powers, 2003) provided a basis for further research and assisted in identifying existing gaps in expedition planning methodologies.

Mountaineering Styles

Currently, mountaineering expeditions use three common approaches to climbing. The first, expedition (or siege) style, is an approach that mitigates risk through over preparation of equipment and expendables. Expedition style utilizes a series of camps which climbers approach and stock after they establish a route. Each camp is stocked from a base camp before the route to the summit is attempted. This style requires a lot of time and expendables (i.e., food and fuel), but increases odds of summit success since so much time is spent on the mountain, mitigating the risks of weather or lack of expendables (Eng, 2010; Soles & Powers, 2003). The second style, capsule style, is similar to expedition style in that the next camp is stocked prior to moving (Soles & Powers, 2003). The difference is that instead of all camps being stocked first, only the next camp is stocked prior to moving. This style is popular on Denali. The final style is alpine style. Alpine style uses the approach that the less time spent on the mountain, the less risk of being caught in bad weather and the less fatigued a climber will be (Eng, 2010; Soles & Powers, 2003). This style moves all equipment and supplies up the mountain in a single push, with camps established along the way as climbers stop. Though this is lighter and faster, there is increased risk due to less equipment and supplies than other styles. The below table shows the pros and cons to each style.

Style	Pros	Cons
Alpine	- Lighter weight from expendables - Less time at altitude - Less mental fatigue - Less exposure to mountain risks (e.g., avalanche)	- Less equipment - Less supplies - Less time to acclimatize - Less margin of safety in inclement weather
Expedition (Siege)	- Ability to extend duration for inclement weather - Established route between camps - Time to acclimatize - Ability to deal with equipment or medical issues	- More weight in equipment and expendables - More time spent at higher altitudes - Mental fatigue due to time spent on mountain - Physical fatigue from ferrying loads to each camp multiple times - Higher chance of medical issues (e.g., gastro-intestinal)
Capsule	- Ability to deal with inclement weather - Established route to next camp - Time to acclimatize	- More weight in expendables - More time spent at higher elevation - Possibility of being trapped at higher elevation during storms - Physical fatigue from moving twice to each camp.

EXHIBIT 1 – MOUNTAINEERING STYLES

Planning Techniques

There are several current approaches to overland expedition planning. These approaches generally focus on the objective and do not detail associated sub-systems of expedition planning. According to *Mountaineering: The Freedom of the Hills* (Eng, 2010), expedition planning consists of the following parts:

- Choose an objective
- Choose the team
- Develop the itinerary
- Gather supplies and gear
- Physical and mental conditioning
- Understand the weather

Though this provides decent guidelines, there is not adequate information in each portion to cover the entire system of planning. The *Guide to the Project Management Body of Knowledge* (Project Managment Institute, 2013) shows the use of interactive process groups used to accomplish planning which consist of: initiating, planning, executing, monitoring and controlling and closing. Would using the project management phases and a predictive life cycle in the various sub-systems of expedition planning improve expeditionary preparation and objective success?

Training

Training can be broken into two components, skills and physical training. Several books approach the subject of the climber as an athlete and even more books that discuss the skills necessary to be safe as a mountaineer. The step

missing in the expedition planning system is incorporating a training regimen into the pre-expedition planning cycle in order to gain necessary fitness or knowledge prior to the expedition. Knowledge is not a substitute for experience, so proper time must be allotted to hone specific skill sets and to gain the fitness necessary to achieve the objective.

Physical Training

Fitness is a crucial component to mountaineering. Mountaineering is an endurance sport, but training strictly for endurance will not build the muscular systems that are needed at higher altitudes, or train the ability to carry loads through steep terrain (House & Johnston, 2014). Structured training for climbing is a recent innovation. Climbers, historically, have been a group of non-conformists who train simply through climbing. Though this approach has worked in the past, the amazing feats that athletes accomplish today are more about the training leading to an objective, rather than repeating the same objective (House & Johnston, 2014). Physical training has two main components, baseline fitness in preparation to event-specific training and event-specific training (House & Johnston, 2014). The team members for this project already had an established fitness base, but required an event-specific physical training plan in order to prepare for Mount Sanford and Denali. Adaptation is an important concept in physical training, in which the body adapts to the physical demands placed on it within a three to six-week cycle. After three weeks of training the body begins to plateau and receives diminishing returns from the same level of intensity and effort (Hörst, 2008). Physical training plans need to take into account these micro-cycles in order to achieve higher levels of fitness. Important systems to take into account for training are anaerobic threshold, aerobic base, and strength. Anaerobic threshold training increases speed and use of systems that do not require oxygen to burn, the by product of this training is lactic acid which is responsible for muscle soreness. Aerobic base training increases volume of oxygen maximization (VO2 max), which assists with burning energy stores requiring oxygen, this is vital to the endurance athlete. Strength training is the only way to increase strength of tendons and ligaments and is necessary for continuing improvements between micro-cycles (Hörst, 2008; House & Johnston, 2014). A physical training plan has to take into account each of these components in order to adequately build on the base fitness.

Skills and Knowledge Training

Glacier mountaineering requires many skills that a climber cannot learn on the objective. Basic skills range from using crampons and ice axe, to establishing a winter camp (Eng, 2010). More advanced skills include: crevasse rescue, rope work and glacier navigation (Tyson & Clelland, 2009). Other skills that can enhance safety are ski touring and climbing. Using skis instead of snow shoes can increase safety in a knowledgeable party since skis disperse weight over a greater area than snowshoes or boots alone (Tyson & Clelland, 2009; Selters, 1999). Less ground pressure can make it less likely for a climber to fall through snow bridges covering a crevasse. Skiing can increase risk in inexperienced teams, since teams should be roped when there is a crevasse hazard, and skiing while roped is an advanced technique. Training skills and knowledge has to account for expedition member time, experience and prior knowledge. It should not purely focus on the acquisition of new skills, but must also account for retraining and practicing old skills.

Equipment

Nearly every mountaineering book discusses the specialty equipment required for general mountaineering, from technical equipment (i.e., ropes, pickets, ice screws), to group equipment (i.e., tent, stove, shovel), and personal equipment (i.e., clothing, sleeping bag, pad). The basic clothing and equipment used in most high-altitude environments is similar, but requires experience with use to judge comfort level and may require some modifications for safety and enhanced performance (Eng, 2010; Tyson & Clelland, 2009; NWTC, 2016).

Necessary Equipment

Equipment in this category forms the basic equipment needed to survive for an extended duration in a mountain environment. This equipment falls into two broad categories (group and personal), but sub-divides into sub-categories in each (Eng, 2010). Expeditionary styles use different approaches regarding what type of equipment is necessary. Alpine style expeditions seek to lighten a climber's load by eliminating equipment that is single purpose or has a use that may redundant. Siege style climbers will take redundant equipment, and equipment that may increase physical comfort due to the time spent on the objective. The table below shows the broad categories and sub-categories in each group with some examples of what may be found in the sub-categories.

Category	Sub-categories	Examples
Personal	- Sleeping	Pad, bag, booties
	- Clothing	Base layers, insulation layers, shell
	- Cooking	Bowl, spoon, bottles
	- Conveyance	Skis, boots
	- Safety	Harness, helmet
	- Repair	1st aid
	- Navigation	GPS, map
Group	- Shelter	Tent, tarp
	- Safety	Pickets, rope
	- Cooking	Stove, fuel
	- Repair	Repair kit, 1st aid (large)

EXHIBIT 2 – EQUIPMENT CATEGORIES

Equipment Modifications and Experimentation

Certain modifications to equipment is necessary for safe travel in a mountainous environment. There are also numerous experimental equipment combinations or modifications that may increase the comfort and safety during an expedition. Necessary equipment modifications include modifications such as: ice axe padding, foot and waist prusik cords, backpack strap reinforcement, ski leashes, ice axe leash, et cetera (Tyson & Clelland, 2009; Selters, 1999). These modifications make lost equipment unlikely. Experimental systems that may increase safety and comfort include items like vapor barrier liners (Dawson, 2010; Tyson & Clelland, 2009; O'Bannon & Clelland, 2007). Vapor barrier liners work with the ski boot and sock in order to prevent sweat from permeating the boot

insulation by encasing the foot in an impermeable membrane. In order to assess the system for the team's purposes, the team tested several equipment modifications to better understand how the modifications affected the climber and whether the modifications were value added. Other equipment may be unnecessary and allow us to decrease overall weight.

Logistics

Expedition logistics is often where an expedition may fail. A majority of expeditions are self-supporting, meaning that there is no external team providing for the expedition's needs. Once an expedition departs for the objective, there is little or no ability for the team to acquire anything they do not already have. Though logistics originally appeared as as a sub-component of expedition planning, it has proven to be the most important aspect to achieving the expedition's goals. Expedition logistics covers all the pre-expedition logistics such as: permits, flights, and training, as well as expedition-specific logistics, such as: fuel, water, and food. Failure at any level in logistics often means failure on the expedition (Hall, 2014; Simpson, Touching the Void, 1988; The American Alpine Club, 2014; Waterman, 2010).

Nutrition

Food and water the components of nutrition. Though at first straightforward, there are nuances to endurance activities, weather, and altitude that make mountaineering nutrition more onerous than not. Walking without a load, on level terrain and in normal weather burns approximately 300 Calories per hour. Cold weather generally increases Calorie consumption by 10% and carrying a load can increase calorie consumption by 10% per 10% of total body weight carried (e.g., 180-pound person carrying an 18-pound pack will increase calories burned by 10%) (U.S. Army, 2000). This means that a 180-pound climber in a cold, mountainous environment, carrying a 54-pound pack, who is working 8 hours a day burns approximately 3,100 Calories (not including their base metabolic rate). Replacing those Calories is vital to the climber's continued performance. Though literature focuses heavily on caloric needs, there is no research that encompasses incorporating an endurance sports style diet into a mountaineering expedition. In sports nutrition, macro-nutrients (protein, fats and carbohydrates) are an important part of meal planning (Fitzgerald & Fear, 2013). Meals focus on replenishing nutrients based on the activity performed, as well as providing the calories required for continuing exercise. Due to reduced oxygen at altitude, the human body is less capable of digesting fats and proteins. Changing a climber's diet as they increase altitude in order to provide more carbohydrates may increase climber performance. Additionally, providing meals that provide the proper macro-nutrients required based on whether the climber is resting, or doing heavy work may also assist in long term performance over the course of an expedition.

Medical

Climbers experience common issues during an expedition. A medical kit for the group can easily address most of the ailments that a climber may experience. Aches and pains, gastro-intestinal issues, et cetera are easily treated with a variety of over-the-counter medications. *Accidents in North American Mountaineering* (The American Alpine Club,

2014), provides a detailed summary of accidents throughout the Americas and conducts root cause analysis of accidents throughout a given year. Most of these accidents stem from over-confidence and improper training or safety equipment. The analysis *Accidents in North American Mountaineering* (The American Alpine Club, 2014) provides does give significant details for medical planning. With crampons on, falls and slips can result in a broken ankle, this requires including a method of splinting in a first aid kit. Climbing above 10,000 feet, regardless of experience, can result in acute mountain sickness, high-altitude pulmonary edema or high-altitude cerebral edema. Treatment of these conditions requires descent to the lowest symptom-free elevation and can be assisted by taking Diamox (Eng, 2010; Bezruchka, 2005).

Literature Review Results

There is plenty of literature available on best practices, training, skills, and planning the itinerary of the expedition itself. There is a plethora of best practices that various literature reveals. For the majority of expedition planning, combining these best practices in a schedule that allows team members to get the necessary training and practice and identifying the necessary equipment for the expedition takes care of a good portion of the necessary work. The gaps in expedition planning are in fitness planning and logistics (specifically nutrition) planning. A fitness schedule that takes into account climber baseline fitness, expedition objectives and time available may increase success and safety by developing a climber in such a way that the team has similar capabilities, and that the climber is capable of performing in the necessary manner. Developing an expedition menu that accounts for the itinerary, heavy exertion days, rest days and altitude will allow a climber to recover faster and have the energy necessary to climb day after day. Many reference texts gloss over these portions of expedition planning, instead focusing on equipment and techniques.

This literature review has allowed the team to focus on gathering best practices and experimenting with various equipment configurations. The team was able to dedicate more time to ensuring that there was a robust physical training plan in place that was achievable, could be monitored and testable. The team was also able to dedicate time to the expedition's nutritional requirements and developed a meal plan that is light-weight, and meets the macro-nutrient and Calorie requirements of the team.

Research Methods and Approach

Literary Review

Book research provided the bulk of information for this project. Reference texts were used to develop best practices, gear checklists and to assist with mountaineering knowledge and training. Books supplemented team member experience and training. Books on nutrition and backpacking recipes were used to provide a variety in the nutrition plan and adjusted to provide the necessary macro-nutrients determined work best best off of the environment or activity level used. A complete list of texts referenced is included in the references and bibliography.

Comparative Study

There are six authorized guiding companies currently providing guide services on Denali. Each company was compared with the other on their day-by-day itineraries; equipment lists and recommended fitness plans. These companies provided a best practice for risk averse mountaineering. Success rates were relatively low for guided companies based on their priority for client safety and the lack of control over expedition member fitness and training (National Park Service, 2015). The below guide companies provided publically accessible information that was used during this study.

Guide Companies:

- Alaska Mountaineering School (Alaska Mountaineering School, 2016)
- Mountain Trip LLC (Mountain Trip, 2016)
- Alpine Ascents International (Alpine Ascents International, 2016)
- Rainier Mountaineering, Inc. (Rainier Mountaineering, Inc., 2016)

Survey

Though surveys were originally part of the project plan, there were no responses. Interviews were used in lieu of surveys since climbers responded better to direct questioning than to surveys. Interviews used similar questions to the survey and allowed a better understanding of the methods used to plan climbs, equipment used, and techniques that worked for the interviewee.

Interview

Interviews were used to gather requirements from expedition members. Interviews with other mountaineers, particularly mountaineers that had previous experience on Denali, was beneficial in identifying gaps in their expedition planning and what they felt was necessary or unnecessary for their success. These interviews were particularly useful in identifying gaps in the common mountaineer's expedition planning process.

Short List of Interviewees:

- Dylan Van Rozeboom (expedition member, prior climber)
- Matt McGinnis (expedition member, medic)
- Adam Schoffstall (mountaineer)
- Matt Cauda (mountaineer)
- Steve Wadleigh (mountaineer)
- Matt Hickey (mountaineer, prior climber)
- Dolly LeFever (prior guide)

Statistical Analysis

Statistical analysis was a small part of the research methodology used in this project. Five years of weather data, provided by the National Park Service (National Park Service, 2015), was analyzed to attempt to identify historical weather patterns and summit windows. Data from *Accidents in North American Mountaineering* (The American Alpine Club, 2014), provided data since 1951 on trends in mountaineering accidents throughout North America and by specific mountain. Weather analysis was most useful for identifying observations that preceded adverse weather, and estimating how long that adverse weather may last.

National Park Service (National Park Service, 2015) – Database yielded historical data for Denali weather over the past five years

- Best summit windows
- Weather patterns
- Average days of adverse weather for each camp
- Basis for estimation on length of adverse weather conditions

American Alpine Club (The American Alpine Club, 2014)– Database provided a basis for accident trends over the past decade.

- Mountaineering and climbing accidents
- Root cause of accidents

Method Testing and Experimentation

The primary method of research was testing and evaluation of various best practices, techniques and equipment identified through previous research. The predictive life cycle was the basis for research, design and experimentation (Project Managment Institute, 2013). Each piece of equipment went through a cycle of market research, modification (if required) and field testing to ensure that it would work for Denali. Field testing was conducted in a similar environment to Denali with testing culminating with an ascent of Mount Sanford.

Mount Sanford provided a complete look at all aspects of the expedition planning system, with evaluation of the physical training plan, use of and evaluation of equipment, use of and evaluation of the meal plan, and the subjective evaluation of teamwork for the expedition. The field test also provided a direct comparison of the current expedition planning method to the system utilized in the project. Exhibit 3, below, shows the process used to research and evaluate various aspects of the expedition.

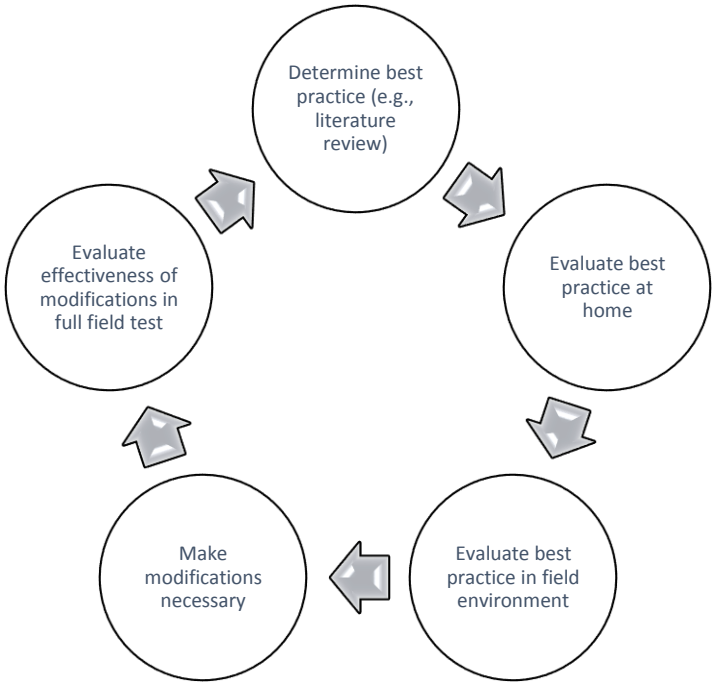

EXHIBIT 3 – RESEARCH AND EVALUATION PROCESS DIAGRAM

Analysis of Research

Since certain testing equipment was not available outside of a lab or without expending additional funds, subjective and qualitative analysis were mostly used to evaluate different aspect of the project. Teamwork, comfort of items during wear and temperature comfort are all items that could only be measured based on the subject testing the equipment, and not off of a quantitative assessment. When research favored a particular method, the method was tested under local field conditions to ensure it was consistent, and provided desirable outcomes. Final field testing took place from March 11 to March 17, 2016 on the approach and climb of Mount Sanford, Alaska. Mount Sanford was chosen because of the length of the approach (25 miles one-way to the mountain, and 10 miles from the mountain to the summit), the type of terrain (glaciated), elevation (16,237 feet), average temperatures during period of testing (ambient temperatures of -20º F to 25º F) and accessibility (Wrangell/Saint Elias National Park). During the evaluation the expedition members attempted to use all equipment and meals in a fashion similar to what they expected to use during their attempt on Denali. Though the team was not able to reach the summit of Mount Sanford, the evaluation of training, equipment, and nutrition was accomplished and provided all of the necessary information for the team to determine whether or not they were ready to attempt Denali.

Weather

Analysis of weather patterns on Denali proved problematic. The National Park Service provides weather data from 2007 to 2014 on their website (National Park Service, 2015). The Park Service has observations during the climbing season taken at 7,200 feet (Kahiltna Base Camp) and at 14,200 feet. The data provides adequate information

regarding averages for the seasons, but the information was inadequate to provide weather trends by day. The forecaster observations are useful sources of information to estimate what type of conditions the team can expect to see after specific observations. If a lenticular cloud (lens like cloud formation that forms over peaks, often indicating high-winds and precipitation within 48-hours, see exhibit 4 below) forms over the summit of Denali, weather tends to be unclimbable for about three days with a window of about two or three days before bad weather again (Eng, 2010; National Park Service, 2015).

EXHIBIT 4 – LENTICULAR CLOUD OVER THE SUMMIT OF MOUNT SANFORD, ALASKA

During the field test on Mount Sanford, the expedition team observed a lenticular cloud on the summit on March 15, 2016. This lenticular cloud preceded a storm that was due to strike the mountain on March 17, 2016. At 11,000 feet, when the team turned around and descended, they experienced winds at a sustained 20 miles per hour with gusts to about 25 miles per hour. By March 17, 2016 the team had returned to the parking lot and was still able to observe the lenticular cloud and obscured peak.

Weather on mountains tends to be highly unpredictable. Analysis of weather is able to give an expedition a large window in which weather may be stable, but is unable to accurately predict day-to-day weather. During the Mount Sanford field test, the expedition team was able to check the weather forecast prior to departure and half-way through the test. Both forecasts indicated favorable conditions for the anticipated summit days. Unfortunately, the storm indicated later in the forecast arrived early, creating unsafe conditions which the team could not wait through. The forecast was useful in determining the length of the storm, and allowed the team to reach the conclusion that provisions were not enough to wait out the storm and attempt later.

Analysis of weather trends and patterns did not yield a method for pinpointing specific days for summit windows, but did allow the team to develop a basis for risk estimation methods to utilize in decision making based on specific observations. This method of risk analysis was used to great effect on Mount Sanford. The team experienced an identified risk through observation (lenticular cloud on the summit) and using previous data as an estimate was able to determine that a summit attempt would not be feasible with the remaining supplies. This decision was validated two days later when the team returned to the parking area and observed the lenticular cloud formation persisting on Mount Sanford.

Accidents

Accidents tended to cover risk planning during the research portion of this project. Unfortunately, most accidents that occur on Denali are already mitigated by equipment or training. Crevasse fall, the highest hazard on Denali, is mitigated through use of safety ropes, self-arrest training and crevasse rescue training. Snow fall, the second highest hazard (but resulting in the highest casualty rate) is already mitigated through use of a safety rope, fixed lines, crampons and training. According to *Accidents in North American Mountaineering* (The American Alpine Club, 2014), a slip on snow or ice is the second highest cause of injury in North America, see Exhibit 5 below.

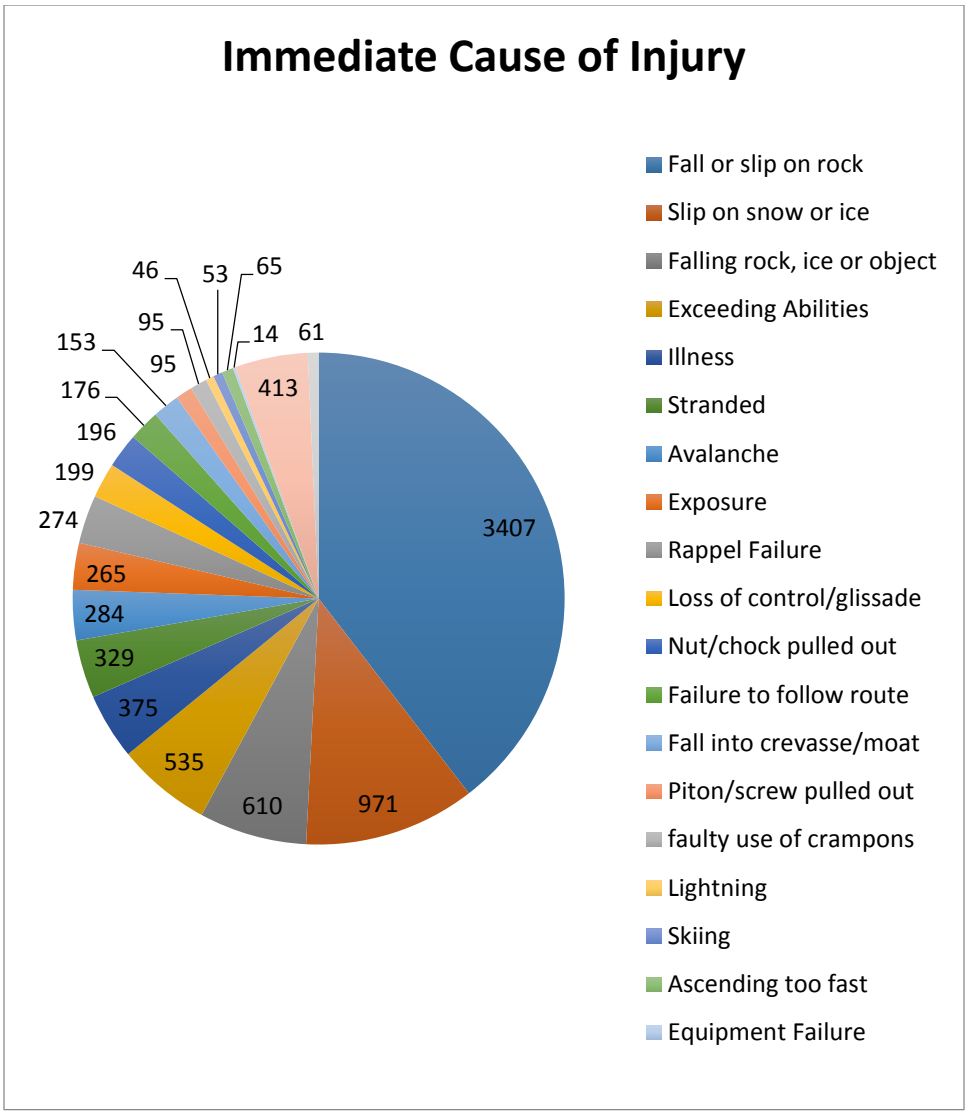

EXHIBIT 5 – LEADING CAUSE OF INJURY IN NORTH AMERICAN MOUNTAINEERING

Analysis of common accidents helped steer the expedition team toward developing skills training that could help further mitigate the common risks through proper team training. Though the team may be better at navigating these risks, it cannot mitigate risks from other teams that do not take a similar approach. The majority of falls tend to happen on the fixed lines which the National Park Service installs on the first 800 feet of the route leading from 14,200 feet camp to high camp, at 17,200 feet. During the 2014 season, inexperience among team members resulted in two slips on the headwall ending in evacuation of the casualties (The American Alpine Club, 2014). Taking this analysis into account, the team focused on training fixed line skills and navigating steep snow fields using crampons and an ice axe. Practicing these skills should keep the team from joining the statistics on accidents on the headwall.

Analysis of common accidents on similar mountains in North America guided the team's training plan. This knowledge was tested during the field test in two very specific ways. During the descent a team member's sled fell

into a crevasse, the team was properly prepared with the equipment necessary to self arrest and establish a hauling system to retrieve the sled. The gear carried was not excessive and provided the exact amount of equipment necessary for the rescue. Additionally, the team's first aid kit provided adequate medical supplies for all of the injuries the team encountered without being overly burdensome with low probability of use equipment.

Nutrition

Meal planning was one of the more detailed portions of research for this project. Sports nutrition encompasses replacing Calories lost during exercise, as well as macro-nutrients necessary for the body to recover. A typical macro-nutrient diet consists of 50% carbohydrates, 30% fat and 20% protein (Fitzgerald & Fear, 2013). Only a small adjustment to macros is necessary to experience a change in body response. During high endurance activities, as little as a 5% change to any macro-nutrient is enough to change the body's response and recovery.

Research led the team to look at developing a menu that incorporated dehydrated food items (in order to save weight), real food items (to stimulate appetite) and freeze-dried food items (for ease and weight) (Mountain Trip, 2016; Pearson, 2004; Eng, 2010). For macro planning, days were split into five different types, low altitude rest, low altitude climbing, high altitude rest, high altitude climbing and pre-summit. The below exhibit (Exhibit 6) shows the macro-nutrient breakdown for the different types. The menus selected will achieve a similar macro-nutrient load.

Menu Type	Carbohydrate	Fat	Protein
Low-Altitude Rest	52%	28%	20%
Low-Altitude Climb	51%	28%	21%
High-Altitude Rest	55%	27%	18%
High-Altitude Climb	60%	25%	15%
Pre-Summit	60%	25%	15%

EXHIBIT 6 – TABLE OF MACRO-NUTRIENT PERCENTAGES DURING CLIMB

During the Mount Sanford field test, the team tested a similar nutrition profile during the field test to what the team would use during the Denali expedition. The meals consisted of dehydrated meals for the approach and commercial off-the-shelf freeze dried meals for the summit attempts. Each dehydrated meal weighed approximately 14 ounces (feeding two people) and provided macro-nutrients within 1% of the above table. The menus were tested by the climbers based on a qualitative assessment that assessed the taste of the menu, the energy provided the next day, and whether or not team members experienced any gastro-intestinal issues. After five and a half days utilizing the selected menu, team members assessed all tastes as above average (as compared to a typical freeze-dried menu). On the approach menu style diet (low-altitude climb) the field test members were able to conduct five and a half days of continuous movement (consisting of 10 plus hours of work) without any ill effect. Day 1 consisted of of a 16-mile movement with 100-pounds of equipment with a 3,200-feet elevation gain. Day 2 was a 10-mile movement with 2,500-feet of elevation gain with 90-pounds of equipment. Day 3 consisted of a 6.5-mile movement with 3,200-feet of elevation gain with a .75-mile double carry (moving over the same distance twice with a load, effectively tripling the distance carried). Day 4 consisted of a 6.7-mile movement with 1,500-feet elevation gain and return the base of

the mountain. Day 5 consisted of a 15-mile movement and descent and day 6 consisted of 13 miles of movement. The nutrition plan was substantial enough during the field test that team members were able to conduct nearly 6 days of continuous 10 to 12-hour days with up to 16 miles a day with a 100-pound load of equipment. After return from the field test, expedition members returned to a normal diet and were able to resume a regular training regimen within five days.

Acclimatization

Acclimatization is an important process in high altitude mountaineering. Above 10,000-feet, the human body experiences detrimental effects due to oxygen deprivation. To mitigate the lack of oxygen, it is suggested that climbers sleep no higher than 1,000-feet a day (they can climb as high as they would like) with a rest day every 3,000-feet climbed (Bezruchka, 2005). For a peak like Denali, this means that climbers should take a minimum of 14 days to ascend from 7,200-feet to 20,320-feet. This baseline is already used to establish common camps on Denali at: 7,200-feet, 9,700-feet, 14,200-feet and 17,200-feet (Coombs, 1997). At first glance, these camps do no adhere to the climb no higher than 1,000 feet per day, what is not seen are the carries between camp and rest days. A typical itinerary looks like Exhibit 7 below (Coombs, 1997).

Day	Camp	Altitude	Activity
1	Kahiltna Base Camp	7,200-feet	Fly-in
2	Move to Camp 1	7,800-feet	Move camp
3	Camp 1	7,800-feet	Carry to 9,700-feet
4	Move to Camp 2	9,700-feet	Move camp
5	Camp 2	9,700-feet	Carry to 11,000-feet
6	Camp 2	9,700-feet	Rest
7	Camp 2	9,700-feet	Carry to 13,500-feet
8	Move to Camp 3	14,200-feet	Move camp
9	Camp 3	14,200-feet	Retrieve 13,500-feet cache
10	Camp 3	14,200-feet	Rest
11	Camp 3	14,200-feet	Carry to 16,200-feet
12	Camp 3	14,200-feet	Rest
13	Move to Camp 4	17,200-feet	Move camp
14	Camp 4	17,200-feet	Rest
15	Camp 4	17,200-feet	Summit day, or retrieve cache
16-19	Camp 4	17,200-feet	Summit days (inclement weather)
20	Camp 3	14,200-feet	Return post-summit
21	Kahiltna Base Camp	7,200-feet	Return flight
22-23	Kahiltna Base Camp	7,200-feet	Return weather days

EXHIBIT 7 – CAMP ACCLIMATIZATION ITINERARY

The above itinerary allows the climber sufficient time climbing high, and sleeping low. A necessary strategy for acclimatization (Bezruchka, 2005). The climber climbs up around 2,000-feet per carry and has a rest day at the higher altitude at which they sleep.

A similar schedule was tested during the Mount Sanford field test. Expedition members planned four camps for the expedition. Camp 1 was located at 2,500-feet, camp 2 at 5,700-feet, camp 3 at 9,200-feet, and camp 4 at 13,100-feet followed by the summit and a return to lower elevation. Though there was a more aggressive push to elevations, the overall elevation was lower than those the team will experience on Denali. Altitude effects were noticeable about 7,000-feet in that perceived exertion was lower than the heart rate at a lower elevation. Expedition members climbing a steep slope at altitude experienced heart rates around 150 beats per minute, the same as someone running at an endurance pace (e.g., 9:00 minutes per mile).

Physical Training

Fitness was another key component of this project. Complications included differences in individual team member baseline fitness, tracking of fitness training, and measuring fitness levels. A baseline plan to build endurance, and pack-specific weight training was developed for the members to follow based on their own fitness level. The plan was kept vague enough that members with different fitness levels could follow and still realize fitness gains. The fitness plan included weight training, endurance training, and recreation to develop skills. A micro-cycle of three to four weeks was built into each successive phase in order to build fitness. Exhibit 8 is an example of one physical training micro-cycle.

<u>November (3 days cardio, 2 days strength, 1 day stairs, 1 day pack) – 6 months prior to expedition (this first month should be a fairly easy transition into a scheduled training routine)</u>

- Cardio: Elevated heart rate for 30-40 minutes (this should be in the upper regime of around 150-170 bpm)
- Stairs: Walk stairs without weight for 45 minutes
- Strength: Three sets of pushups, pullups, and abdominal exercises. Core workouts will strengthen your back for when the time comes and you're lugging up a baby whale on your back day after day. Make sure to increase repetitions periodically as you gain strength.
- Pack: Carry a 15 lbs. pack for an hour
- Recreation: Climbing, skiing, hiking, etc.
- Rest days: Take them when you need, you know your body better than anyone. Don't push yourself to injury
- Technique: Basic crampon work, self-arrest, passing fixed gear on a rope team, fixed line ascension, crevasse rescue, etc. (should be done as a team at least once a month)

	Sunday	*Monday*	*Tuesday*	*Wednesday*	*Thursday*	*Friday*	*Saturday*
Cardio			**X**	**X**	**X**		
Stairs						**X**	
Strength		**X**				**X**	
Pack	**X**						
Recreation		**X**	**X**		**X**		**X**

**Example schedule

EXHIBIT 8 – PHYSICAL TRAINING MICRO-CYCLE

The physical training plan was tested during the Mount Sanford field test. During the field test, expedition members carried a load similar to what they will carry for Denali, but traveled longer distances. The team traveled approximately 67 miles in under 6 days. Each day included 10-12 hours of continuous movement with weight. This far exceeded the team's expectations. At the end of 5 days the team was still prepared to continue over a longer distance. During the climb team members never experienced heart rates above 155 beats per minute. The team noticed that during climbing a spiked heart rate that elevated to 155 from a lower rate within 2 minutes of activity necessitated a brief rest to reduce heart rate to approximately 135 before continuing. Perceived exertion did not increase with heart rate. Climbers did not feel as tired climbing as the elevated heart rate typically would warrant. At 9,000-feet both climbers felt the effects of altitude in the form of shortness of breath and elevated exertion heart rate, but were able to accomplish all camp activities with no issues.

Product Development

Products for the project included the expedition itinerary, the meal plan and the physical training plan. The itinerary, based on Colby Coombs book (Coombs, 1997) and various guide services, was straightforward. There are few variations of the West Buttress route that allot adequate time for acclimatization. Equipment and modifications were a more robust portion of the project and accounted for a significant time investiture. The meal plan required more research, development and testing to ensure products were easing to cook, and provided the proper nutrients.

Itinerary

The itinerary with the lowest incident rate to climb Denali takes a minimum of 14 days to account for acclimatization. Most guide services include a 7-day buffer to account for weather, taking at least 21-days to climb the mountain. The team's schedule allots 25-days from Talkeetna, Alaska to the summit and back. The itinerary uses the basic schedule outline, using single and double carries to different caches and camps, and allots additional days for weather at Talkeetna and base camp (Coombs, 1997; Hult, 2009). The team itinerary, located in Appendix B, represents the basic schedule including contingencies in case of bad weather. Interviews with climbers indicated that the wait for a flight to the glacier could last 1-2 days, cutting into the climb permit time before the expedition even begins the climb. Allotting additional days for the in town weather delays allows the team to follow the actual climb schedule more closely.

Equipment and Modifications

Equipment procurement and modifications were an extensive part of this project. Several equipment modifications were identified during the research phase and tested during training and on the Mount Sanford field test. Some of these modifications were found to be beneficial; some were found to not produce benefits worth the weight of the modification. Only value added equipment that could replace a similar piece of equipment, or equipment and modifications that made a significant improvement in comfort, or safety without adding significantly to the load were determined to be useful. Using field testing, the team was able to eliminate 18 pounds of additional gear and expendables. The gear list can be found in Appendix C.

Vapor Barrier Liners

Vapor barriers keep moisture from sweat from entering insulation layers, allowing insulation to maintain insulation value over a longer period of time due to not becoming saturated (Clelland, 2011). Commercial vapor liners are a thick, impermeable sock made of nylon. These barriers were expensive for the team's purposes and created a sock that was too thick to comfortably fit the team's fitted boot liners. An inexpensive solution was to use large oven bags in place of commercial vapor barrier liners. During the Mount Sanford field test, the oven bags proved to have a significant effect on comfort and warmth. The team was able to use the same wool sock and liners over the course of the 6-day field test. At the end of a 10-12-hour day there was a significant reduction in moisture retained by the ski boot liner, allowing them to dry over night within the team's sleeping bags. At .5 ounces for a pair, they were well worth the weight since boots did not get heavier due to sweat and less wool socks were required. The vapor barrier liners also allowed the team to eliminate the added weight of additional insulating socks. The team had to pay more attention to foot hygiene since the foot was immersed in sweat all day. See Exhibit 9 below for an example of the vapor barrier system.

EXHIBIT 9 – VAPOR BARRIER LINER SYSTEM

1/8” Foam Tent Floor

A tent floor was used during the Mount Sanford field test in order to provide insulation from the glacier across the entire tent floor. The tent floor did provide some additional comfort when sitting off of a sleeping pad, but did not increase tent warmth significantly. The tent floor needed to be used in addition to team member’s foam and inflatable sleeping pads. Difficulties with the tent floor were noted in folding and rolling the tent floor. The tent floor did noticeably increase tent comfort or temperature; it also did not eliminate the need for a secondary foam pad for the sleep system. Since the floor added 2.5 pounds to the load without eliminating another piece of equipment and did not add value, the team determined that it did not add value and was not worthwhile to carry.

Sled Rigid Traces

Rigid traces provide a strong connection from the backpack to the sled, allowing the climber to have greater control of the sled during descent. The team used ¼” fiberglass rods to provide the rigid connection. Unfortunately, the rods twisted and broke while traversing across a hill with the sled. The traces worked well for the rolling hills, but were incapable of dealing with the rigors of cross hill travel. The rigid traces had to be replaced with a rope trace system on day 2 of the Field Test. Since the equipment failed during testing, the team determined that the more complicated rigid traces did not add value to the sled system and will not be pursued during Denali.

Sled Aluminum Runners

Aluminum runners were attached to the sled to increase the sled’s ability to track behind the skier. The aluminum runners worked well during the ascent, unfortunately during the descent they became detached due to the way the sled moved across the fall-line. During skiing the skier would turn across the hill, while the sled continued downward, as the sled passed the skier it would catch on the traces and violently turn toward the skier. The aluminum runners would catch in the snow during the violent turn and broke after 1,000 feet of descent. Since the runners were unable to remain attached to the sled during the entire descent, they created a hazard for other team members and the team decided not to use them for Denali.

Candle Lantern

Candle lanterns have been used in numerous winter camping applications in order to provide warmth and light inside of snow shelters. The team utilized a small candle lantern in order to pre-heat the tent and provide additional warmth during cold nights. At 8.8 ounces, the candle lantern was well worth the additional weight. During use, the team noticed that the tent temperature increased approximately 10º F.

Over Boot Tech Binding Holes

In order to use over boots with ski bindings the boot needs to be modified by cutting small holes through the neoprene. Though it appeared trivial, the holes did allow infiltration of snow when the over boots were used for around camp applications, such as: warming boot liners and when worn over camp booties. The team determined

that duct tape was useful to apply to the over boots unless used while ski touring. Since using ski boots in lieu of mountaineering boots, it is likely that the team will need the over boots during early morning climbs in skis as well as during summit day.

Aluminized Stove Board and Pot Rest

A stove board and pot rest are necessary to prevent the stove and pot from melting into the snow. An insulated pot rest allows the pot to retain warmth longer than a non-insulated pot rest. The built a pot rest and stove board out of ¼" closed cell foam with aluminized tape to reflect heat. On warmer nights during the Mount Sanford field test, the team was able to leave water in pots overnight without significant freezing, allowing them to heat water in the morning much faster. At 5.5 ounces the stove board and pot rest were heavy, but worth the weight due to time saving in the mornings.

Meal Plan

The nutrition planning was one of the more complicated portions of the project. Due to the expense, lack of calories, and proper nutrition found in commercial freeze-dried foods, the expedition team decided to use home dehydrated foods. Use of dehydrated meals also gave the team finer control on the nutrients included in the menus. The original menu plan called for a side and main meal plus a dessert for dinner. During field testing, the team found that the side added additional time and effort with little gain in nutrients. The team opined that a side was not worth while, and preferred to plan the Denali menu with a soup, main course and dessert. The meal plan can be found in Appendix D.

Refined Planning System

Both Denali and Mount Sanford were planned using the refined planning system. During the field test the team compared the traditional planning approach and the refined system. In all instances of comparison, the refined system provided better estimates and predictability than the traditional system. The team eliminated excess weight, had the proper equipment for all situations encountered and was adequately prepared for the stress of the objective. During the comparison the team conducted parallel planning using both approaches. The traditional approach provided a schedule that required a 25 mile approach on the first day and did not account for acclimatization above 10,000 feet by planning a summit attempt from a camp at 10,000 feet. The refined planning system accounted for the team's fitness, and the amount of equipment carried over estimated trail conditions. The refined system yielded an estimated camp at 16 miles, and another at the base of the mountain with two days of climbing and a summit on the third day. During the test, the team accomplished 16 miles on the first day, made it to the base of the mountain on the second day and were on track for an ascent schedule planned using the refined planning system. The system used for planning is illustrated in Exhibit 10 below.

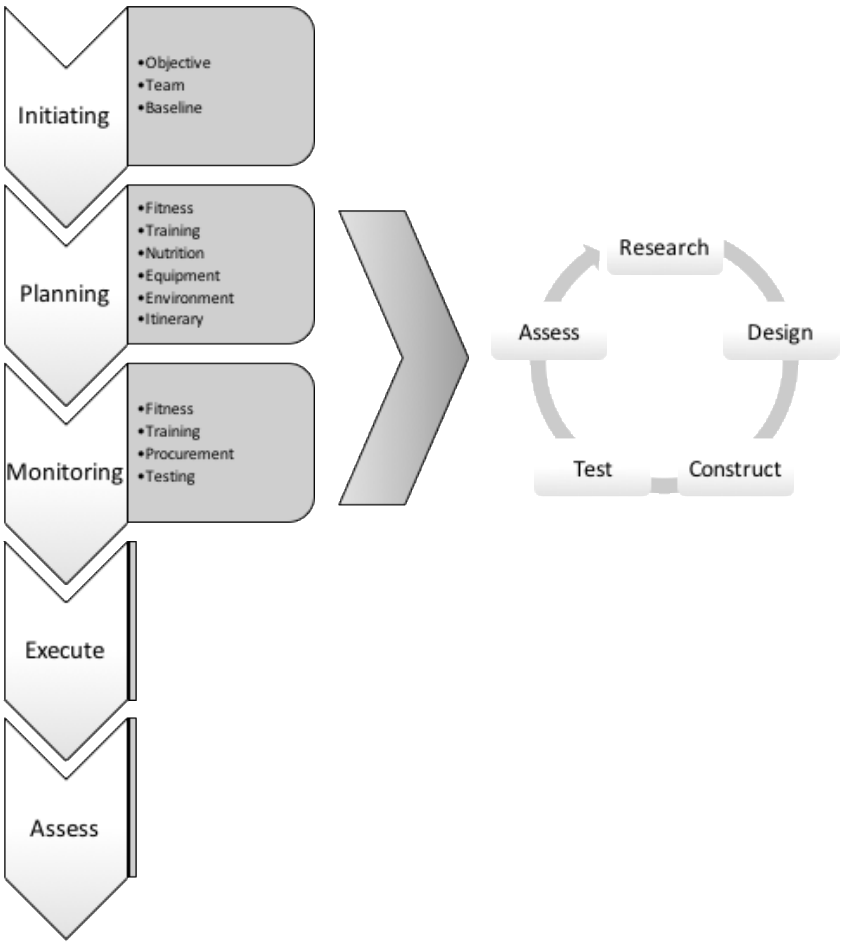

EXHIBIT 10 – REFINED EXPEDITION PLANNING SYSTEM

Conclusions

A refined approach to expedition planning is effective in predicting expedition outcomes, though expedition success rates may still be affected by events outside of planned deviations. Current planning lacks a systematic approach for research and estimation needed to develop a thorough plan. Utilizing a project management approach allows expedition planners to design an expedition plan that walks the line between excessive and sparse. The field test provided an environment to analyze and compare planning techniques in a real environment. Though the team failed to achieve the summit, they had a plan and decision matrix for risks encountered, did not carry excessive equipment and did not have any equipment they wished they had brought. During the assessment phase of the planning system, there are two questions a team must ask: was there anything that was missing, and was there anything that was not used (skills, equipment, fitness, planning)? Capturing these allows the team to further refine estimates in future planning, just as with any project. Expedition planning is a project that benefits from proper planning and execution in the same way as any other project. The project management approach is a value added approach to expedition planning. The refined expedition planning system takes the guess work out of the planning process.

The purpose of this project was to plan an expedition climbing Denali, to include selecting and training the team, and procuring and testing all equipment, while utilizing a project management style approach. After training, procurement and field testing, the team is confident in the approaching climb, the plan, and the team's abilities. The goal of the project was to increase expedition safety and success. One field test was not enough to determine whether or not safety and success for expeditions will trend upwards. The testing team did feel that safety, due to training and proper equipping, was higher. Use of risk planning and decision making proved to be extremely effective, the team was able to execute the correct choice for each risk encountered based on analysis prior to the climb. Success rates still need to be determined since the field test was not successful in achieving the summit of Mount Sanford. This summit failure was not a result of inadequate planning, but was an example of outside of standard deviation risks (forecasted storm system arriving three days earlier than forecasted).

Recommendations for Further Research

Numerous opportunities for future research exist for this project. The scope of the project was limited to developing a plan to climb Denali, and did not include provisions for developing, evaluating and refining a planning system. The basic refined expedition planning system requires further development and testing. The system also has potential for adaptation outside of the expedition planning community to encompass numerous aspects of planning goal-oriented endeavors. There is also potential to develop a business utilizing a similar process for consulting organizations or individuals with a clear objective, but no path for advancement toward the objective. The following items are recommended for future research:

1) Refinement and testing of planning system
2) Adapting planning system for use in goal oriented activities
3) Utilizing planning system in consulting business

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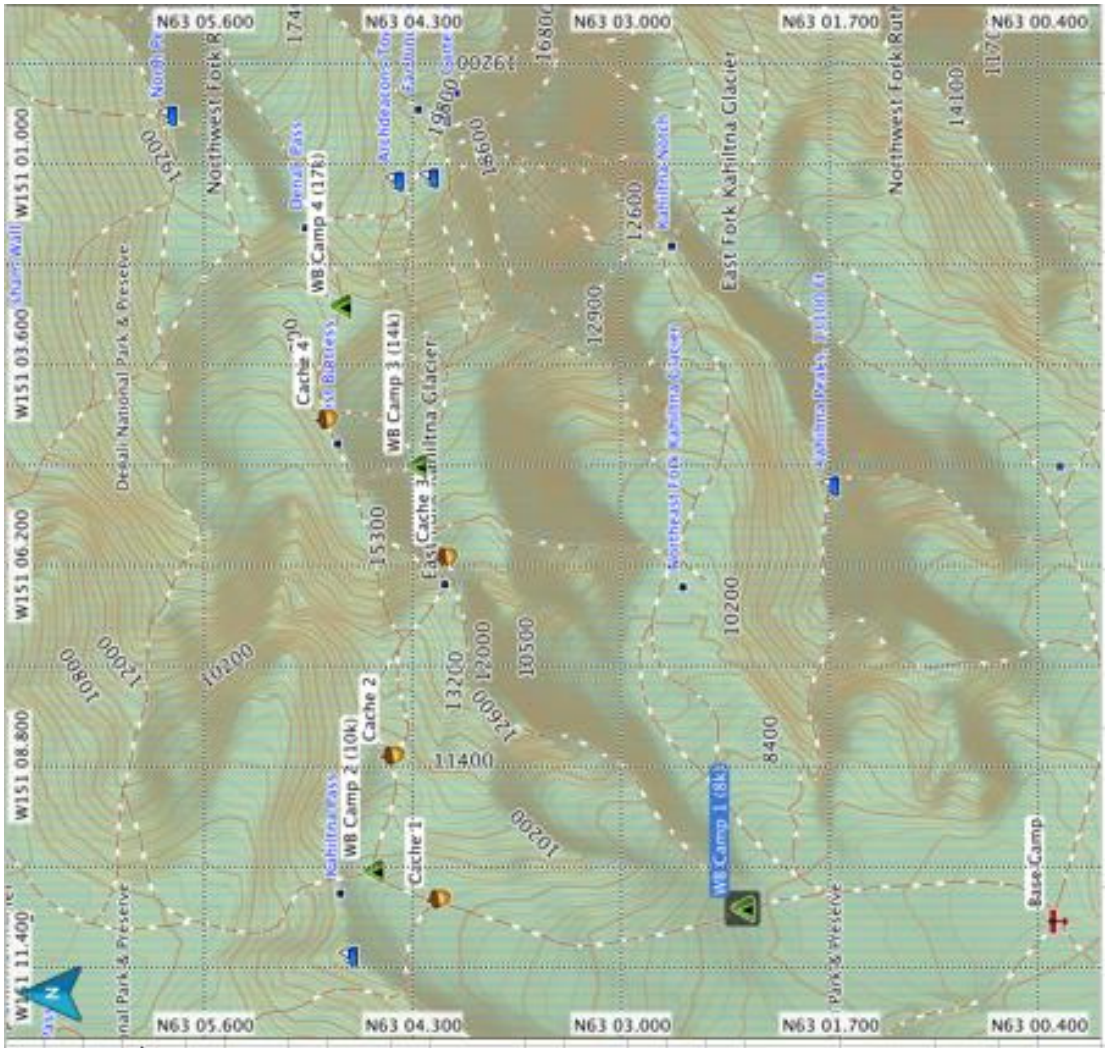
Appendix B: Itinerary



Day	Camp	Altitude	Activity
1	Kahiltna Base Camp	7,200-feet	Fly-in
2	Move to Camp 1	7,800-feet	Move camp
3	Camp 1	7,800-feet	Carry to 9,700-feet
4	Move to Camp 2	9,700-feet	Move camp
5	Camp 2	9,700-feet	Carry to 11,000-feet
6	Camp 2	9,700-feet	Rest
7	Camp 2	9,700-feet	Carry to 13,500-feet
8	Move to Camp 3	14,200-feet	Move camp
9	Camp 3	14,200-feet	Retrieve 13,500-feet cache
10	Camp 3	14,200-feet	Rest
11	Camp 3	14,200-feet	Carry to 16,200-feet
12	Camp 3	14,200-feet	Rest
13	Move to Camp 4	17,200-feet	Move camp
14	Camp 4	17,200-feet	Rest
15	Camp 4	17,200-feet	Summit day, or retrieve cache
16-19	Camp 4	17,200-feet	Summit days (inclement weather)
20	Camp 3	14,200-feet	Return post-summit
21	Kahiltna Base Camp	7,200-feet	Return flight
22-23	Kahiltna Base Camp	7,200-feet	Return weather days

Appendix C: Equipment List

Category	Name	Quantity	lbs	oz	Total Weight
Clothing	Socks, Sleeping	1		2.9	2.9
Clothing	Top, Midweight	1		10.4	10.4
Clothing	Bottom, Midweight	1		7.7	7.7
Clothing	40º Below Booties	1		11	11
Clothing	Beanie, Midweight	1		1.8	1.8
Clothing	Beanie, Light	1		0.6	0.6
Clothing	Socks, Liner	2		1	2
Clothing	Socks, Ski	1		3.8	3.8
Clothing	Gloves, Midweight Liner	1		2.6	2.6
Clothing	Balaclava	1		2.2	2.2
Clothing	Gloves, BD Guide	1		12.9	12.9
Clothing	Gloves, OR Alti-mitts	1		13.2	13.2
Clothing	Overboots	1	1	6.1	22.1
Clothing	Jacket, Goretex	1	1	5.2	21.2
Clothing	Pants, Goretex	1	1	4.8	20.8
Clothing	Vest	1		10.1	10.1
Clothing	Buff	1		1.4	1.4
Clothing	Jacket, Parka	1	1	4.8	20.8
Clothing	Jacket, Puffy	1		13.3	13.3
Clothing	Pants, Puffy	1		14.9	14.9
Cooking	Mug, insulated	1		4.3	4.3
Cooking	Pot Scraper	1		0.8	0.8
Cooking	Spoon	1		0.4	0.4
Cooking	Mug, Fairshare	1		7.7	7.7
Cooking	40º Below Cozy	1		1.5	1.5
Cooking	Pot, 2.4L	1		10.6	10.6
Cooking	Nalgene Bottle (Full)	2	2	12.6	89.2
Cooking	Bottle Cover	2		4	8
Cooking	Stoveboard	2		5.2	10.4
Cooking	Stove, Whisperlite	1		12.2	12.2
Cooking	Fire Paste	1		1.2	1.2
Cooking	30oz Fuel Bottle (Full)	1	2	0.4	32.4
Equipment	Headlamp	1		3.6	3.6
Equipment	Goal Zero Guide 10+	1		2.1	2.1

Category	Name	Quantity	lbs	oz	Total Weight
Equipment	AAA Batteries	4		0.6	2.4
Equipment	AA Bateries	8		1.05	8.4
Equipment	1st Aid Kit	1		14.5	14.5
Equipment	GPS	1		4.2	4.2
Equipment	Inclinometer	1		1	1
Equipment	Whippet	1	1	0.5	16.5
Equipment	Ski Pole	1		10.7	10.7
Equipment	Glacier Glasses	1		1.4	1.4
Equipment	Goggles	1		5.3	5.3
Equipment	In Reach	1		7	7
Equipment	Crampons, Ski	1		10.6	10.6
Equipment	Nomad 7 Solar Panel	1	1	4.1	20.1
Equipment	Lantern, Candle	1		8.1	8.1
Equipment	Bottle, Pee	1		2.3	2.3
Equipment	Shovel, Avalanche	1	1	4.7	20.7
Equipment	Saw, Snow	1		9.5	9.5
Equipment	Hygiene Kit	1		12.1	12.1
Equipment	Repair Kit	1	1	5.5	21.5
Equipment	Stuff Sack, Mesh (Snacks)	1		1	1
Equipment	Stuff Sack, Waterproof (Clothes)	1		1.6	1.6
Equipment	Stuff Sack, Orange (Lunch)	1		0.7	0.7
Equipment	Stuff Sack, Green (Food)	2		1.4	2.8
Equipment	Boots, Ski	1	6	10.6	106.6
Equipment	Skis	1	8	9.2	137.2
Equipment	Bags, Trash	2		4.3	8.6
Equipment	Duffel Bag	1	1	10.2	26.2
Equipment	Sled	1	5	4.9	84.9
Equipment	Backpack	1	4	5.3	69.3
Equipment	Cord, Sled	1		1.6	1.6
Equipment	Ski, Skins	1	1	5.3	21.3
Food	ProBar	10		3.2	32
Food	Sandwich	8		5.8	46.4
Food	Breakfast and Dinner	7	1	11	189
Glacier	Helmet	1		12.3	12.3
Glacier	Wands	12		1	12

Category	Name	Quantity	lbs	oz	Total Weight
Glacier	Cordelette w/ Locker	1		6.9	6.9
Glacier	Locker, Prusik	1		1.9	1.9
Glacier	Locker, Personal	1		2.4	2.4
Glacier	Carabiner	8		1.6	12.8
Glacier	Slings	2		0.7	1.4
Glacier	Chest Harness	1		4.3	4.3
Glacier	Ice Screw, 19cm	1		5.7	5.7
Glacier	Pulley	1		1.8	1.8
Glacier	Picket, 24"	1		14.3	14.3
Glacier	Harness	1	1	0.9	16.9
Glacier	Prussik, Foot	1		4.8	4.8
Glacier	Prussik	2		1.9	3.8
Shelter	Tent Floor	1	2	3.1	35.1
Shelter	Mattress, Air	1	2	1.9	33.9
Shelter	Mattress, Pump Bag	1		2.4	2.4
Shelter	Tent Poles	1	2	15.9	47.9
Shelter	Tent Fly	1	3	10.3	58.3
Shelter	Tent Body	1	4	12	76
Shelter	Parachute Anchors	3		2.5	7.5
Shelter	Guy Lines	8		0.5	4
Shelter	Sleeping Bag	1	4	14	78
Worn	Pants, Softshell w/ suspenders	1	1	8.4	24.4
Worn	Jacket, Softshell	1		13.9	13.9
Worn	Underwear	1		3.7	3.7
Worn	Top, Lightweight	1		9.1	9.1
Worn	Bottom, Lightweight	1		5.6	5.6
Worn	Gloves, Lightweight Liner	1		1.6	1.6
Worn	Socks, VB Liner	1		0.5	0.5
Worn	Watch	1		1.9	1.9
Worn	Chapstick	1		0.5	0.5
Worn	Lighter	1		0.7	0.7
Worn	Knife	1		3.4	3.4
Worn	ID and Credit Card	1		0.4	0.4
Worn	iPhone	1		5.9	5.9

Total Carried Weight – 73.2 lbs

Appendix D: Meal Plan

	REQUIRED CALORIES PPPD	2900								GOAL	28%	52%	20%
Meal	Name	Servings	Serving Calories	Total Calories	Fat (g)	Carbs (g)	Protein (g)	Total Fat (g)	Total Carbs (g)	Total Protein (g)	Fat (%)	Carbs (%)	Protein (%)
Breakfast	Wake Up! Omelet	1	394	394	28	6	23	28	6	23	64%	6%	23%
Breakfast	Campfire Hashbrowns	1	150	150	0	34	3	0	34	3	0%	91%	8%
Drink	Shakeology	1	130	130	1.5	13	17	15	13	17	10%	40%	52%
Lunch	Pizza Bagel	2	499	998	20	56	23	40	112	46	36%	45%	18%
Lunch	ProBar	1	360	360	17	48	9	17	48	9	43%	53%	10%
Snack	GORP	1	250	250	10	15	15	10	15	15	36%	24%	24%
Soup	Bear Creek Cheddar Broccoli	2	170	340	7	25	2	14	50	4	37%	59%	5%
Dinner	Orange and Sweet Pepper Chicker	1	128	128	1	15	14	1	15	14	7%	47%	44%
Addition	Brown Rice	1	216	216	2	45	5	2	45	5	8%	83%	9%
Dessert	Apple Spice Rice Pudding	0.75	358	268.5	3	71	10	2.25	53.25	7.5	8%	79%	11%
	MENU 1 TOTALS			**2966**							**35%**	**53%**	**19%**
Breakfast	Jerky, Egg and Mushroom Wrap	1	464	464	27	26	28	27	26	28	52%	22%	24%
Drink	Shakeology	1	130	130	1.5	13	17	15	13	17	10%	40%	52%
Lunch	Grilled Cheese and Soup	2	513	1026	13	72	28	26	144	56	23%	56%	22%
Lunch	ProBar	1	360	360	17	48	9	17	48	9	43%	53%	10%
Snack	GORP	1	250	250	10	15	15	10	15	15	36%	24%	24%
Soup	Bear Creek Creamy Potato	2	160	320	4.5	27	2	9	54	4	25%	68%	5%
Dinner	Chicken and Tomato Risotto	1	423	423	3	69	27	3	69	27	6%	65%	26%
Dessert	Warm Peaches w/ Ginger	1	93	93	1	23	2	1	23	2	10%	99%	9%
	MENU 2 TOTALS			**3066**							**28%**	**51%**	**21%**
Breakfast	Cornbread Johnny Cakes	1	582	582	5	128	11	5	128	11	8%	88%	8%
Addition	Bacon	2	90	180	7	0	5	14	0	10	70%	0%	22%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	Mac and Cheese	1	326	326	2	52	20	2	52	20	6%	64%	25%
Addition	Cheddar Cheese	1	110	110	9	0	7	9	0	7	74%	0%	25%
Addition	Salmon	1	70	70	1	0.5	15	1	0.5	15	13%	3%	86%
Lunch	ProBar	1	360	360	17	48	9	17	48	9	43%	53%	10%
Snack	GORP	1	250	250	10	15	15	10	15	15	36%	24%	24%
Soup	Bear Creek Cheddar Broccoli	2	170	340	7	25	2	14	50	4	37%	59%	5%
Dinner	Curried Chicken w/ Apples	1	334	334	1	66	17	1	66	17	3%	79%	20%
Dessert	Banana PB S'mores	0.5	328	164	18	39	6	9	19.5	3	49%	48%	7%
	MENU 3 TOTALS			**2846**							**26%**	**55%**	**18%**
Breakfast	Huevos Rancheros	1.33	540	718.2	31	35	28	41.23	46.55	37.24	52%	26%	21%
Drink	Shakeology	1	130	130	1.5	13	17	15	13	17	10%	40%	52%
Lunch	Tex-Mex Beef Fajitas	1	399	399	7	70	14	7	70	14	16%	70%	14%
Lunch	ProBar	1	360	360	17	48	9	17	48	9	43%	53%	10%
Snack	GORP	1	250	250	10	15	15	10	15	15	36%	24%	24%
Soup	Bear Creek Tortilla Soup	2	110	220	1	22	4	2	44	8	8%	80%	15%
Dinner	Beef Chili	2	268	536	6	42	14	12	84	28	20%	63%	21%
Dessert	Blueberry Cheesecake	1	270	270	4	43	17	4	43	17	13%	64%	25%
	MENU 4 TOTALS			**2883.2**							**30%**	**50%**	**20%**
Breakfast	Jerked Beef Hash	2	204	408	4	35	9	8	70	18	18%	69%	18%
Drink	Shakeology	1	130	130	1.5	13	17	15	13	17	10%	40%	52%
Soup	Top Ramen	2	190	380	7	26	5	14	52	10	33%	55%	11%
Addition	Quesodilla	1	245	245	13	22	11	13	22	11	48%	36%	18%
Lunch	ProBar	1	360	360	17	48	9	17	48	9	43%	53%	10%
Snack	GORP	1	250	250	10	15	15	10	15	15	36%	24%	24%
Soup	Bear Creek Cheddar Broccoli	2	170	340	7	25	2	14	50	4	37%	59%	5%
Dinner	Beef Stroganoff	1.5	397	595.5	8	52	26	12	78	39	18%	52%	26%
Dessert	Raspberry Chocolate Pudding	1	141	141	1	28	6	1	28	6	6%	79%	17%
	MENU 5 TOTALS			**2849.5**							**29%**	**53%**	**18%**

*Low Altitude Rest Menus

	REQUIRED CALORIES PP	3500								GOAL	27%	52%	21%
Meal	**Name**	**Servings**	**Serving Calories**	**Total Calories**	**Fat (g)**	**Carbs (g)**	**Protein (g)**	**Total Fat (g)**	**Total Carbs (g)**	**Total Protein (g)**	**Fat (%)**	**Carbs (%)**	**Protein (%)**
Breakfast	Brown Rice Porridge	2	204	408	1	39	7	2	78	14	4%	76%	14%
Drink	Whey Protein Shake	2	130	260	1.5	4	24	3	8	48	10%	12%	74%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	ProBar	2	360	720	17	48	9	34	96	18	43%	53%	10%
Lunch	ProBar Base	1	290	290	9	33	20	9	33	20	28%	46%	28%
Addition	Cheddar Cheese	1	110	110	9	0	7	9	0	7	74%	0%	25%
Addition	Salami	1	100	100	9	9	6	9	9	6	81%	36%	24%
Drink	Whey Protein Shake	1	130	130	1.5	4	24	1.5	4	24	10%	12%	74%
Snack	Recovery Bar	1	195	195	10	21	6	10	21	6	46%	43%	12%
Soup	Bear Creek Cheddar Broccoli	2	170	340	7	25	2	14	50	4	37%	59%	5%
Dinner	Smoked Sausage Risotto	1.5	479	718.5	16	68	14	24	102	21	30%	57%	12%
Dessert	Raspberry Chocolate Pudding	1	141	141	1	28	6	1	28	6	6%	79%	17%
	MENU 1 TOTAL			**3542.5**							**30%**	**50%**	**22%**
Breakfast	5 Minute Super Cereal	2	200	400	3	36	8	6	72	16	14%	72%	16%
Drink	Whey Protein Shake	2	130	260	1.5	4	24	3	8	48	10%	12%	74%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	ProBar	2	360	720	17	48	9	34	96	18	43%	53%	10%
Lunch	ProBar Base	1	290	290	9	33	20	9	33	20	28%	46%	28%
Addition	Cheddar Cheese	1	110	110	9	0	7	9	0	7	74%	0%	25%
Addition	Salami	1	100	100	9	9	6	9	9	6	81%	36%	24%
Drink	Whey Protein Shake	1	130	130	1.5	4	24	1.5	4	24	10%	12%	74%
Snack	Recovery Bar	1	195	195	10	21	6	10	21	6	46%	43%	12%
Soup	Top Ramen	2	190	380	7	26	5	14	52	10	33%	55%	11%
Dinner	Cajun Shrimp and Rice	2	338	676	3	65	11	6	130	22	8%	77%	13%
Dessert	Warm Peaches w/ Ginger	2	93	186	1	23	2	2	46	4	10%	99%	9%
	MENU 2 TOTAL			**3577**							**26%**	**54%**	**22%**
Breakfast	Mason Jar Ancient Grain	2	270	540	4.5	53	9	9	106	18	15%	79%	13%
Drink	Whey Protein Shake	1	130	130	1.5	4	24	1.5	4	24	10%	12%	74%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	ProBar	2	360	720	17	48	9	34	96	18	43%	53%	10%
Lunch	ProBar Base	1	290	290	9	33	20	9	33	20	28%	46%	28%
Addition	Cheddar Cheese	1	110	110	9	0	7	9	0	7	74%	0%	25%
Addition	Salami	2	100	200	9	9	6	18	18	12	81%	36%	24%
Drink	Whey Protein Shake	1	130	130	1.5	4	24	1.5	4	24	10%	12%	74%
Snack	Recovery Bar	1	195	195	10	21	6	10	21	6	46%	43%	12%
Soup	Top Ramen	2	190	380	7	26	5	14	52	10	33%	55%	11%
Dinner	Curried Chicken w/ Apples	1	334	334	1	66	17	1	66	17	3%	79%	20%
Dessert	Apple Spice Rice Pudding	1	358	358	3	71	10	3	71	10	8%	79%	11%
	MENU 3 TOTAL			**3517**							**29%**	**55%**	**21%**
Breakfast	Lemon Ginger Ancient Grains	2	200	400	6	33	4	12	66	8	27%	66%	8%
Drink	Whey Protein Shake	1	130	130	1.5	4	24	1.5	4	24	10%	12%	74%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	ProBar	2	360	720	17	48	9	34	96	18	43%	53%	10%
Lunch	ProBar Base	1	290	290	9	33	20	9	33	20	28%	46%	28%
Addition	Cheddar Cheese	1	110	110	9	0	7	9	0	7	74%	0%	25%
Addition	Salami	1	100	100	9	9	6	9	9	6	81%	36%	24%
Drink	Whey Protein Shake	1	130	130	1.5	4	24	1.5	4	24	10%	12%	74%
Snack	Recovery Bar	1	195	195	10	21	6	10	21	6	46%	43%	12%
Soup	Bear Creek Cheddar Broccoli	2	170	340	7	25	2	14	50	4	37%	59%	5%
Dinner	Chicken and Tomato Risotto	2	423	846	3	69	27	6	138	54	6%	65%	26%
Dessert	Warm Peaches w/ Ginger	1	93	93	1	23	2	1	23	2	10%	99%	9%
	MENU 4 TOTAL			**3484**							**28%**	**52%**	**22%**
Breakfast	Oatmeal	2	150	300	3	27	5	6	54	10	18%	72%	13%
Drink	Whey Protein Shake	1	130	130	1.5	4	24	1.5	4	24	10%	12%	74%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	ProBar	2	360	720	17	48	9	34	96	18	43%	53%	10%
Lunch	ProBar Base	1	290	290	9	33	20	9	33	20	28%	46%	28%
Addition	Cheddar Cheese	1	110	110	9	0	7	9	0	7	74%	0%	25%
Addition	Salami	2	100	200	9	9	6	18	18	12	81%	36%	24%
Drink	Whey Protein Shake	1	130	130	1.5	4	24	1.5	4	24	10%	12%	74%
Snack	Recovery Bar	1	195	195	10	21	6	10	21	6	46%	43%	12%
Soup	Top Ramen	2	190	380	7	26	5	14	52	10	33%	55%	11%
Dinner	Veggie Bean Chili	2	304	608	2	55	21	4	110	42	6%	72%	28%
Dessert	Apple Crumble	1	283	283	8	55	3	8	55	3	25%	78%	4%
	MENU 5 TOTAL			**3476**							**30%**	**53%**	**22%**

*Low Altitude Climb Menus

	REQUIRED CALORIES PPPD	3200								GOAL	27%	55%	18%
Meal	Name	Servings	Serving Calories	Total Calories	Fat (g)	Carbs (g)	Protein (g)	Total Fat (g)	Total Carbs (g)	Total Protein (g)	Fat (%)	Carbs (%)	Protein (%)
Breakfast	Jerked Beef Hash	2	204	408	4	35	9	8	70	18	18%	69%	18%
Addition	Cottage Cheese Biscuits	1	355	355	12	60	4	12	60	4	30%	68%	5%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	Mac and Cheese	1	326	326	2	52	20	2	52	20	6%	64%	25%
Addition	Salmon	1	70	70	1	0.5	15	1	0.5	15	13%	3%	86%
Lunch	ProBar	1	360	360	17	48	9	17	48	9	43%	53%	10%
Snack	GORP	1	250	250	10	15	15	10	15	15	36%	24%	24%
Soup	Bear Creek Cheddar Broccoli	2	170	340	7	25	2	14	50	4	37%	59%	5%
Dinner	Thanksgiving	2	435	870	13	61	22	26	122	44	27%	56%	20%
Dessert	Raspberry Chocolate Pudding	1	141	141	1	28	6	1	28	6	6%	79%	17%
	MENU 1 TOTALS			**3250**							**26%**	**56%**	**19%**
Breakfast	Wake Up! Omelet	1	394	394	28	6	23	28	6	23	64%	6%	23%
Breakfast	Blueberry Pancakes	1	400	400	8	66	15	8	66	15	18%	66%	15%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Soup	Top Ramen	2	190	380	7	26	5	14	52	10	33%	55%	11%
Lunch	ProBar	1	360	360	17	48	9	17	48	9	43%	53%	10%
Snack	GORP	1	250	250	10	15	15	10	15	15	36%	24%	24%
Soup	Bear Creek Creamy Potato	2	160	320	4.5	27	2	9	54	4	25%	68%	5%
Dinner	Beef and Noodles	2	380	760	7	57	21	14	114	42	17%	60%	22%
Dessert	Apple Spice Rice Pudding	0.5	358	179	3	71	10	1.5	35.5	5	8%	79%	11%
	MENU 2 TOTALS			**3173**							**29%**	**51%**	**18%**
Breakfast	Strawberry Pan Bread	1	311	311	1	67	10	1	67	10	3%	86%	13%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	Pizza Bagel	1.5	499	748.5	20	56	23	30	84	34.5	36%	45%	18%
Lunch	ProBar	1	360	360	17	48	9	17	48	9	43%	53%	10%
Snack	GORP	1	250	250	10	15	15	10	15	15	36%	24%	24%
Soup	Bear Creek Creamy Potato	2	160	320	4.5	27	2	9	54	4	25%	68%	5%
Dinner	Beef Stroganoff	2	397	794	8	52	26	16	104	52	18%	52%	26%
Dessert	Apple Crumble	1	283	283	8	55	3	8	55	3	25%	78%	4%
	MENU 3 TOTALS			**3196.5**							**26%**	**55%**	**18%**
Breakfast	Jerky, Egg and Mushroom Wrap	1	464	464	27	26	28	27	26	28	52%	22%	24%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	Tex-Mex Beef Fajitas	1.3	399	518.7	7	70	14	9.1	91	18.2	16%	70%	14%
Lunch	ProBar	1	360	360	17	48	9	17	48	9	43%	53%	10%
Snack	GORP	1	250	250	10	15	15	10	15	15	36%	24%	24%
Soup	Bear Creek Cheddar Broccoli	2	170	340	7	25	2	14	50	4	37%	59%	5%
Dinner	Wheat Berries Parmesan	2	335	670	5	64	11	10	128	22	13%	76%	13%
Addition	Herb Skillet Biscuits	1	270	270	2	43	13	2	43	13	7%	64%	19%
Dessert	Banana PB S'mores	0.5	328	164	18	39	6	9	19.5	3	49%	48%	7%
	MENU 4 TOTALS			**3166.7**							**28%**	**55%**	**16%**
Breakfast	Granola Pancakes	1	627	627	13	115	15	13	115	15	19%	73%	10%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	Mac and Cheese	1	326	326	2	52	20	2	52	20	6%	64%	25%
Addition	Cheddar Cheese	1	110	110	9	0	7	9	0	7	74%	0%	25%
Addition	Salmon	1	70	70	1	0.5	15	1	0.5	15	13%	3%	86%
Lunch	ProBar	1	360	360	17	48	9	17	48	9	43%	53%	10%
Snack	GORP	1	250	250	10	15	15	10	15	15	36%	24%	24%
Soup	Top Ramen	2	190	380	7	26	5	14	52	10	33%	55%	11%
Dinner	Beef Chili	1	268	268	6	42	14	6	42	14	20%	63%	21%
Addition	Herb Skillet Biscuits	1	270	270	2	43	13	2	43	13	7%	64%	19%
Dessert	Banana PB S'mores	1	328	328	18	39	6	18	39	6	49%	48%	7%
	MENU 5 TOTALS			**3119**							**27%**	**54%**	**18%**

*High Altitude Rest Menus

	REQUIRED CALORIES PPPD	4000								GOAL	25%	60%	15%
Meal	Name	Servings	Serving Calories	Total Calories	Fat (g)	Carbs (g)	Protein (g)	Total Fat (g)	Total Carbs (g)	Total Protein (g)	Fat (%)	Carbs (%)	Protein (%)
Breakfast	Brown Rice Porridge	3	204	612	1	39	7	3	117	21	4%	76%	14%
Drink	Whey Protein Shake	1	130	130	1.5	4	24	1.5	4	24	10%	12%	74%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	ProBar	3	360	1080	17	48	9	51	144	27	43%	53%	10%
Lunch	ProBar Base	1	290	290	9	33	20	9	33	20	28%	46%	28%
Snack	Recovery Bar	1	195	195	10	21	6	10	21	6	46%	43%	12%
Soup	Bear Creek Cheddar Broccoli	2	170	340	7	25	2	14	50	4	37%	59%	5%
Dinner	Smoked Sausage Risotto	2	479	958	16	68	14	32	136	28	30%	57%	12%
Dessert	Raspberry Chocolate Pudding	2	141	282	1	28	6	2	56	12	6%	79%	17%
	MENU 1 TOTAL			**4017**							**28%**	**57%**	**16%**
Breakfast	5 Minute Super Cereal	3	200	600	3	36	8	9	108	24	14%	72%	16%
Drink	Whey Protein Shake	1	130	130	1.5	4	24	1.5	4	24	10%	12%	74%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	ProBar	3	360	1080	17	48	9	51	144	27	43%	53%	10%
Lunch	ProBar Base	1	290	290	9	33	20	9	33	20	28%	46%	28%
Snack	Recovery Bar	1	195	195	10	21	6	10	21	6	46%	43%	12%
Soup	Top Ramen	2	190	380	7	26	5	14	52	10	33%	55%	11%
Dinner	Cajun Shrimp and Rice	3	338	1014	3	65	11	9	195	33	8%	77%	13%
Dessert	Warm Peaches w/ Ginger	2	93	186	1	23	2	2	46	4	10%	99%	9%
	MENU 2 TOTAL			**4005**							**24%**	**62%**	**16%**
Breakfast	Mason Jar Ancient Grain	3	270	810	4.5	53	9	13.5	159	27	15%	79%	13%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	ProBar	3	360	1080	17	48	9	51	144	27	43%	53%	10%
Lunch	ProBar Base	1	290	290	9	33	20	9	33	20	28%	46%	28%
Snack	Recovery Bar	1	195	195	10	21	6	10	21	6	46%	43%	12%
Soup	Top Ramen	2	190	380	7	26	5	14	52	10	33%	55%	11%
Dinner	Curried Chicken w/ Apples	2	334	668	1	66	17	2	132	34	3%	79%	20%
Dessert	Apple Spice Rice Pudding	1	358	358	3	71	10	3	71	10	8%	79%	11%
	MENU 3 TOTAL			**3911**							**24%**	**64%**	**15%**
Breakfast	Lemon Ginger Ancient Grains	3	200	600	6	33	4	18	99	12	27%	66%	8%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	ProBar	3	360	1080	17	48	9	51	144	27	43%	53%	10%
Lunch	ProBar Base	1	290	290	9	33	20	9	33	20	28%	46%	28%
Snack	Recovery Bar	1	195	195	10	21	6	10	21	6	46%	43%	12%
Soup	Bear Creek Cheddar Broccoli	2	170	340	7	25	2	14	50	4	37%	59%	5%
Dinner	Chicken and Tomato Risotto	3	423	1269	3	69	27	9	207	81	6%	65%	26%
Dessert	Warm Peaches w/ Ginger	2	93	186	1	23	2	2	46	4	10%	99%	9%
	MENU 4 TOTAL			**4090**							**25%**	**60%**	**17%**
Breakfast	Oatmeal	3	150	450	3	27	5	9	81	15	18%	72%	13%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	ProBar	3	360	1080	17	48	9	51	144	27	43%	53%	10%
Lunch	ProBar Base	1	290	290	9	33	20	9	33	20	28%	46%	28%
Snack	Recovery Bar	1	195	195	10	21	6	10	21	6	46%	43%	12%
Soup	Top Ramen	3	190	570	7	26	5	21	78	15	33%	55%	11%
Dinner	Veggie Bean Chili	3	304	912	2	55	21	6	165	63	6%	72%	28%
Dessert	Apple Crumble	1	283	283	8	55	3	8	55	3	25%	78%	4%
	MENU 5 TOTAL			**3910**							**27%**	**60%**	**17%**
Breakfast	Oatmeal	3	150	450	3	27	5	9	81	15	18%	72%	13%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	ProBar	3	360	1080	17	48	9	51	144	27	43%	53%	10%
Lunch	ProBar Base	1	290	290	9	33	20	9	33	20	28%	46%	28%
Snack	Recovery Bar	1	195	195	10	21	6	10	21	6	46%	43%	12%
Soup	Top Ramen	3	190	570	7	26	5	21	78	15	33%	55%	11%
Dinner	Wheat Berries Parmesan	3	335	1005	5	64	11	15	192	33	13%	76%	13%
Dessert	Blueberry Cheesecake	1	270	270	4	43	17	4	43	17	13%	64%	25%
	MENU 6 TOTAL			**3990**							**27%**	**61%**	**15%**

*High Altitude Climb Menus

	REQUIRED CALORIES PPPD	4500								GOAL	25%	60%	15%
Meal	Name	Servings	Serving Calories	Total Calories	Fat (g)	Carbs (g)	Protein (g)	Total Fat (g)	Total Carbs (g)	Total Protein (g)	Fat (%)	Carbs (%)	Protein (%)
Breakfast	Mason Jar Ancient Grain	3	270	810	4.5	53	9	13.5	159	27	15%	79%	13%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	ProBar	3	360	1080	17	48	9	51	144	27	43%	53%	10%
Lunch	ProBar Base	2	290	580	9	33	20	18	66	40	28%	46%	28%
Snack	Recovery Bar	1	195	195	10	21	6	10	21	6	46%	43%	12%
Soup	Top Ramen	3	190	570	7	26	5	21	78	15	33%	55%	11%
Dinner	MH Chicken and Dumplings	2	310	620	14	31	15	28	62	30	41%	40%	19%
Dessert	MH Raspberry Crumble	1.3	140	182	2.5	29	1	3.25	37.7	1.3	16%	83%	3%
	MENU 1 TOTAL			**4167**							**32%**	**56%**	**16%**
Breakfast	Lemon Ginger Ancient Grains	4	200	800	6	33	4	24	132	16	27%	66%	8%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	ProBar	3	360	1080	17	48	9	51	144	27	43%	53%	10%
Lunch	ProBar Base	2	290	580	9	33	20	18	66	40	28%	46%	28%
Snack	Recovery Bar	1	195	195	10	21	6	10	21	6	46%	43%	12%
Soup	Top Ramen	3	190	570	7	26	5	21	78	15	33%	55%	11%
Dinner	MH Beef Stroganoff	2.5	260	650	11	29	11	27.5	72.5	27.5	38%	45%	17%
Dessert	MH Cheesecake Bites	0.33	240	79.2	14	25	4	4.62	8.25	1.32	53%	42%	7%
	MENU 2 TOTAL			**4084.2**							**35%**	**52%**	**15%**
Breakfast	5 Minute Super Cereal	4	200	800	3	36	8	12	144	32	14%	72%	16%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	ProBar	3	360	1080	17	48	9	51	144	27	43%	53%	10%
Lunch	ProBar Base	2	290	580	9	33	20	18	66	40	28%	46%	28%
Snack	Recovery Bar	1	195	195	10	21	6	10	21	6	46%	43%	12%
Soup	Top Ramen	3	190	570	7	26	5	21	78	15	33%	55%	11%
Dinner	MH Sweet and Sour Pork	2.5	290	725	6	49	12	15	122.5	30	19%	68%	17%
Dessert	MH Cheesecake Bites	0.33	240	79.2	14	25	4	4.62	8.25	1.32	53%	42%	7%
	MENU 3 TOTAL			**4159.2**							**29%**	**57%**	**16%**
Breakfast	Oatmeal	3	150	450	3	27	5	9	81	15	18%	72%	13%
Addition	Raisins	3	129	387	0	34	1	0	102	3	0%	105%	3%
Drink	Shakeology	1	130	130	1.5	13	17	1.5	13	17	10%	40%	52%
Lunch	ProBar	3	360	1080	17	48	9	51	144	27	43%	53%	10%
Lunch	ProBar Base	1	290	290	9	33	20	9	33	20	28%	46%	28%
Snack	Recovery Bar	2	195	390	10	21	6	20	42	12	46%	43%	12%
Soup	Top Ramen	3	190	570	7	26	5	21	78	15	33%	55%	11%
Dinner	MH Lasagna	2.5	240	600	8	29	14	20	72.5	35	30%	48%	23%
Dessert	MH Raspberry Crumble	1.3	140	182	2.5	29	1	3.25	37.7	1.3	16%	83%	3%
	MENU 4 TOTAL			**4079**							**30%**	**59%**	**14%**

*Summit Menus

		• project deliverables • Assignment of PPM scores • Provide scores to IOR • Go/No checkpoint recommendation • Assign final grade	Go/No checkpoints	• Ensure consistency across students • Communicate go/no-go decisions to students • Input final grade to UA Online
Administrative Documents	• GSP preparation and submission to PM Office • Signed Expectations agreement • IRB submittal (686A) • Apply for graduation (686B) • RSVP for Hooding and commencement (686B)			• Graduate Studies Plan (GSP signatures and processing • Include signed "Expectations" form in student file. • DF paperwork and annual progress report for students • Graduation Audit • Graduation Requirement Report (GRR) • Archive final project deliverables

Student is responsible for obtaining the following signatures and submitting completed form to PM office to include in student file.

I understand and agree to the expectations described above:

Student Signature: _____ Date: 2015/09/10

Advisor Signature: _____ Date: 10 Sept 2015

Committee Member: _____ Date: 9/10/2015

Committee Member: _____ Date: 10/9/15

Expectations for PM 686A and 686B Capstone Project Advising

Student Name:_____ PM 686A or PM 6896B (Circle one) Semester:_____

Area of Responsibility	Student	Primary Advisor (1 person)	Committee Members (2 people)	Instructor of Record (IOR) and Admin Staff
Project Management	**PRIMARY OWNER**	Coaching, feedback and assessment	Coaching, feedback and assessment input	
Communication and Stakeholder Management	• Clear description of project • Proactive selection of Advisor and Committee members • Demonstrate effective communication and stakeholder management by determining and coordinating necessary and agreed modes and setting expectations for timing, and emphasis or tailoring of feedback and communication across with PA and committee (and other stakeholders) • Provide regular status reports as agreed with PA and committee • Identify and resolve communication issues • Identify, balance and resolve	• Email confirmation of agreement to serve • Availability as agreed	• Email confirmation of agreement to serve • Availability as agreed	• Faculty specialties matrix • Session Lectures • Syllabus • Blackboard materials • Announcements • AV set up • Final presentation schedule and logistics • Student and committee support as requested • Adjunct Faculty appointment letters • Escalation path

PROJECT CHARTER
DENALI EXPEDITION 2016, THE WEST BUTTRESS

Justin P. Ramsey
September 10, 2015

EXECUTIVE SUMMARY

During the summer of 2016 the project team will conduct an expedition to climb the West Buttress of Denali. Denali is the highest peak in North America, with an elevation of 20,320 feet above sea level. The West Buttress is the most commonly climbed route starting at the Kahiltna Glacier and ascending to the summit. The three-week expedition requires robust planning prior to step off since there will be no external support once started.

This project encompasses all pre-expedition planning and support. The project will produce an itinerary for the three-week expedition, will research and procure equipment for the team, research high altitude nutrition and procure food items, develop a comprehensive physical fitness-training plan for expedition members, and develop an expedition risk management plan. These deliverables will ensure a successful and safe expedition. Additionally, the detailed approach to expedition planning will allow the expedition team to establish a balance between unacceptably sparse and excessively burdensome equipment and supplies.

PROJECT PURPOSE/JUSTIFICATION

Business Need/Case

Current expedition planning typically consists of ad hoc methods of planning, consisting of subject matter expert opinion and best guesses. The average summit rate for the past ten years on Denali hovers around 52% and the fatality rate hovers at three climbers a year. Unsuccessful attempts are often attributed to bad weather, injury, lack of fitness and lack of mountaineering knowledge. Proper planning guidelines and pre-expedition go/no-go criteria for expeditions on Denali will significantly increase safety and increase summit success.

Business Objectives

The objectives of this project are to develop an expedition plan and conduct all pre-expedition necessities prior to project execution.

- Use project management approach for expedition planning as proof of concept.
- Continue to use approach to identify and achieve all major requirements for future expeditionary planning.
- Conduct detailed pre-expedition necessities so expedition members can focus on the expedition with knowing everything is already planned.

PROJECT DESCRIPTION

This project encompasses all pre-expedition planning and support. The expedition requires an itinerary for the three-week expedition, research and procurement of equipment for the team, research of high altitude nutrition and procurement of food items, and development of a comprehensive physical fitness-training plan for expedition members.

Project Objectives and Success Criteria

The objectives, which support critical milestones of this project, have been identified, they are as follows:

- Thorough Expedition Risk Plan.
- Consistent communication with team members.
- Timely delivery of deliverables.
- Athleticism. Ability to carry mountaineering load through steep terrain for multiple days.
- Teamwork. Expedition members must work together to accomplish pre-expedition work.

Requirements

This product must meet the following requirements in order to be successful.

- Wilderness First Responder or better trained medical personnel on expedition
- Twice weekly updates to climber families during expedition

Additional requirements may be added as necessary, with project sponsor approval, as the project moves forward.

Constraints

The following constraints exists for this project:

- Individual cost per team member cannot exceed $2,500 with the exception of the project manager.
- Equipment weight, minus water, fuel and clothing worn, cannot exceed 100 lbs.
- Food weight cannot exceed 2.5 lbs per person per day
- Expedition itinerary cannot exceed 23 days.
- Permit application must be sent to Denali National Park Service no later than 90 days before expedition start.

Assumptions

The following assumptions are used for this project:

- All expedition members have general mountaineering experience.
- Expedition members have the majority of the personal equipment necessary.
- Procurement of personal equipment will be limited to shortages identified through equipment list development.
- Expedition members will share in project work load as identified in project schedule.
- All expedition members are in good health.

Preliminary Scope Statement

Denali Expedition 2016, The West Buttress will start with research of previous expeditions through guided companies and historic data. Research will include: weather, climb itinerary, equipment lists, nutrition, and training. Research will include a comparison of authorized guide companies and their client recommendations. Training guidelines for expedition member knowledge in mountaineering and skills to practice are included in this phase. The project will also conduct research on physical fitness for mountaineering and develop a fitness plan for expedition members.

Following research, this project will procure necessary permits, contract flights and lodging and purchase equipment and food. All equipment and food will be repackaged and weighed prior to expedition start to ensure all equipment and supplies stay within weight requirements. The project will deliver a comprehensive expedition itinerary and expedition risk plan for the climb. The risk plan will include expedition termination criteria and go/no-go decision points for expedition members during the climb. This project ends with departure for Talkeetna, Alaska, prior to the expedition start. The budget for this project is $12,000. Additional funding will be approved on a case-by-case basis with approval of all expedition members. Excluded from this project is the execution of the climb itself.

RISKS

The following risks for this project have been identified. The project manager will determine and employ the necessary risk mitigation/avoidance strategies as appropriate to minimize the likelihood of these risks:

- Disapproval of necessary leave
- Weather delays
- Inability to access physical fitness equipment
- Team member inexperience in certain mountaineering aspects

PROJECT DELIVERABLES

The following deliverables must be met upon the successful completion project. Any changes to these deliverables must be approved by the project sponsor.

- Comparison of 4 most successful climbing seasons
- Itinerary
- Equipment List
- Nutrition List
- Fitness Plan

SUMMARY MILESTONE SCHEDULE

The project Summary Milestone Schedule is presented below. As requirements are more clearly defined this schedule may be modified. Any changes will be communicated by the project manager.

Summary Milestone Schedule – List key project milestones relative to project start.	
Project Milestone	**Target Date (mm/dd/yyyy)**
• Project Start	09/11/15
• PMP Complete	11/20/15
• Fitness Plan Complete	12/18/15
• Comparison Complete	01/24/16
• Equipment List Complete	02/12/16
• Nutrition List Complete	02/26/16
• Itinerary Complete	03/25/16
• Equipment Repacked	04/29/16
• Project Complete	05/01/16

SUMMARY BUDGET

The following table contains a summary budget based on the planned cost components and estimated costs required for successful completion of the project.

Summary Budget – List component project costs	
Project Component	**Component Cost**
• Permits	$1,500
• Flight Services	$2,500
• Nutrition	$1,500
• Equipment	$4,000
• Education / Research	$700
• Training	$200
• Overhead	$500
• Travel	$1,100
Total	$12,000

STAKEHOLDERS

Internal	External
Justin Ramsey	National Park Service
Aaron Ramsey	US Army
Dylan Van Rozeboom	Flight Services
Matt McGinnis	Guide Services
Chini Sun-Ramsey	Outfitters
Roger Hull	
LuAnn Piccard	
Mike Lasher	

PROJECT APPROVAL REQUIREMENTS

Success for this project will be achieved when a complete expedition itinerary is produced with all necessary equipment and nutrition procured and repacked ready to depart for Kahiltna Base Camp. The Project Sponsor, Aaron Ramsey, who will also authorize the completion of the project, will determine success.

PROJECT MANAGER

Justin P. Ramsey is hereby named Project Manager for this project. He has authority to execute all necessary actions overseeing the completion of this project within the constraints outlined in this charter. He is authorized to negotiate contracts and procure equipment within the authorized budget.

AUTHORIZATION

Approved by the Project Sponsor:

_____ Date: _____

Dylan Van Rozeboom

Denali Expedition 2016_26APR16.mpp

ID	Task Mode	WBS	Task Name	Work	Start	Finish	Predecessors
0		**0**	**Denali Expedition 2016_8APR16**	**3,363 hrs**	**Tue 9/8/15**	**Mon 4/18/16**	
1		**1**	**Project Management**	**278.73 hrs**	**Tue 9/8/15**	**Mon 4/18/16**	
2		1.1	Communicate with Stakeholders	66.83 hrs	Wed 9/9/15	Mon 3/21/16	
3		1.2	Work on project	26.6 hrs	Wed 9/9/15	Mon 3/21/16	
4		1.3	Conduct general research	35.88 hrs	Wed 9/9/15	Mon 3/21/16	
5		1.4	Conduct physcial fitness training	142.92 hrs	Tue 9/8/15	Sun 3/20/16	
6		**1.5**	**Capstone**	**6.5 hrs**	**Wed 9/9/15**	**Mon 4/18/16**	
7		**1.5.1**	**PM686A**	**6.5 hrs**	**Wed 9/9/15**	**Mon 11/30/15**	
17		**1.5.2**	**PM686B**	**0 hrs**	**Fri 2/5/16**	**Mon 4/18/16**	
18		**1.5.2.1**	**PPM**	**0 hrs**	**Fri 2/5/16**	**Fri 4/8/16**	
19		1.5.2.1.1	Prepare PPM 1	0 hrs	Fri 2/5/16	Fri 2/5/16	
20		1.5.2.1.2	Prepare PPM 2	0 hrs	Fri 2/26/16	Fri 2/26/16	

'15 W | Sep T

Critical	Finish-only	Manual Summary
Critical Split	Duration-only	Project Summary
Critical Progress	Baseline	External Tasks
Task	Baseline Split	External Milestone
Split	Baseline Milestone	Inactive Task
Task Progress	Milestone	Inactive Milestone
Manual Task	Summary Progress	Inactive Summary
Start-only	Summary	Deadline

ID	Task Mode	WBS	Task Name	Work	Start	Finish	Predecessors
21		1.5.2.1.3	Prepare PPM 3	0 hrs	Fri 3/18/16	Fri 3/18/16	
22		1.5.2.1.4	Prepare PPM 4	0 hrs	Fri 4/8/16	Fri 4/8/16	
23		1.5.2.2	Defend Project	0 hrs	Mon 4/18/16	Mon 4/18/16	
24		**2**	**Planning**	**126.4 hrs**	**Tue 9/8/15**	**Sat 11/21/15**	
25		**2.1**	**Project Management Plan**	**126.4 hrs**	**Tue 9/8/15**	**Sat 11/21/15**	
54		**3**	**Research**	**152.1 hrs**	**Wed 9/30/15**	**Sat 3/5/16**	
55		**3.1**	**Fitness Plan**	**15.4 hrs**	**Wed 9/30/15**	**Mon 10/19/15**	
60		**3.2**	**Comparison**	**110.7 hrs**	**Tue 1/5/16**	**Mon 2/22/16**	
61		3.2.1	Conduct research on previous 5 years of Denali climb itineraries	20 hrs	Tue 1/5/16	Fri 1/15/16	58,53
62		3.2.2	Conduct comparison of most successful 4 itineraries	10 hrs	Fri 1/15/16	Mon 1/18/16	61
63		3.2.3	Analyze current trends in alpine accidents	8 hrs	Mon 1/18/16	Sat 1/23/16	62
64		3.2.4	Interview Climbers	72.7 hrs	Sat 1/23/16	Mon 2/22/16	63

'15 W | Sep T

Critical	Finish-only	Manual Summary
Critical Split	Duration-only	Project Summary
Critical Progress	Baseline	External Tasks
Task	Baseline Split	External Milestone
Split	Baseline Milestone	Inactive Task
Task Progress	Milestone	Inactive Milestone
Manual Task	Summary Progress	Inactive Summary
Start-only	Summary	Deadline

ID	Task Mode	WBS	Task Name	Work	Start	Finish	Predecessors
65		**3.3**	**Nutrition Plan**	**13.5 hrs**	**Mon 2/22/16**	**Sun 2/28/16**	
66		3.3.1	Research high altitude nutrition	3 hrs	Mon 2/22/16	Wed 2/24/16	64
67		3.3.2	Develop meal plan	10 hrs	Wed 2/24/16	Sun 2/28/16	66
68		3.3.3	Send meal plan to team members	0.5 hrs	Sun 2/28/16	Sun 2/28/16	67
69		**3.4**	**Equipment List**	**12.5 hrs**	**Mon 2/29/16**	**Sat 3/5/16**	
70		3.4.1	Research current mountaineering equipment	8 hrs	Mon 2/29/16	Fri 3/4/16	68
71		3.4.2	Develop equipment list	4 hrs	Fri 3/4/16	Sat 3/5/16	70
72		3.4.3	Send equipment list to team members	0.5 hrs	Sat 3/5/16	Sat 3/5/16	71
73		3.4.4	Comparisons Complete	0 hrs	Sat 3/5/16	Sat 3/5/16	64,68,72
74		**4**	**Regulatory / Contracting**	**267.55 hrs**	**Mon 1/25/16**	**Mon 4/4/16**	
75		4.1	Gather funds for permits	0.3 hrs	Tue 1/26/16	Tue 1/26/16	53
76		4.2	Request leave from Army	63.6 hrs	Wed 1/27/16	Tue 2/23/16	75

'15 W | Sep T

Critical
Critical Split
Critical Progress
Task
Split
Task Progress
Manual Task
Start-only
Finish-only
Duration-only
Baseline
Baseline Split
Baseline Milestone
Milestone
Summary Progress
Summary
Manual Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Milestone
Inactive Summary
Deadline

ID	Task Mode	WBS	Task Name	Work	Start	Finish	Predecessors
77		4.3	Apply for Denali climbing permit	5.7 hrs	Mon 1/25/16	Thu 1/28/16	76
78		~~4.4~~	~~Book passendger airline flights~~	~~1 hr~~	~~Wed 2/3/16~~	~~Thu 2/4/16~~	~~77~~
79		4.5	Contract expedition flight	3 hrs	Sat 1/30/16	Sat 1/30/16	77
80		4.6	Collect funds for flight services	179.95 hrs	Sun 1/31/16	Tue 3/29/16	79
81		4.7	Contract satellite phone service	15 hrs	Wed 3/30/16	Mon 4/4/16	80
82		~~4.8~~	~~Book hotel rooms~~	~~0.5 hrs~~	~~Mon 4/4/16~~	~~Mon 4/4/16~~	~~81~~
83		**5**	**Education**	**929.22 hrs**	**Thu 10/22/15**	**Sun 3/20/16**	
84		**5.1**	**Avalanch Training**	**32.5 hrs**	**Thu 10/22/15**	**Sat 12/12/15**	
85		5.1.1	Book AAIRE lvl 1 class	0.5 hrs	Thu 10/22/15	Thu 10/22/15	45
86		5.1.2	Take AAIRE Avalanche lvl 1 Class	16 hrs	Sat 11/21/15	Sat 11/28/15	85
87		5.1.3	Attend Avalanche lvl 1 Field	16 hrs	Sat 12/5/15	Sat 12/12/15	86
88		**5.2**	**Mountaineering Skills**	**896.72 hrs**	**Sun 10/25/15**	**Sun 3/20/16**	

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Critical	Finish-only	Manual Summary
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Split	Baseline Milestone	Inactive Task
Task Progress	Milestone	Inactive Milestone
Manual Task	Summary Progress	Inactive Summary
Start-only	Summary	Deadline

ID	Task Mode	WBS	Task Name	Work	Start	Finish	Predecessors
89		5.2.1	Train glacier travel skills	60 hrs	Sat 1/30/16	Fri 2/26/16	59
90		5.2.2	Train crevasse rescue	8 hrs	Sun 10/25/15	Fri 10/30/15	59
91		5.2.3	Train winter camping	20 hrs	Wed 10/28/15	Sun 11/1/15	59
92		5.2.4	Train cache building	3 hrs	Sun 11/1/15	Wed 11/4/15	59
93		5.2.5	Train pulk packing	3 hrs	Sat 12/26/15	Wed 1/6/16	59
94		5.2.6	Train alpine touring skiing	382.72 hrs	Sat 11/7/15	Sat 2/20/16	59
95		5.2.7	Train alpine mountaineering skills	60 hrs	Sat 1/30/16	Wed 2/17/16	59
96		5.2.8	Conduct shakedown trip	360 hrs	Sun 3/13/16	Sun 3/20/16	89,90,91,92,93,94,
97		**6**	**Procurement**	**32.12 hrs**	**Sun 2/28/16**	**Mon 3/7/16**	
98		**6.1**	**Equipment**	**26.12 hrs**	**Sun 3/6/16**	**Mon 3/7/16**	
99		6.1.1	Compare current equipment to equipm	3 hrs	Sun 3/6/16	Sun 3/6/16	72
100		6.1.2	Purchase necessary clothing	8.12 hrs	Sun 3/6/16	Mon 3/7/16	99

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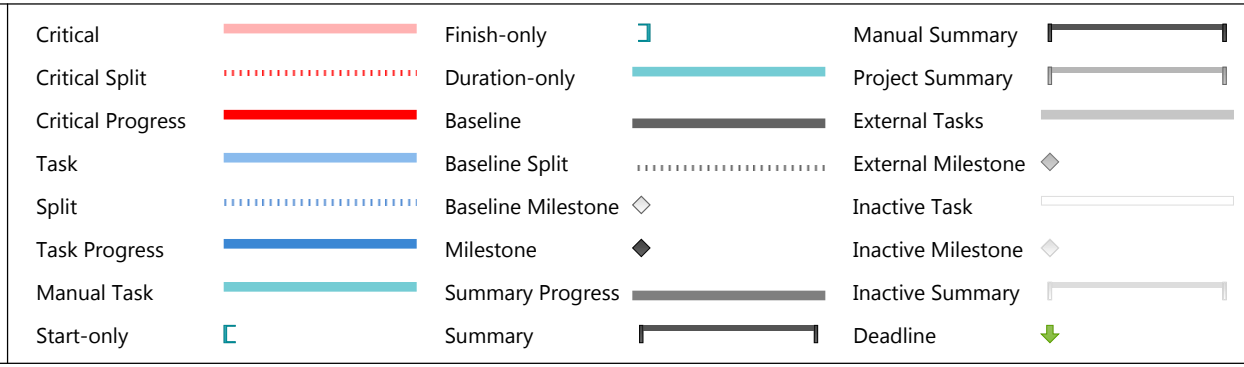

ID	Task Mode	WBS	Task Name	Work	Start	Finish	Predecessors
101		6.1.3	Purchase group gear	6 hrs	Sun 3/6/16	Mon 3/7/16	99
102		6.1.4	Purchase personal equipment	9 hrs	Sun 3/6/16	Mon 3/7/16	99
103		6.1.5	Equipment List Complete	0 hrs	Mon 3/7/16	Mon 3/7/16	102,101,100
104		**6.2**	**Nutrition**	**6 hrs**	**Sun 2/28/16**	**Fri 3/4/16**	
105		6.2.1	Purchase packaging items	2 hrs	Sun 2/28/16	Mon 2/29/16	68
106		6.2.2	Purchase food items	4 hrs	Mon 2/29/16	Fri 3/4/16	105
107		6.2.3	Nutrition Plan Complete	0 hrs	Fri 3/4/16	Fri 3/4/16	106
108		**7**	**Preparation**	**1,567.9 hrs**	**Fri 11/20/15**	**Fri 4/1/16**	
109		**7.1**	**Itinerary and Risk Plan**	**107.25 hrs**	**Sat 3/5/16**	**Thu 3/31/16**	
110		**7.1.1**	**Development**	**107.25 hrs**	**Sat 3/5/16**	**Thu 3/31/16**	
111		7.1.1.1	Develop expedition itinerary	103.25 hrs	Sat 3/5/16	Thu 3/31/16	73
112		7.1.1.2	Develop expedition risk management	4 hrs	Sun 3/6/16	Thu 3/31/16	111

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ID	Task Mode	WBS	Task Name	Work	Start	Finish	Predecessors
113		**7.2**	**Medical**	**1,439.25 hrs**	**Fri 11/20/15**	**Fri 4/1/16**	
114		7.2.1	Schedule doctor visit	6 hrs	Fri 11/20/15	Sat 11/21/15	53
115		7.2.2	Have doctor conduct physical	661.05 hrs	Mon 12/7/15	Mon 3/28/16	114
116		7.2.3	Identify first aid kit requirements	0 hrs	Tue 3/29/16	Tue 3/29/16	115,112
117		7.2.4	Build first aid kits	8.4 hrs	Wed 3/30/16	Fri 4/1/16	116
118		7.2.5	Update will	763.8 hrs	Fri 11/20/15	Fri 4/1/16	53
119		**7.3**	**Packing**	**21.4 hrs**	**Fri 3/4/16**	**Sat 3/26/16**	
120		7.3.1	Pack equipment	6 hrs	Sun 3/20/16	Fri 3/25/16	103,96
121		7.3.2	Build pulk	4 hrs	Fri 3/25/16	Sat 3/26/16	120
122		7.3.3	Weigh equipment	1.4 hrs	Sat 3/26/16	Sat 3/26/16	121
123		7.3.4	Repackage food items	4 hrs	Fri 3/4/16	Sat 3/5/16	107
124		7.3.5	Weigh food	3 hrs	Sat 3/5/16	Sat 3/5/16	123

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ID	Task Mode	WBS	Task Name	Work	Start	Finish	Predecessors
125		7.3.6	Pack food items	3 hrs	Sat 3/5/16	Sat 3/5/16	124
126		7.3.7	Packing Complete	0 hrs	Sat 3/26/16	Sat 3/26/16	122,125
127		7.4	Expedition go/no-go decision	0 hrs	Fri 4/1/16	Fri 4/1/16	126FS+1 day,117,1
128		**8**	**Project Closing**	**9 hrs**	**Sat 3/26/16**	**Wed 4/6/16**	
129		8.1	Conduct lessons learned	4 hrs	Sat 3/26/16	Sun 3/27/16	126
130		8.2	Archive project documents	3 hrs	Mon 3/28/16	Tue 3/29/16	129
131		8.3	Handover to operations	2 hrs	Tue 4/5/16	Wed 4/6/16	130,82
132		8.4	Project Complete	0 hrs	Wed 4/6/16	Wed 4/6/16	131

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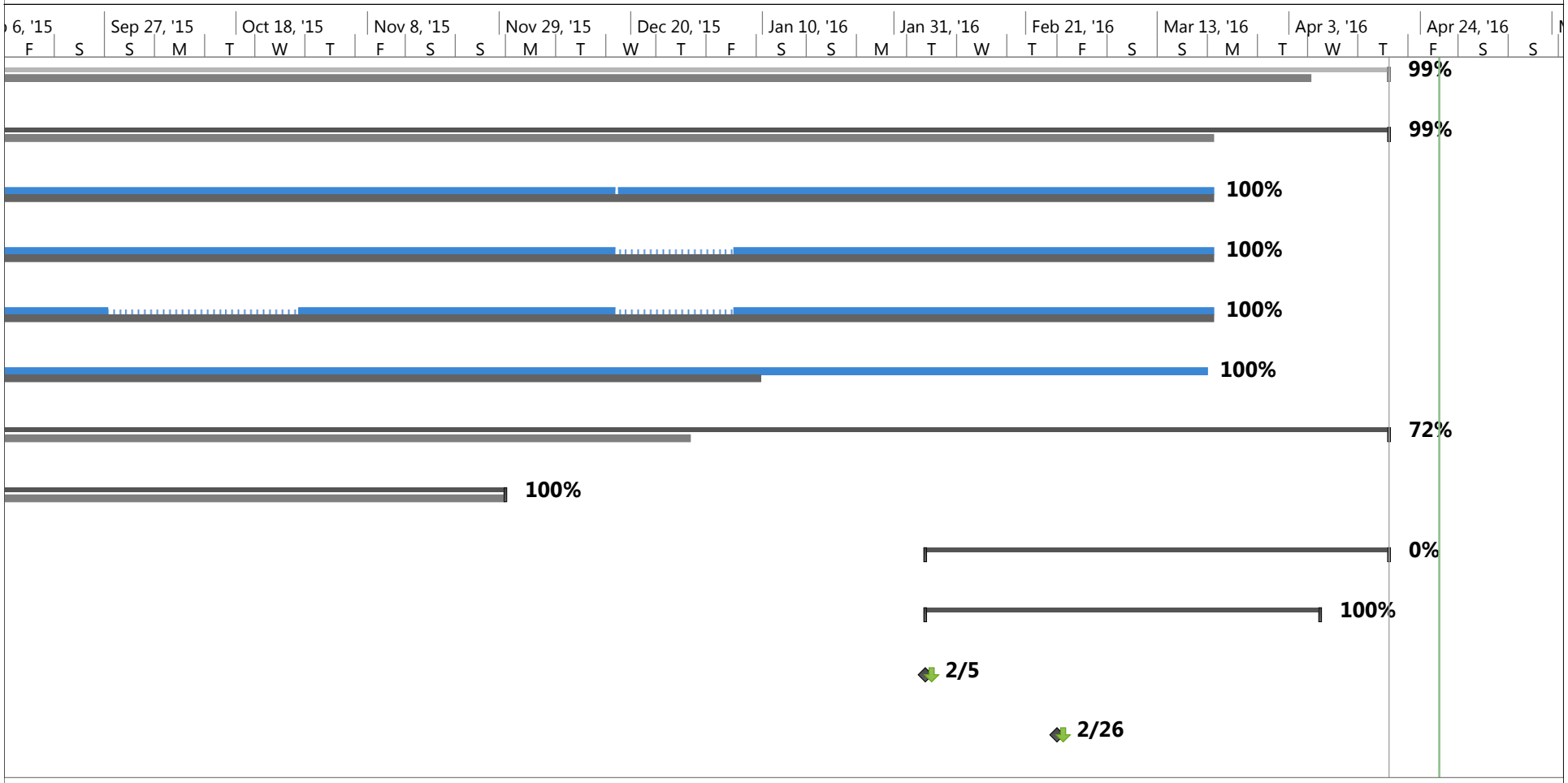
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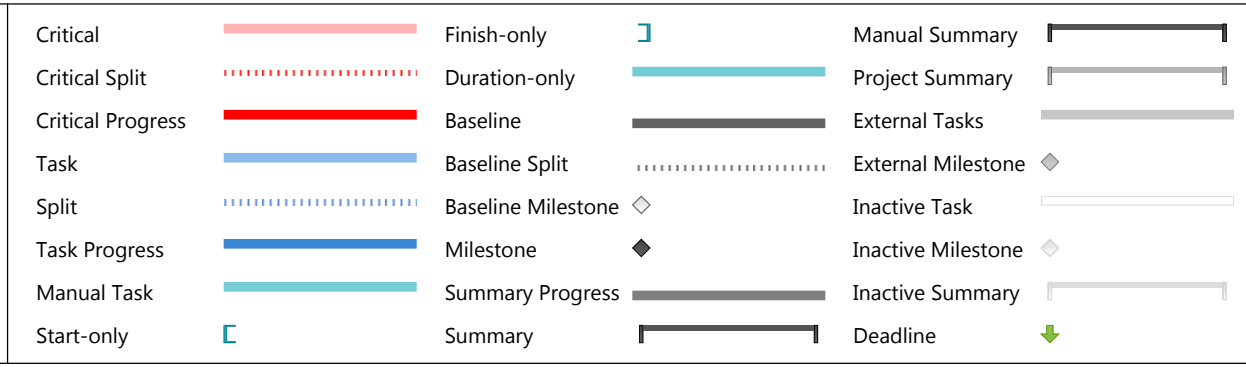
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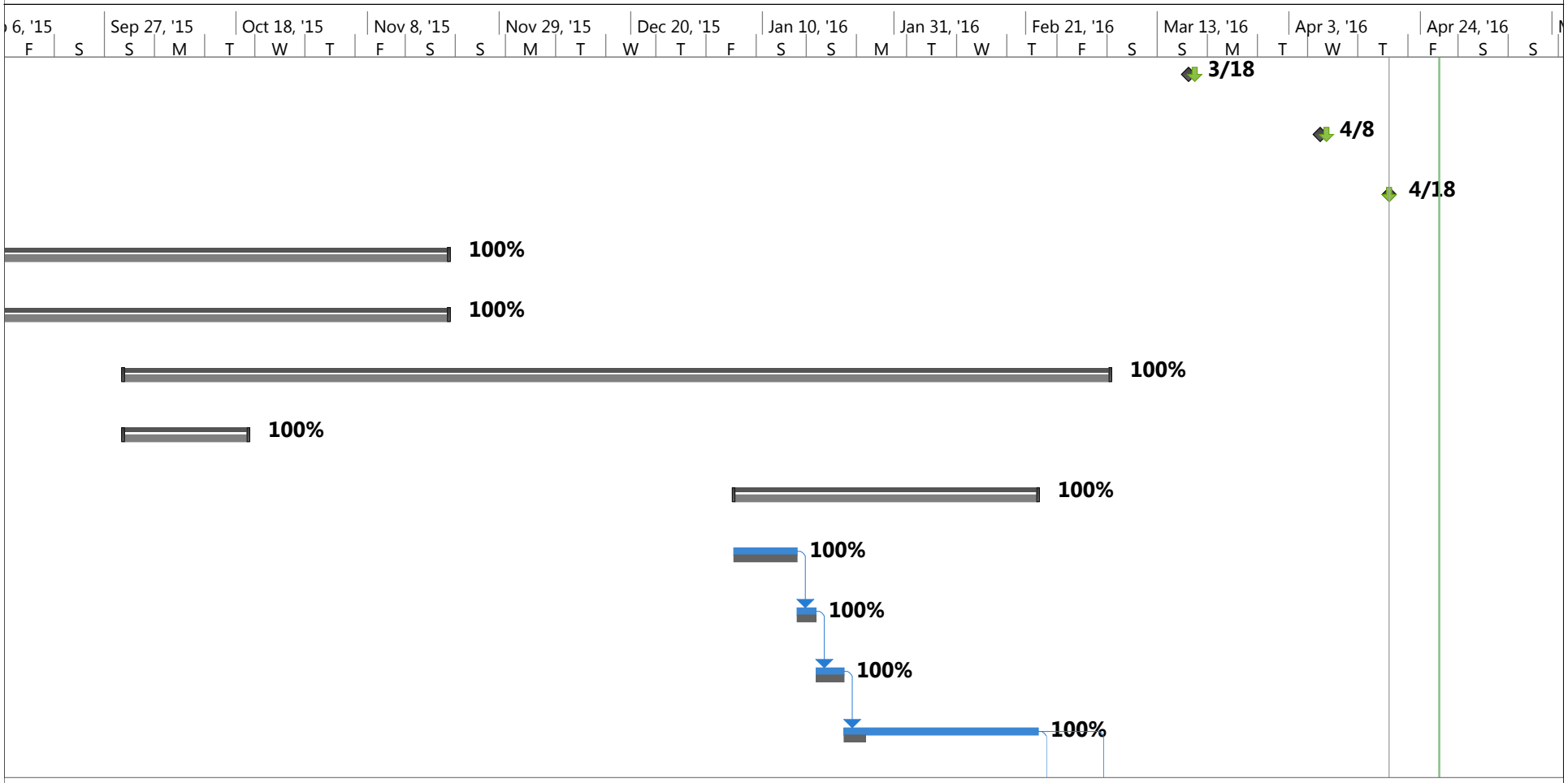

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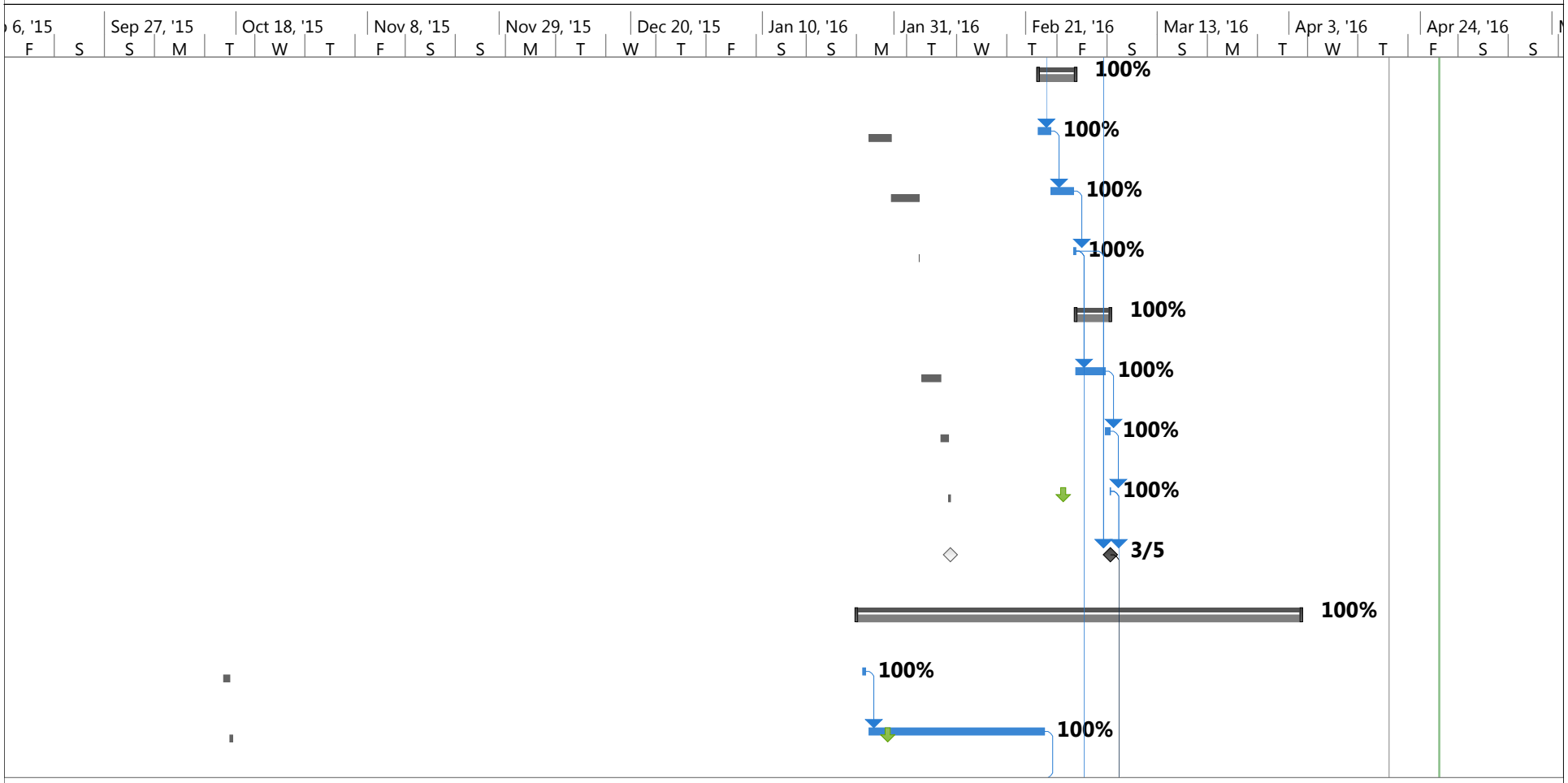

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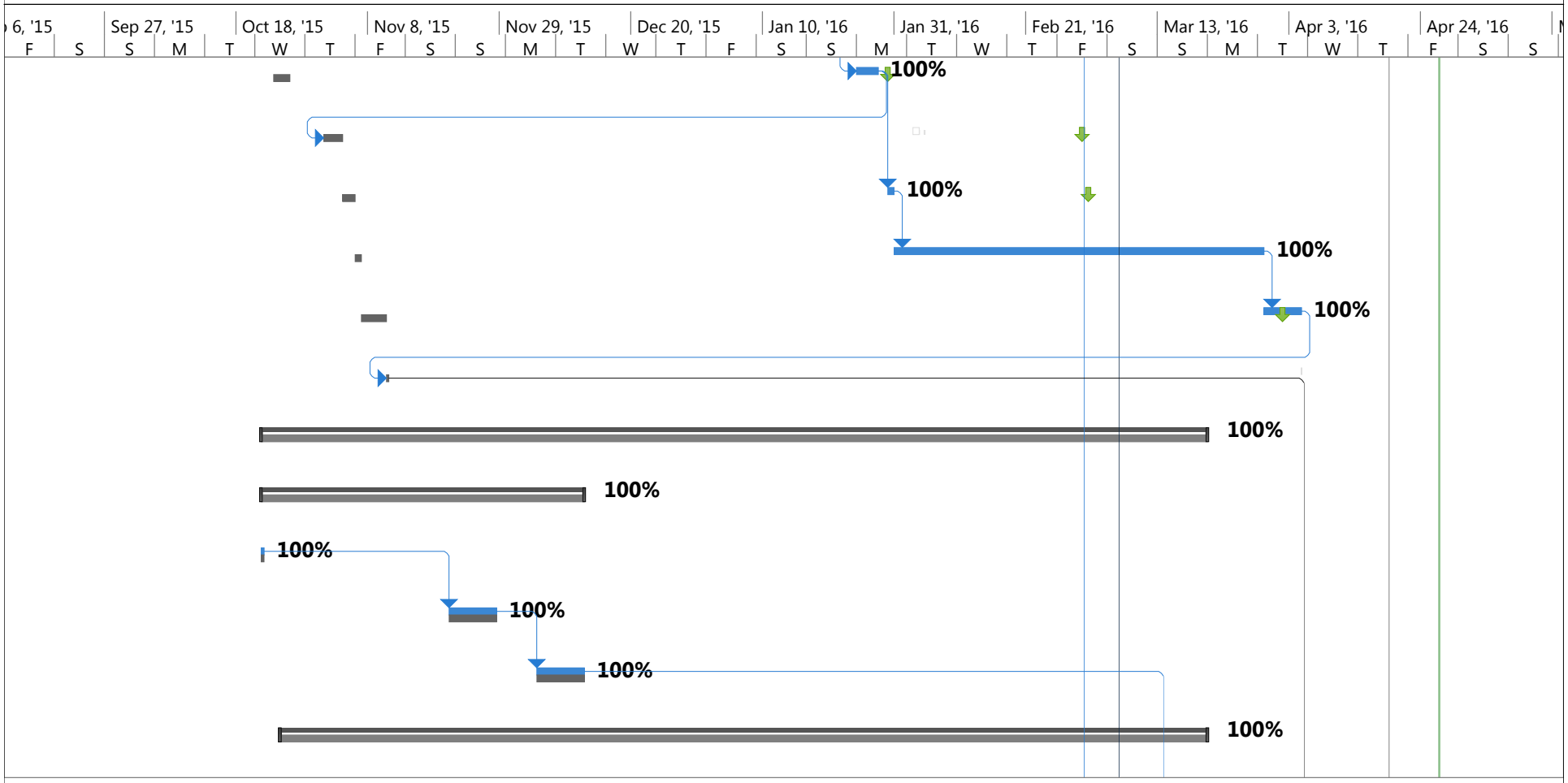

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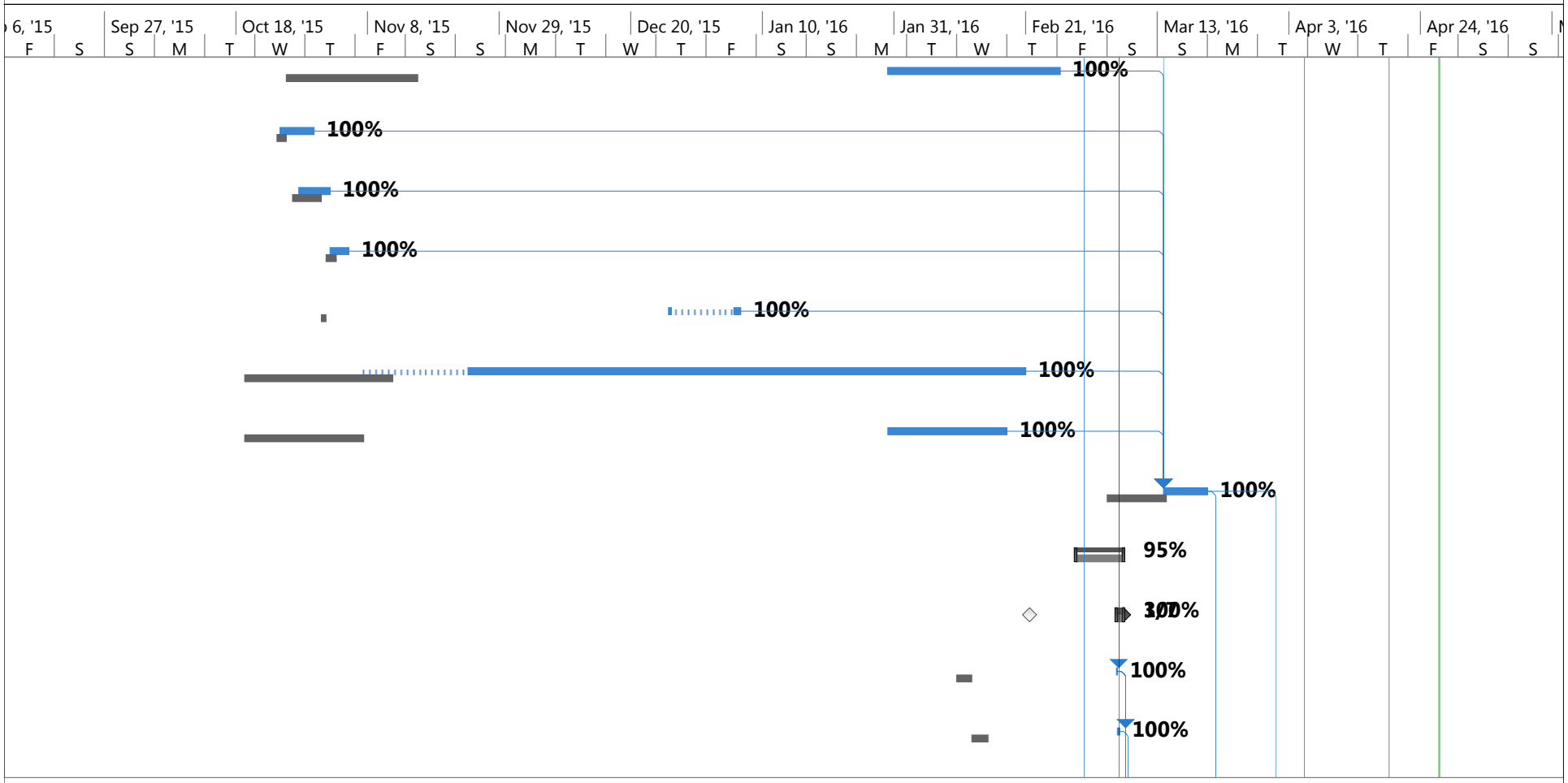
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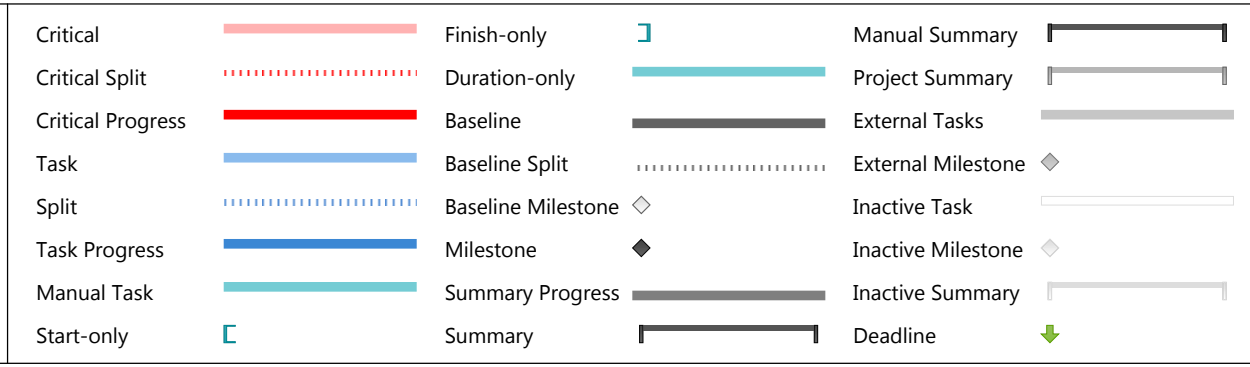
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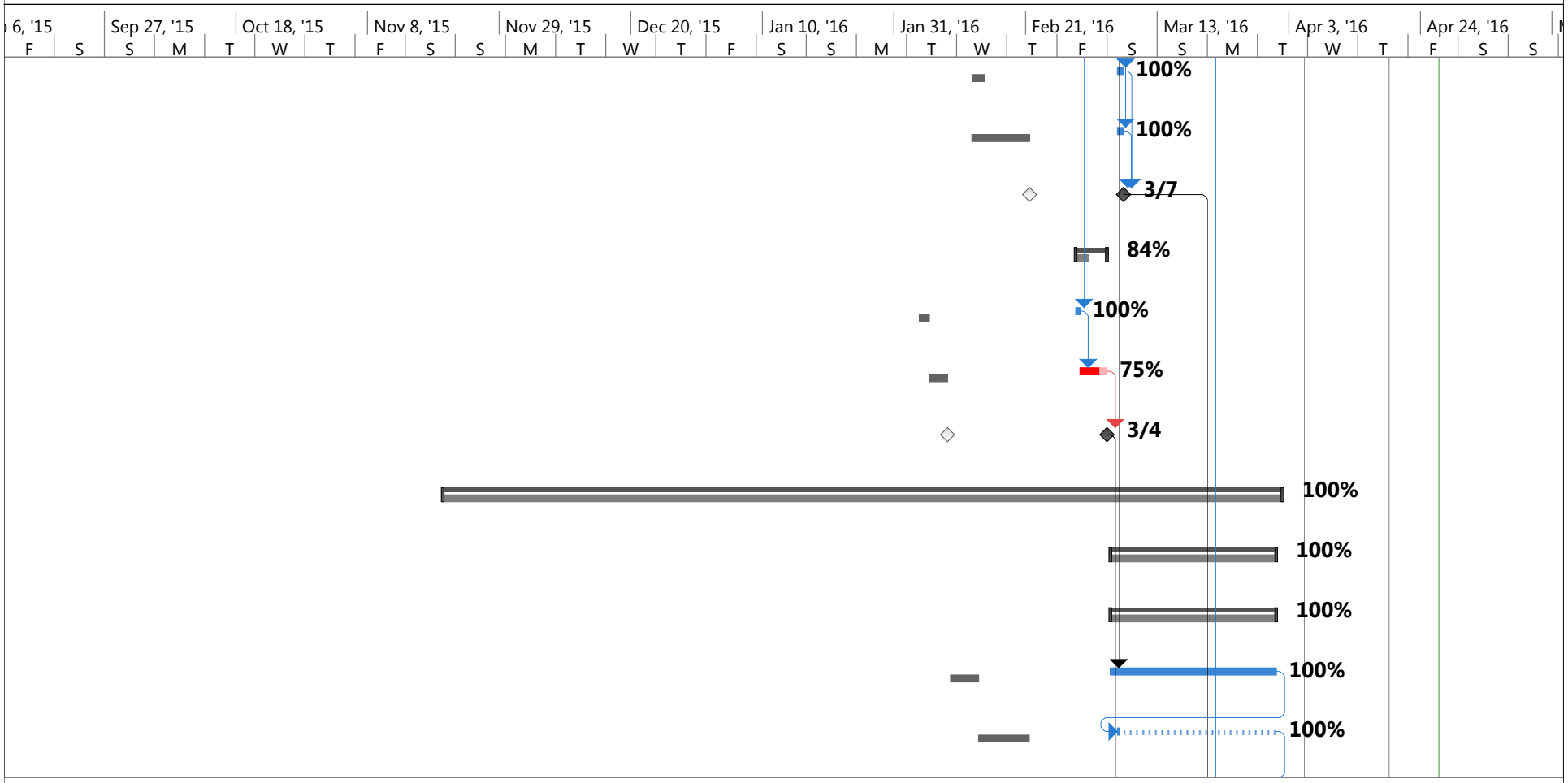

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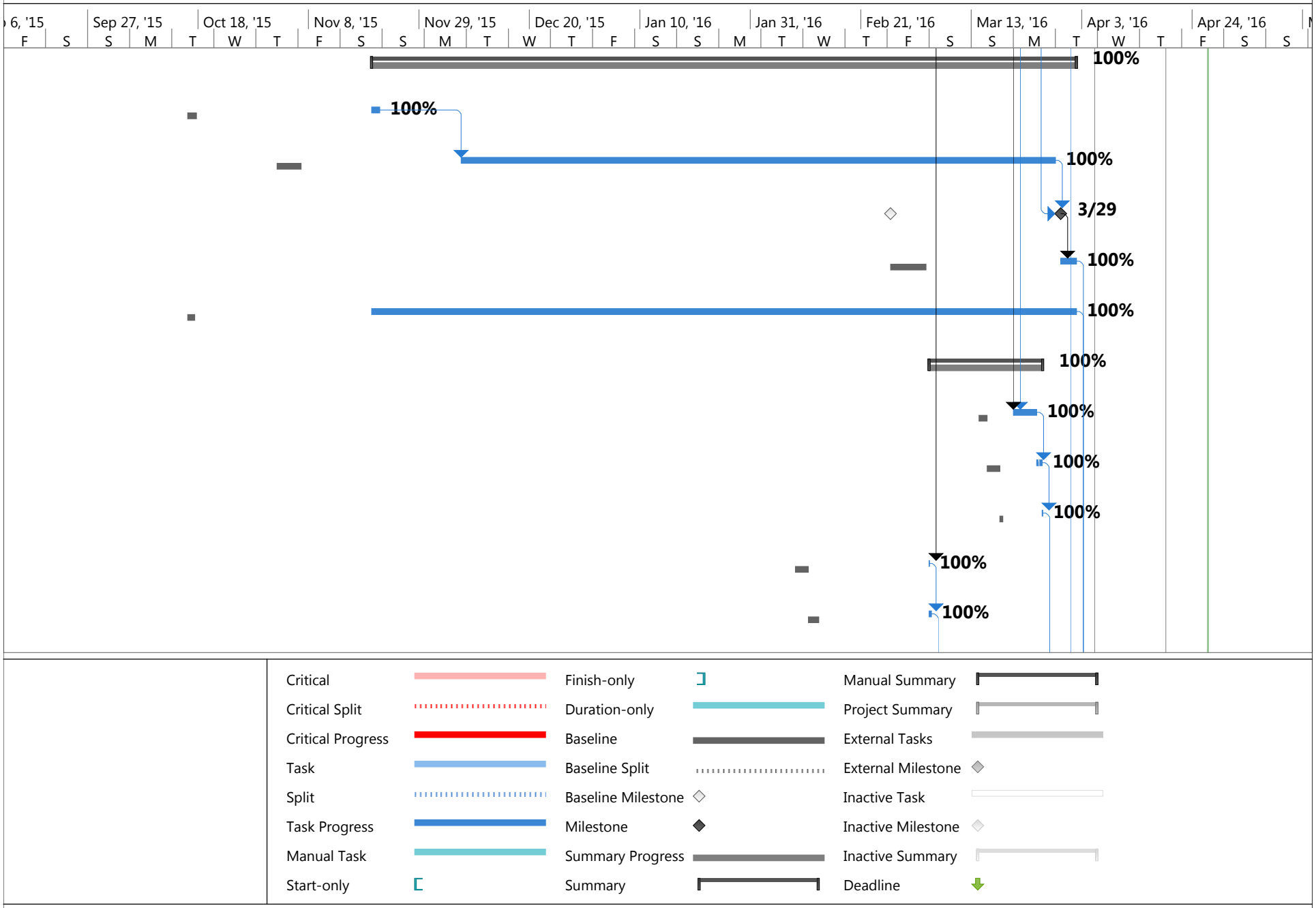
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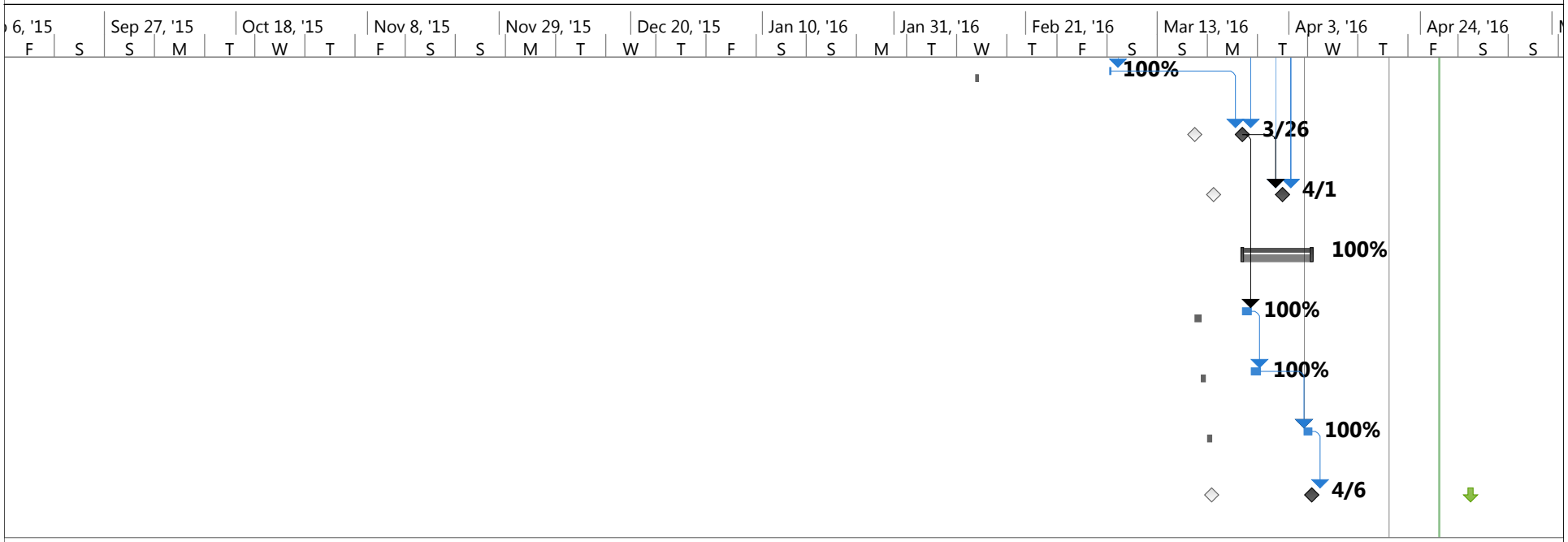

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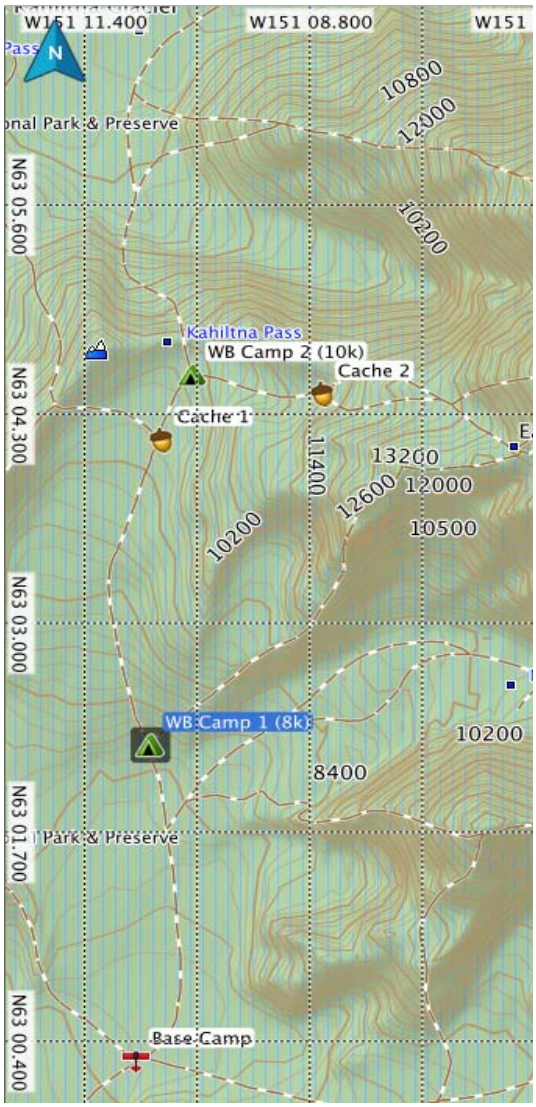
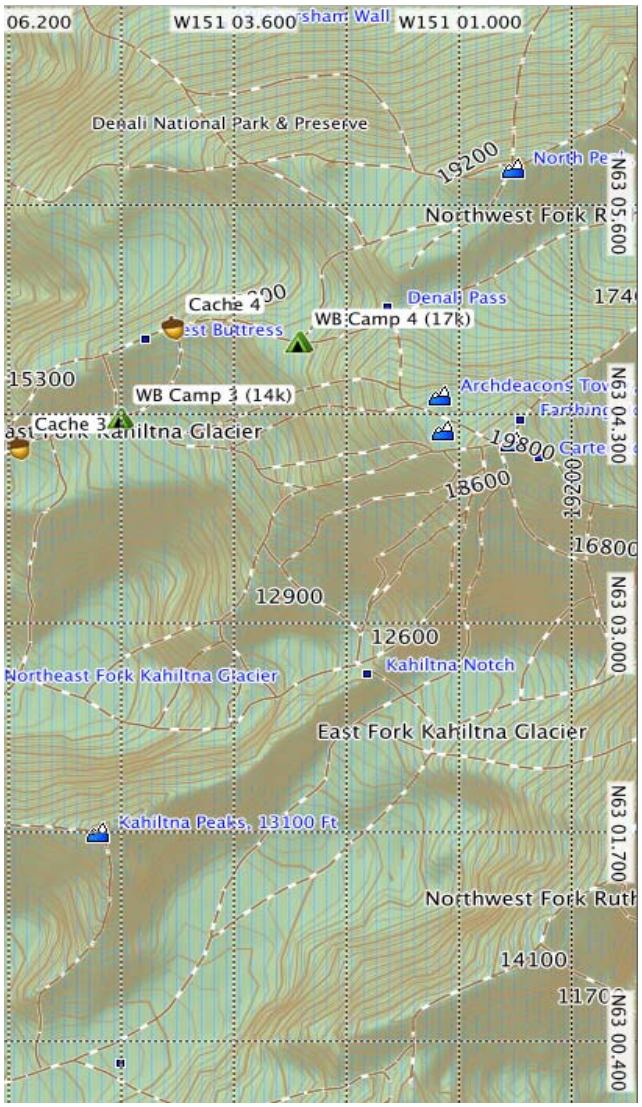
Day	Camp	Altitude	Activity
1	Kahiltna Base Camp	7,200-feet	Fly-in
2	Move to Camp 1	7,800-feet	Move camp
3	Camp 1	7,800-feet	Carry to 9,700-feet
4	Move to Camp 2	9,700-feet	Move camp
5	Camp 2	9,700-feet	Carry to 11,000-feet
6	Camp 2	9,700-feet	Rest
7	Camp 2	9,700-feet	Carry to 13,500-feet
8	Move to Camp 3	14,200-feet	Move camp
9	Camp 3	14,200-feet	Retrieve 13,500-feet
10	Camp 3	14,200-feet	Rest
11	Camp 3	14,200-feet	Carry to 16,200-feet
12	Camp 3	14,200-feet	Rest
13	Move to Camp 4	17,200-feet	Move camp
14	Camp 4	17,200-feet	Rest
15	Camp 4	17,200-feet	Summit day, or retrieve cache
16-19	Camp 4	17,200-feet	Summit days (inclement weather)
20	Camp 3	14,200-feet	Return post-summit
21	Kahiltna Base Camp	7,200-feet	Return flight
22-23	Kahiltna Base Camp	7,200-feet	Return weather days

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Knowledge Area 1 –
Stakeholder Management and Communication

Overview:

Stakeholder management and communication were combined during project. These two knowledge areas complement each other. Stakeholder management is key in this project since it will not exist without the stakeholders, and their input is an essential part of expedition planning. Expeditions are about achieving a particular objective. Understanding the stakeholders, why they want to be there, what they can and will contribute to the expedition and what motivates them intrinsically is vital for project success. This is tied with communication, since engaging with the stakeholders is a form of communication. Communication also means collaboration within the key stakeholder circle. The quality of communication is important, and how easily communication flows. Engaging with stakeholders should not be a constant pull for information, but a free flowing exchange, push and pull. As communication quality increases, so will stakeholder engagement and the ability to assess the cohesiveness of the expedition team.

Measurement:

Throughout the execution of the project, I measure stakeholder engagement and communication through the use of trackers that measure the team member's fitness and a tracker that tracked the number of times I communicated with the various key stakeholders. The purpose of the fitness tracker was to measure how much buy-in stakeholders had with the project. By tracking how closely stakeholders stayed with the fitness plan, I was able to asses whether they were following the expedition plan, or were continuing with prior expedition measures.

Engagement and communication increased throughout the semester. During January, expedition members and me were taking vacations and re-establishing work priorities. By February, engagement and communication with expedition members had returned to previous semester averages. Communication with academic advisors followed the same trends as the previous semester, with meetings increasing toward the end of the semester.

Through the execution phase of the project, the expedition team maintained a 90% match to the expedition fitness plan. This was measured by collecting team member's exercise journals at the end of the week and comparing the exercises they

conducted to the recommended exercises in the fitness plan. A 90% match means that the expedition member's journal matched the fitness plan 90% of the time.

Communication measurement did not have a threshold, but remained consistent among expedition members from week to week and correlated to the previous semester for communication with academic advisors.

Assessment:

Engagement with expedition members went well, with all members stating that they felt they were aware of what the project was accomplishing and engaged with the planning. Communication with advisors could have been better by engaging advisors earlier in order to better incorporate feedback into project deliverables.

Assessment at PPM 1 – 3/5. Need to improve advisory committee communication.
Assessment at PPM 2 – 2/5.
Assessment at PPM 3 – 4/5.
Assessment at PPM 4 – 3/5. Lack of communication with an advisor has caused the advisor to no longer be able to work with me on my project.

Knowledge Area 2 –
Schedule Management

Overview:

This project has a lot to accomplish, and management of schedule is key to accomplishing the tasks that the project team identified as necessary to project success. Ensuring that the schedule was well estimated will help me ensure that we have time to accomplish all the necessary tasks prior to the expedition.

Schedule management practices were also used for itinerary planning during the Mount Sanford field test. This was mostly an analysis of travel time required between camps based on likely conditions encounters.

Measurement:
Measurement of schedule management was through SPI and SV%. I utilized a timesheet to track the amount of hours actually spent on tasks which I then applied to the schedule with estimated work.

During the Mount Sanford field test, measurement was by comparison of experiential planning distances as compared to predictive planning distances.

Assessment:

All tasks required for the project were accomplished within the time allotted. The schedule did not account for several tasks that required additional time. These tasks were, food dehydration, and writing the academic report. Fortunately, there was enough slack in the schedule for these tasks.

PPM 1 Assessment – SPI – .91, SV % - (-9%)
4/5. There is room to improve within this knowledge area by better capturing effort required within tasks.

PPM 2 Assessment – SPI – .94, SV % - (-6%)
4/5. Research paper time and effort needs to be better captured by the schedule.
PPM 3 Assessment – SPI – .91, SV % - (-9%)
4/5.

PPM 4 Assessment – 4/5. I can better track hours spent on the project in order to more accurately measure performance. Hours tracking has suffered due to the nature of the project, it is difficult to assess what parts of daily activities constitute part of the project and which do not.

Knowledge Area 3 –
Risk Management

Overview:

Risk is a large part of this project. Risk includes training risks, which mirror expedition risks, but also risks to completing the project or being ready for the expedition. Understanding the risks and tracking them will allow a better understanding of the risks associated with the expedition itself. Not only understanding the risks, but also understanding what risks will be mitigated and how they will be mitigated is important to this project. Some of the project risks may have a low probability, but an extremely high impact and must be mitigated regardless of their probability (e.g. avalanche). Careful analysis of risks guides expedition gear selection and menu plan and is an integral part of the expedition plan.

Measurement:

To measure this knowledge area, I will track the number of risks that occur and whether or not the risk impact was identified prior to the risk occurrence. During the planning of this project, it is less likely that certain risks will occur. During the planning phase identifying risks, and identifying certain risks that require mitigation regardless of probability will assess this knowledge area.

Assessment:

Through risk planning, the expedition was able to reduce gear weight by removing redundant safety equipment and calculation of calorie expenditure. Redundant safety equipment included items such as carabiners, anchor cord and pickets. Menus were calculated to provide calories based on the anticipated calorie expenditure, instead of a standard calorie amount.
PPM1 – 3/5. Though the risk was originally captured, the effects were not fully understood ahead of time, and the opportunities were not fully captured due to not being fully understood.

PPM2 – 4/5. Risk effects are still not quite fully understood, especially with unanticipated risks.

PPM3 – 4/5.

PPM4 – 5/5.

Lessons Learned

Issue –
Accounting for time to dehydrate food.

Discussion –
For the Mount Sanford expedition and for Denali food preparation, the time required to dehydrate food was not adequately calculated. There was plenty of slack in the schedule to account for the additional time required, but dehydrating did require crashing by waking early to change over dehydrator trays.

Recommendation –
Since time is such a finite resource, it is extremely important to manage it properly. Dehydrating is a task that has lag time built-in, but preparation and tray turnovers do require time. Start dehydrating at least 1 month ahead of tasks where dehydrated food is required in order to avoid rushing.

Issue –
Organizational resistance to change

Discussion –
The mountain climbing community is very resistant to changing processes. Climbers will require personal experience with changes in planning that result in increased success before accepting new methods of general planning, nutrition and risk planning.

Recommendation –
Continue working with mountaineers to demonstrate advantages of a detailed planning system. Conduct side-by-side comparisons with mountaineers using their current planning conducted separately from predictive planning.

Issue –
Simple systems in-lieu of complex systems

Discussion –
I attempted to improve sled handling by making a series of enhancements to the standard Paris Expedition sled. These enhancements included rigid fiber glass traces to keep the sled from running into my feet, aluminum runners on the bootom of the sled to increase sled tracking and fastek buckles to secure the load. Though initial experimentation demonstrated that the modifications made a drastic improvement to sled hauling, field testing resulted in failure of 2 of the 3

modifications. The rigid traces failed while climbing across the fall-line of a slope and the runners failed during descent after shearing off of the sled. The buckles were a positive enhancement that increased speed of securing and retrieving loads.

Recommendation –
Simpler systems that require less components are less likely to fail than more complicated systems. Improvements to existing systems should attempt to increase effectiveness without a corresponding increase to complexity.

Issue –
Equipment failures during extended field test

Discussion –
A predictive lifecycle model was used to conduct testing of all experimental or modified equipment. This included testing at home, testing in the local field environment during training and concluded with a final field test during Mount Sanford. Some equipment, such as the sled modifications, performed extremely well in local area testing, but failed during extended testing.

Recommendation –
Always follow a series of testing protocols that continue to build on conditions and duration before accepting a modification. During extended testing have a back-up in place in case of failure.

Issue –
Accounting for time to write research paper

Discussion –
The schedule was originally planned in such a way that the project would account for all academic deliverables through the execution of the project. This worked well in PM686A where project deliverables included parts of the project management plan. In PM686B, academic deliverables do not necessarily coincide with project deliverables, this necessitates proper planning to account for the additional time required to fulfill academic requirements as well as project requirements.

Recommendations –
For the PM686B part of the schedule, allocate time for drafting, writing and proofing the research paper and presentation. Where research can be a level of effort task, writing, etc. should be individual tasks.

Lessons Learned

Issue –
Infrequent meeting with academic committee

Discussion –
The academic committee is an important part of the project and they provide valuable insights and wisdom. Meeting regularly with them can help keep the project on track. Though committee members may not have understanding of the specifics of the project deliverables and requirements (mountaineering), knowledge on processes and approaches is absolutely necessary for project success.

Recommendation –
Schedule regular meetings with all committee members. Arrive to the meeting with prepared questions and discussion topics to get the most out of the meeting.

Itinerary

Day	Date	Start	End	Activity
1	2-May	Talkeetna	KBC	Fly
2	3-May	KBC	Ski Hill (7,8k)	Single Carry
3	4-May	Ski Hill (7,8k)	9,7k (Cache) -> Ski Hill	Cache and Return
4	5-May	Ski Hill (7,8k)	Motorcycle Hill (11k)	Move to Camp
5	6-May	Motorcycle Hill (11k)	Motorcycle Hill (11k)	Rest
6	7-May	Motorcycle Hill (11k)	11k -> Windy Corner (13,5k)	Cache and Return
7	8-May	Motorcycle Hill (11k)	Basin Camp (14,2k)	Move to Camp
8	9-May	Basin Camp (14,2k)	Windy Corner (13,5k) -> 14k	Retrieve Cache
9	10-May	Basin Camp (14,2k)	Basin Camp (14,2k)	Rest
10	11-May	Basin Camp (14,2k)	14k -> Ridge Camp (16,2k)	Cache and Return
11	12-May	Basin Camp (14,2k)	Basin Camp (14,2k)	Rest
12	13-May	Basin Camp (14,2k)	High Camp (17,2k)	Move to Camp
13	14-May	High Camp (17,2k)	High Camp (17,2k)	Rest
14	15-May	High Camp (17,2k)	Summit -> 11k	
15	16-May	11k	KBC	
16	17-May	KBC		Wait for Flight
17	18-May	High Camp (17,2k)	Summit -> 11k	
18	19-May	High Camp (17,2k)	Summit -> 11k	
19	20-May	High Camp (17,2k)	Summit -> 11k	
20	21-May			
21	22-May			
22	23-May			
23	24-May			
24	25-May	KBC		Wait for Flight
25	26-May			

Alternate	Alternate	Menu Type	REQUIRED CALORIES	Distance	Elevation
		LAR	2717	0	0
		LAC	3377	5.5	600
		LAC	3707	2.5	1900
		LAC	3487	2.5	1900
		LAC	3377	1.5	1300
		LAR	2717	0	0
		LAC	4037	1.75	2500
		HAC	4147	2.75	3200
		HAC	3157	1	700
		HAR	2717	0	0
		HAC	4697	1	2000
		HAR	2717	0	0
		HAC	4587	1.75	3000
		HAR	2717	0	0
17200 to 16200	Retrieve Cache	SUM	4587	2.5	3100
		HAC	3267	0.75	1000
High Camp (17,2k)	Summit -> 11k	SUM	4587		
11k to KBC		SUM	4587		
11k to KBC		SUM	4587		
11k to KBC		HAC	3487		
WX Delay (LA)		LAR	2717		
WX Delay (LA)		LAR	2717		
WX Delay (LA)		LAR	2717		
WX Delay (HA)		HAR	2717		
WX Delay (HA)		HAR	2717		

	LAR	LAC	HAR	HAC
# Menus	5	5	5	6
Calories	2717	3597	2717	3890
Rounded	2900	3500	3200	3900

Calories (Ascent)	Calories (Decent)	Calories (Exercise)
		0
600		600
700	200	900
700		700
600		600
		0
1100	100	1200
1300		1300
300	100	400
		0
1700	100	1800
		0
1700		1700
		0
1200	500	1700
400	100	500
1200	500	1700
1200	500	1700
1200	500	1700
700		700
		0
		0
		0
		0
		0

Weight	
	190
RMR	

S
4
4587
4200

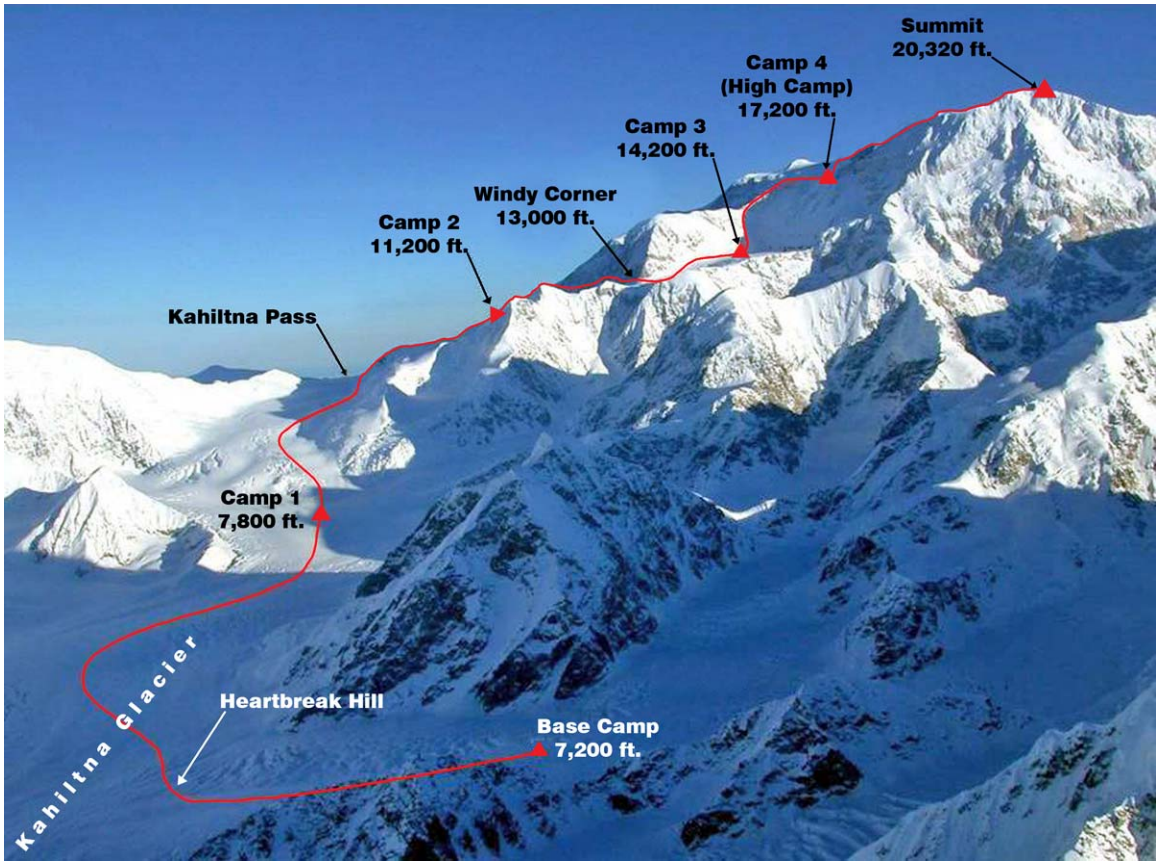
Activity Level	Cold WX
30%	10%

2470

Denali Expedition 2016, the West Buttress

Project Management Plan

Justin Ramsey



Abstract

During the summer of 2016 the project team will conduct an expedition to climb the West Buttress of Denali. Denali is the highest peak in North America, with an elevation of 20,320 feet above sea level. The West Buttress is the most commonly climbed route starting at the Kahiltna Glacier and ascending to the summit. The three-week expedition requires robust planning prior to step off since there will be no external support once started.

Current expedition planning typically consists of ad hoc methods of planning, consisting of subject matter expert opinion and best guesses. The average summit rate for the past ten years on Denali hovers around 52% and the fatality rate hovers at three climbers a year. Unsuccessful attempts are often attributed to bad weather, injury, lack of fitness and lack of mountaineering knowledge. Proper planning guidelines and pre-expedition go/no-go criteria for expeditions on Denali will significantly increase safety and increase summit success.

This project encompasses all pre-expedition planning and support. The project will produce an itinerary for the three-week expedition, will research and procure equipment for the team, research high altitude nutrition and procure food items, develop a comprehensive physical fitness-training plan for expedition members, and develop an expedition risk management plan. These deliverables will ensure a successful and safe expedition. Additionally, the detailed approach to expedition planning will allow the expedition team to establish a balance between too little and too much equipment and supplies.

Key words: Denali, Mount McKinley, West Buttress, Expedition

Revision History

REVISION HISTORY			
REVISION #	DATE	OWNER	SUMMARY OF CHANGES
1.0	10/22/15	JPR	Initial document
1.1	11/19/15	JPR	Updates and general revisions
1.2	04/08/16	JPR	Update scope

Approvals

AARON RAMSEY, PROJECT SPONSOR — DATE

JUSTIN RAMSEY, PROJECT MANAGER — DATE

Table of Contents

1 Introduction

1.1 The Project

During the summer of 2016 the project team will conduct an expedition to climb the West Buttress of Denali. Denali is the highest peak in North America, with an elevation of 20,320 feet above sea level. The West Buttress is the most commonly climbed route starting at the Kahiltna Glacier and ascending to the summit. The three-week expedition requires robust planning prior to step off since there will be no external support once started.

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This project encompasses all pre-expedition planning and support. The will produce an itinerary for the three-week expedition, will research and procure equipment for the team, research high altitude nutrition and procure food items, develop a comprehensive physical fitness-training plan for expedition members, and develop an expedition risk management plan. These deliverables will ensure a successful and safe expedition.

1.2 Purpose of Project Management Plan

This Project Management Plan (PMP) provides the detailed plans and processes for managing and controlling activities associated with expedition planning for climbing Denali's West Buttress route during the summer of 2016. This PMP will lay out the fundamentals of communication and execution through subsidiary plans and appendices to facilitate shared understanding among all stakeholders. The project management plan provides a method of ensuring that project deliverables are tracked through development and accepted upon completion.

1.3 Project Management Approach

Justin Ramsey is the Project Manager (PM) for this project. He has the overall authority and responsibility for managing and executing this project in accordance with this project management plan. The project team consists of expedition team members: the project manager, a physical trainer and nutritionist, a geologist, and a medical technician. The PM will draft the PMP, subsidiary plans and project documents. The PM has approval authority for all change requests, corrective activities and risk responses. Any changes to project budget require approval of the project sponsor. The project charter provides further details regarding the roles and responsibilities of the project manager (Appendix A)

2 Project Scope

2.1 Project Scope Statement

Denali Expedition 2016, The West Buttress will start with research of previous expeditions through guided companies and historic data. Research will include: weather, climb itinerary, equipment lists, nutrition, and training. Research will include a comparison of authorized guide companies and their client recommendations. Training guidelines for expedition member knowledge in mountaineering and skills to practice are included in this phase. The project will also conduct research on physical fitness for mountaineering and develop a fitness plan for expedition members.

Following research, this project will procure necessary permits, contract flights and lodging and purchase equipment and food. All equipment and food will be repackaged and weighed prior to expedition start to ensure all equipment and supplies stay within weight requirements. The project will deliver a comprehensive expedition itinerary and expedition risk plan for the climb. The risk plan will include expedition termination criteria and go/no-go decision points for expedition members during the climb. The project will also develop a refined expedition planning system for future expedition use. This project ends with departure for Talkeetna, Alaska, prior to the expedition start. The budget for this project is $12,000. Additional funding will be approved on a case-by-case basis with approval of all expedition members. Excluded from this project is the execution of the climb itself.

2.1.2 Major Deliverables

The project includes the following major deliverables:

- Expedition physical training plan
- Expedition mountaineering training guidelines
- Expedition nutrition plan
- Expedition itinerary
- Expedition equipment List
- Expedition risk plan
- Permitting
- Procurement of expedition supplies and resources

2.1.3 Exclusions

The execution of the expedition itself is not within the scope of this project.

2.1.4 Assumptions

The project will operate with the following assumptions:

- All expedition members have general mountaineering experience.
- Expedition members have the majority of the personal equipment necessary.
- Procurement of personal equipment will be limited to shortages identified through equipment list development.
- Expedition members will share in project work load as identified in project schedule.
- All expedition members are in good health.

2.1.5 Constraints

The following constraints have been identified for project execution:

- Individual cost per team member cannot exceed $2,500 with the exception of the project manager.
- Equipment weight, minus water, fuel and clothing worn, cannot exceed 100 lbs.
- Food weight cannot exceed 2.5 lbs per person per day
- Expedition itinerary cannot exceed 23 days.
- Permit application must be sent to Denali National Park Service no later than 90 days before expedition start.

2.1.5.1 Project Prioritization

	Constrain	Enhance	Accept
Schedule			**X**
Scope		**X**	
Budget	**X**		

2.1.6 Critical Success Factors

The expedition plan must account for all aspects of expedition planning and preparation. This includes time enough for all expedition members to train and attain necessary equipment, skills and knowledge. A thorough expedition risk plan is absolutely necessary for expedition safety. Consistent communication with expedition members to gauge progress and needs is necessary for this project to succeed.

- Thorough Expedition Risk Plan.
- Consistent communication with team members.
- Timely delivery of deliverables.
- Athleticism. Ability to carry mountaineering load through steep terrain for multiple days.
- Teamwork. Expedition members must work together to accomplish pre-expedition work.

2.1.7 Key Performance Indicators

The project will use the following key performance indicators to gauge project progress.

- Cost Variance – A positive cost variance is acceptable, any negative cost variance greater than $200 will require approval of expedition members for acceptance.
- SPI – Though schedule is flexible, expedition members have a preference for expedition start time. SPI will be used to judge progress toward being ready for the expedition. SPI of less than .85 will trigger an assessment of scheduled tasks that can be crashed to return SPI to acceptable values.
- TCPI – Will indicate that amount of work required to complete remaining work. The upper threshold will be 1.05 and will trigger a review of remaining work for crashing opportunities.
- Cardiovascular fitness – as assessed through five kilometer run times.

3 Project Management Plan

3.1 Scope Management

The scope management plan will lay the foundation for ensuring all work associated with the project is accounted for and that additional work not required for project completion is not added to the project. Documents associated with the scope management plan include: the scope statement, work breakdown structure and the requirements traceability matrix. The PM and project sponsor will approve all changes to project scope as outlined in the Change Management Plan.

3.1.1 Requirements Collection

The PM will interview the expedition members to gather their requirements for expedition planning. Additional requirements for the expedition will be gathered through research on previous expedition on Denali and interviews with guide companies. Requirements are broken into two categories: project requirements and product requirements. Project requirements are those requirements necessary to keep the project functioning. Product requirements are those requirements that detail specifics of the project.

Documentation for requirements includes: Requirements Traceability Matrix (Appendix B), and Scope Statement (Section 2.1).

Requirements will be reassessed at each meeting with stakeholders to ensure that listed requirements are still valid and to add requirements not previously identified. Requirements that do not require the addition of work will be added without a need for the change management process.

3.1.2 Project Requirements

- PM686 deliverables.

- Expedition Plan and Itinerary consisting of: itinerary, nutrition plan, equipment list, expedition risk plan, and physical training plan.
- Performance tracking through KPIs.
- Project controls and processes for change management.
- Physical training plan for all expedition member's fitness.
- Mountaineering skills training guidelines, to include: glacier travel, crevasse rescue, winter camping, fixed rope ascent, skiing, and sled building.
- Procurement of supplies and resources needed by expedition members including aviation services contract and satellite phone contract.
- Attain necessary permits.

3.1.3 Product Requirements

- Nutrition plan accounting for 3900 kCal per person per day and food weight of less than 2.25 lbs per person per day.
- Nutrition consisting of unique food, not repeating within a three day period.
- Physical training plan that builds expedition members to the ability to carry 50 lbs through steep terrain for 2 hours without rest.
- Expedition risk plan with risk management processes for identified key risks, at a minimum: bad weather go/no-go decisions, injury or illness go/no-go, and expedition termination criteria.
- Equipment list accounting for all equipment carried by each expedition member and equipment weight.
- Equipment weight (minus fuel, water and worn clothing) less than 50 lbs.
- Itinerary by day for the expedition. The itinerary must have an ascent schedule for acclimatization with mandatory rest days at 11k, and 14k.
- Itinerary no shorter than 14 days.
- Itinerary no longer than 23 days.

3.1.4 Acceptance Criteria

Upon completion of each deliverable, the product will be emailed to the expedition members. Deliverables will be accepted by expedition members through email. Upon receipt of all acceptances, the project sponsor will formally accept the deliverable for inclusion in the Expedition Plan and Itinerary. The requirements traceability matrix includes specific acceptance criteria for each requirement (Appendix B).

3.1.5 Managing Scope

Project and product requirements define the scope of work. Initial requirements gathered through interviews with expedition members and basic research set the base schedule and scope. As further research and interviews are conducted, changes to scope may be necessary. The PM is responsible for ensuring that all requirements are captured in the project scope and that the project is executed in a manner which fulfills all requirements.

The scope of this project specifically excludes the expedition execution. Managing scope will ensure that all work prepares for the expedition, but does not delve into the specifics of expedition execution.

3.1.6 Change

Changes to project scope will go through the project change management process. The change requestor will submit a change request to the PM, upon analysis the PM will recommend change approval to the change review board, consisting of at least three (3) members of the expedition. A majority approval is necessary for all changes to scope. The change management plan documents all change process, change request forms and the change log. All changes, upon approval, will be communicated to expedition members within one (1) day of approval. Disapproval will be communicated to the requestor within one (1) day of disapproval.

3.1.7 Metrics

The following metrics will be used as a basis to improve the project planning process and increase the effectiveness of future projects/

- Number of requirements identified after project planning
- Project activities with no perceive benefit to the project
- Number of total requested changes to project scope

3.2 Schedule Management

The schedule management plan formalizes the methods used to manage all tasks associated with the WBS and planned milestones. This process verifies sequencing of activities, work required to complete all activities and the resources assigned to complete each activity. The project will be executed in the manner sequenced on the schedule. Documents that are associated with this plan are: the Gantt chart (Appendix C), Work Breakdown Structure (Appendix D), the WBS Dictionary (Appendix E) and the timesheet (Appendix F).

3.2.1 Methods

This project will use Microsoft Project 2013 for tracking execution of scheduled activities.

3.2.1.1 Backstage Options

- Decimal digits reduced to zero(0)

- American dollar currency (USD, $)
- New tasks are auto scheduled at project start
- Calculate multiple critical paths if slack is equal than or less than 1 day

3.2.1.2 Calendars

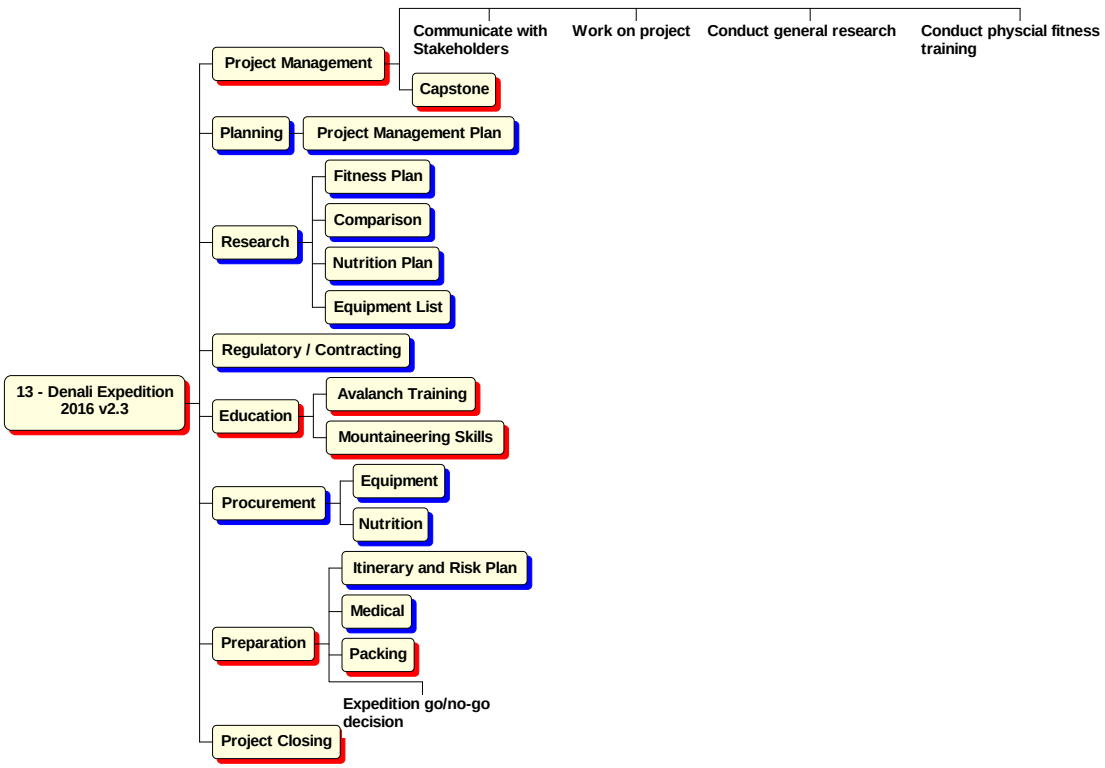
Due to the unique nature of resources working on this project, individual resources have a detailed calendar set at 24 hour work shift. American holidays are included as days off in the project calendar.

3.2.2 Milestones

Project Component	Target Date
Project Start	09/11/15
PMP Complete	11/20/15
Fitness Plan Complete	12/18/15
Comparison Complete	01/24/16
Equipment List Complete	02/12/16
Nutrition List Complete	02/26/16
Itinerary Complete	03/25/16
Equipment Repacked	04/29/16
Project Complete	05/01/16

3.2.3 WBS

The WBS contains all work associated with the project. Work outside of the WBS that is associated with the project must be requested for addition to the project. Any work on the WBS which is determined not to further the project will be considered for removal. This will be done in accordance with the change process included in this plan. The level 2 WBS is shown below, see Appendix D for the full WBS.



3.2.4 Timesheet

In order to track time spent on tasks and task completion, team members will use a timesheet. The timesheet is used to track hourly time per week spent on specific tasks. Since a large amount of tasks will be alternating during execution (e.g. mountaineering skills, weekends will alternate between different tasks instead of completing one task at a time). The timesheet is included in Appendix F.

3.2.5 Schedule Changes

Changes to the project schedule will be made within 48 hours of any approved change to the project. The PM is responsible for using the notes feature to record the reason for the change. Changes to the schedule will be documented in the change log. The schedule will be updated weekly with hours and progress provided by assigned resources.

Tasks that are removed due to a scope change will be inactivated. The PM will write a note identifying the change number and associated documentation. The change number will be written next to the task name for any tasks added or removed due to a change.

3.2.6 Metrics

This project will use SPI and SV to track schedule performance. Cumulative SPI for the critical path must stay above .85 for the project to complete on time. If the SPI drops below .85 this will trigger a review of remaining work and assessment of

remaining tasks to de-scope. De-scoping the project may adversely affect the expedition go/no-go milestone.

3.3 Stakeholder Management

Stakeholder management defines the methods used to identify and interact with project stakeholders. The communications plan assists this plan by identifying methods of communications delivery with specific stakeholders. Documents associated with this plan include: the stakeholder register (Appendix G), and the stakeholder power-interest grid.

3.3.1 Stakeholder Analysis

Stakeholders were identified using the stakeholder circle methodology. The 5-step process consists of: 1) Identify, 2) Prioritize, 3) Visualize, 4) Engage, 5) Monitor. The following key stakeholders were identified and placed in a power-interest grid.

3.3.1.1 Internal Stakeholders

- Justin Ramsey (PM)
- ~~Aaron Ramsey (Sponsor)~~ *No longer part of project, see change 005*
- Dylan Van Rozeboom (Expedition Member)
- Matt McGinnis (Expedition Member)
- Chini Sun-Ramsey (PM Spouse)
- Roger Hull (Faculty Advisor)
- LuAnn Piccard (Faculty Advisor)
- Mike Lasher (Student Advisor)
- USASD Commander

3.3.1.2 External Stakeholders

- National Park Service
- Guide Services
- Flight Services
- Outfitters / Outdoor Equipment Manufacturers
- Other Climbers
- Expedition Member Family

3.3.2 Power-Interest Grid

Power	Low Interest	High Interest
High	**HIGH POWER, LOW INTEREST, KEEP SATISFIED** Chini Sun-Ramsey National Park Service Flying Services CPT Green	**HIGH POWER, HIGH INTEREST, MANAGE CLOSELY** ~~Aaron Ramsey~~ Dylan Van Rozeboom Matt McGinnis Justin Ramsey
Low	**LOW POWER, LOW INTEREST, MONITOR (MINIMUN EFFORT)** Other Climbers	**LOW POWER, HIGH INTEREST, KEEP INFORMED** Roger Hull LuAnn Piccard Mike Lasher Expedition member families

3.3.3 Stakeholder Changes

The PM will make changes to the stakeholder register as needed. There is no formal process to identify changes to the stakeholder register.

3.3.4 Documentation

Communication with stakeholders will be documented in the project archives files. This includes emails, transcribed conversations and surveys.

3.3.5 Stakeholder Management Metrics

To measure the effectiveness of stakeholder engagement, the project will assess how stakeholders collaborate on aspects of the project. Since fitness is critical to project success, expedition member fitness will be tracked using a Fitbit and exercise journal. Collaborative conversations with stakeholders will also show effective engagement. The following metrics will measure stakeholder engagement and collaboration.

- Number of times stakeholders engaged effectively (conversation versus response) as tracked in a log sheet.
- Fitbit and exercise journal data (upward trend in repetitions or speed).

3.4 Risk Management

Risk Management will deal only with risks associated with expedition planning and training. The PMP risk management plan is not associated with the Expedition Risk

Plan. A two stage evaluation is used to plan risks, qualitative risk analysis and quantitative risk analysis. The quantitative risk analysis only focuses on those risks that are identified as having a high impact to the project schedule or budget. Documents associated with the risk management plan include: the risk register (Appendix H), and the risk realization matrix (Appendix I).

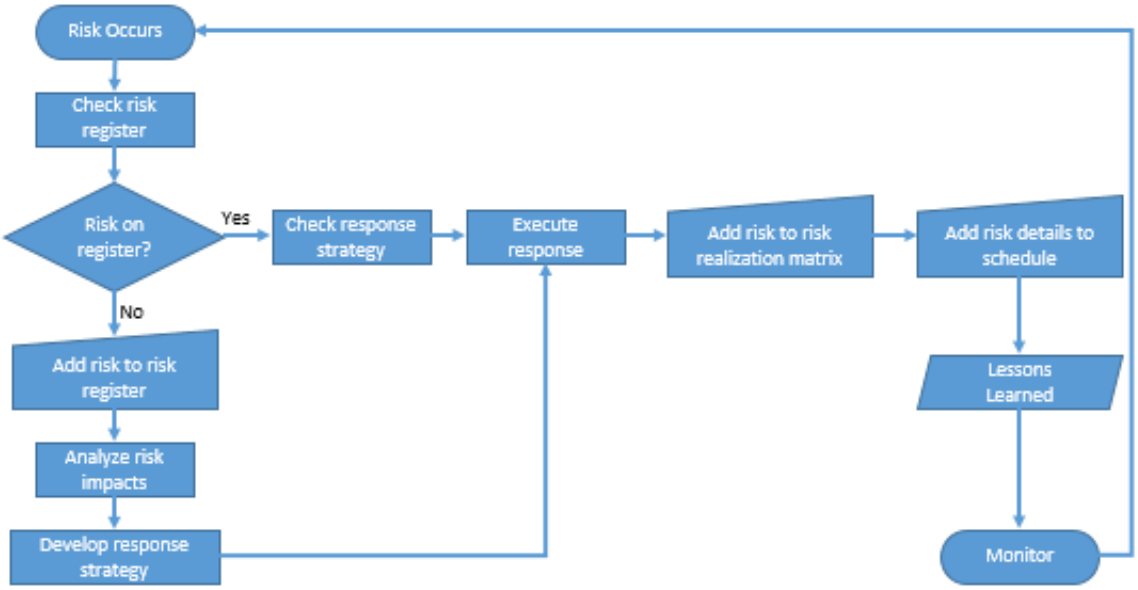
3.4.1 Active Management

Risk management is an ongoing process. The risk register is a living document that will continue to grow through project planning and execution. Risks occur in windows of time during which they are active. The PM will identify risks associated with the current work being performed and the next weeks' worth of work packages. As risks occur the PM will conduct an analysis to ensure the risk will not have an unforeseen impact on future work packages. If the risk was identified, it will be added to risk realization matrix where effects will be recorded. If the risk was unforeseen, the risk will be added to the risk register and the risk realization matrix. The PM will immediately analyze the impact of the unforeseen risk on the current work package and predecessor work packages to determine if there is further impact associated.

3.4.2 Risk Response Implementation

The PM has full authority to execute risk responses as listed on the risk register. If additional responses are added due to unforeseen risks, they will be approved by the project sponsor. The following process will the used as risks occur:

- Check risk register to ensure risk is identified.
- If response is identified, execute response.
- If no response identified, determine if response is needed.
- Add response to schedule if warranted.
- Record risk in risk realization matrix.
- Assess any lessons learned from risk response.



3.4.3 Risk Register

The Risk Register for this project is Appendix H.

3.4.3.1 Qualitative Risk

Qualitative risk analysis will be used to analyze all risks associated with each work package. The method used to identify probability and impact will be recorded with the risk. A combination of probability, impact, and severity will be used to determine if the risk requires a mitigation measure or response. The residual risk after any mitigation measure will be recorded next to the risk.

Primary risks will be associated with any secondary risks that can occur as a result of the response action. Risks that affect multiple work packages are identified in the notes section.

3.4.3.2 Quantitative Risk

This project uses quantitative risk analysis to identify risk exposure and effect of simultaneous risk occurrence. Both the critical path and non-critical path are analyzed to ensure that risk occurrences on non-critical path tasks do not affect the critical path.

The project uses PERT estimation in order to estimate the significance of risks. A Monte Carlo simulation further quantifies the magnitude of risk for the project based off of random risk execution.

3.4.4 Response Planning

Risk responses are planned using a cost / benefit analysis. If the mitigation costs is more than accepting the risk, no mitigation measure will be used. Risks that have a pre-planned response will be hidden and inactivated on the project schedule for quick addition to the project schedule and identification of impact to schedule.

3.4.5 Risk Metrics

The following metrics will be used as a part of risk management:

- How many un-identified risks occurred?
- How many identified risks occurred?
- How effective was the planned response? On time and budget?

3.5 Cost Management

The PM is responsible for cost planning and management of expedition funds. This project's budget has been determined by the expedition members. Costs over the expedition's planned budget will not be approved without a majority consensus of the expedition team members. Reporting associated with costs is included in the Communications Management Plan. Documents associated with this plan include: budget worksheet (Appendix J).

3.5.1 Rough Order of Magnitude Budget

Component	Cost
Permits	$1,500
Flight Services	$2,500
Nutrition	$1,500
Equipment	$4,000
Education / Research	$700
Training	$200
Overhead	$500
Travel	$1,100
Total	**$12,000**

3.5.2 Accounts

Costs are distributed among expedition team members. For group purchase items, such as contracts and group gear, the team will use a PayPal account to collect funds and hold funds for group use. Group funds will only be used for work packages requiring purchase of group gear. Individual team members will use personal funds to cover costs associated with personal equipment.

Any remaining funds will be evenly redistributed among all team members during project closing.

PayPal account to be used will be the project manager's at: psifox@gmail.com.

3.5.3 Cost Metrics

Cost is a high priority constraint for this project. The following metrics and collection measures will be used to gauge execution of the cost management plan.

- All receipts associated with the expedition will be emailed to the PM bi-weekly.
- Variance greater than $200 will trigger a review by the project team for acceptance.
- EVM will be used to keep track of project costs.
- Work Performance Index (WPI), calculated as CPI, except resources have no actual cost associated with work.

3.6 Procurement Management

This project has minimal contractual obligations. The PM will assist individual team members with rent / buy decisions as necessary for individual gear.

3.6.1 Contracts and Method

3.6.1.1 Aviation Services

The project will include one contract for aviation services flying to Kahiltna Glacier. The PM will send a RFQ to the aviation services located in Talkeetna, AK. Upon acceptance of the RFQ, the PM and aviation service will enter a FFP contract for services. Payment on contract will be upon start of contract services.

The RFQ will be non-formal in the form of an email.

3.6.1.2 Satellite Phone Service

This project will rent and purchase satellite phone service for the period of the expedition. The PM will send a RFQ to satellite phone providers. Upon acceptance of the RFP, the PM and satellite phone provider will enter a Time and Materials contract. Contract payment to start will include phone rental and a prepaid bundle of minutes. Costs over minutes will be paid at end of expedition.

RFQ will be non-formal in the form of an email.

3.6.2 Equipment Procurement

Expedition members will procure individual gear through their own means. Costs will be tracked as part of the management process. The PM will determine discounts available to assist expedition members with individual procurement.

Current available discounts:

- Mountain Hardwear
- Outdoor Research
- Black Diamond
- G3 (Genuine Guide Gear)
- La Sportiva

- Scarpa
- Lowe
- POC
- Julbo
- Smartwool
- Back Country Access
- Cascade Designs (Mountain Safety Research, Platypus, Therm-a-rest)
- Liberty Skis
- Millett
- GSI Outdoors
- Faction Skis
- Trango
- CAMP
- 4FRNT Skis
- Superfeet
- Smith Optics
- Adventure Medical Kits
- Scott Sports
- Gregory
- Intuition Liners
- Eider
- Minus 33
- KT Tape

3.6.3 Nutrition Procurement

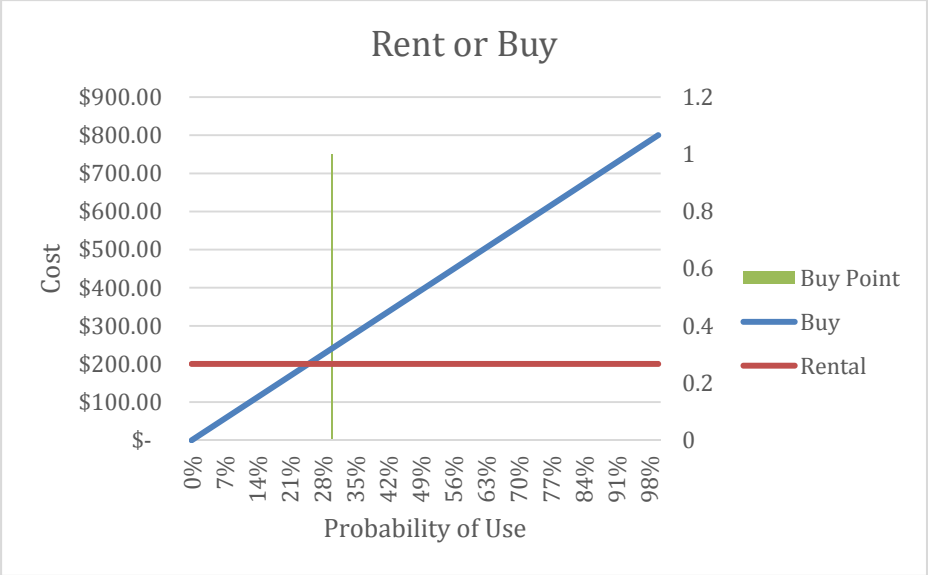
Nutrition will be procured through a food wholesale market to reduce food costs. Bulk items will be repackaged by expedition members to reduce weight and size of food.

Current available discounts:

- Mountain House
- ProBar
- PowerBar
- Honey Stinger
- Costco

3.6.4 Rent versus Buy

Upon receiving individual equipment lists from expedition members, the PM will assist the expedition member in making a rent / buy decision for high-expense gear they do not have. An excel model taking into account likelihood of use and cost will be used to assist in these decisions.



3.6.5 Metrics

To track procurement management maturity, savings over market value will be used to determine money saved. The value of goods and services will be compared to the retail value of the same service. Cost savings will be annotated in a savings log for the project. At project conclusion, cost of the project without discounts will be compared to cost of the project with discounts. A positive value will show cost savings.

3.7 Communications Management

The communications management plan outlines how team members in the project will communicate project activities, work package progress and document project materials. Documents supporting this plan are: the stakeholder register (Appendix G) and the PM department status update template (Appendix K).

3.7.1 Communication Method

Email is the primary method of communication for project activities. Face-to-face or Skype will be used for all training associated with mountaineering skills. Acceptance of deliverables will be made via email.

See the Stakeholder Register (Appendix G) for specific stakeholder communication details.

3.7.2 Status Updates

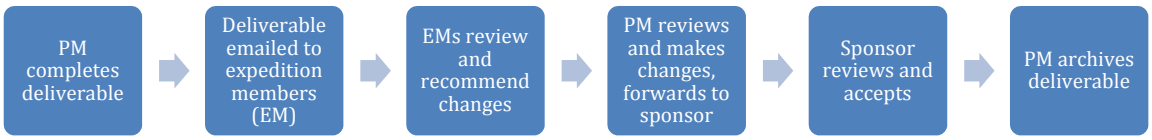
This project will use the status update template in Appendix K to provide monthly status updates to Faculty Advisors.

3.7.3 Communications Frequency

Communications with the project team will be on an as needed basis, with a minimum of one contact a week between team members and the project manager.

3.8 Quality Management

The quality management plan provides the method for quality checks and quality assurance of deliverables prior to deliverables being submitted for approval. Due to the nature of this project, there is no need for a robust quality management plan.



Drafts of deliverables will be reviewed by expedition team members for approval prior to submittal to the project sponsor for signature.

3.9 Staff Management

The staffing management plan breaks down responsibility for tasks within the project. The project team consists of the expedition members, all expedition members provided their personal calendar and availability prior to building the project schedule.

3.9.1 Roles and Responsibilities

3.9.1.1 Project Manager

The project manager is responsible for tracking all work and maintaining the project schedule. The PM will conduct background research, develop project deliverables and manage archiving of project documents. The PM will formalize all expedition processes, capture them and record for addition to future organizational process documents.

~~*3.9.1.2 Physical Trainer / Nutritionist*~~

~~The physical trainer / nutritionists is an expedition member and assists the project manager with developing the physical training plan and the nutrition plan. The physical trainer will assess expedition member fitness throughout the training process and provide advice to expedition members based on fitness progress~~.

Removed from project, see Change 005.

3.9.1.3 Medical Technician

The medical technician is an expedition member and assists the project manager in developing the expedition risk plan for medical issues. The medical technician

ensures that the appropriate equipment is procured for the expedition first aid kit and assists with developing a list of equipment for individual first aid kits.

3.9.1.4 Geologist

The geologist is an expedition member and assists the project manager with understanding the environment of the expedition. The geologist assists with developing the equipment list with necessary clothing and equipment and assists the physical trainer with developing a physical training plan for the environment encountered during the expedition.

3.9.2 Changes

The PM will be notified of any changes to project member availability. Changes will be annotated in the change log and added to the schedule within 24 hours of notification.

3.9.3 Resource Calendars

Since expedition planning is a secondary job for the project resources, individual resource calendars will be used to determine resource availability for project demands.

3.10 Change Management

The change management process is necessary for smooth management of project progress. All project team members will use the process identified in this plan in order to recommend, and approve changes to the project. Documents associated with this plan include: the change request form (Appendix L) and the change log (Appendix M).

3.10.1 Process

3.10.2 Change Review Board

The CRB consists of a minimum of three expedition members. A majority is necessary to approve a change.

4 Project Execution

The project will be executed in accordance with the above plans. Work will be completed in accordance with the project schedule. Documents that support execution are located in the Project Documents folder, these include: Project Schedule (Appendix C), WBS Dictionary (Appendix E), the Project Narrative (Appendix F), Stakeholder Register (Appendix G), Risk Register (Appendix H), Risk Realization Matrix (Appendix I), Change Log (Appendix M).

4.1 Project Management Plan Execution

4.1.1 Intent

The intent of this project is not to micro-manage aspects of expedition member lives leading up to expedition departure, but to provide guidelines and a repository of knowledge in order for expedition members to have shared and common understanding of the group and all member's abilities. The team will forge a bound preparing for the expedition by working together to develop the plan.

Statistical analysis will allow the expedition to build an itinerary that has a high chance of success based on historic success on the mountain. By building the expedition risk plan prior to the expedition, it will free expedition members from making hard decisions during the expedition, the decisions will already be made. This will increase climber safety due to developing shared understanding without the stress and fatigue of being on the expedition.

Ultimately, the aim of this project is to ensure climber safety. Secondary to climber safety, is increasing summit success.

4.1.2 Goal

This project will increase mountaineering safety on Denali and summit success. It will do this by using a thorough and precise process in order to determine climber fitness, knowledge and preparedness. The climb itinerary will increase summit success by using database and literature review to understand reasons that climbers fail to summit, and include ways to avoid common failures.

4.1.3 Description of Product and Deliverables

The project will produce two items for the team to take on the expedition. All other deliverables will be pre-expedition, but necessary to expedition success. The product produced for the expedition with be the Expedition Plan and Itinerary. This consists of: the day by day itinerary, maps and route information, daily menus, go/no-go criteria, emergency contact information, risk assessment and planning, expedition termination criteria and standing operating procedures. The product will be a plan that each expedition member can carry to have necessary information to complete the route. The expedition team will work closely to determine necessary information and ensure the final product has only necessary information for the safe execution of the expedition. The final product must be small, light, easy to read and

easy to carry. Since space is a premium, only necessary information should be contained within the final product.

4.1.3.1 Fitness Plan

The fitness plan provides simple guidelines for expedition members to follow in their personal training regimens. It will supplement personal training regimens, but will not replace what expedition members currently do for their personal fitness. The fitness plan will provide a guideline so that expedition members will gain strength and cardio vascular fitness, particularly related to climbing, over the course of six months.

The fitness plan will include cardiovascular fitness goals per week and backpacking distance and weight goals. Ideally, by following the plan, expedition members will be able to carry a 50+ lbs pack for two hours without rest, run without resting for one hour maintaining a heart rate above 150 BPM, and walk stairs for 90 minutes without rest.

4.1.3.2 Nutrition Plan

The nutrition plan will develop the menu for the expedition. The menu will provide 3900 kCal per person per day. Meals should not repeat within three days, with the exception of lunch and snacks. Meals must be properly balanced, providing calories with proper macro-nutrients. The menu also will need to tailor macro-nutrients to altitude as the climb progresses. The menu will use a variety of dried items that can be cooked using a single pot and stove combination.

4.1.3.3 Expedition Risk Plan

Using analysis of trends in mountaineering accidents and Denali accidents, the project will develop the expedition risk plan. The risk plan will cover likely risks on Denali, and response or mitigation measures for each risk. Included in the risk plan will be go/no-go criteria for each camp and termination criteria for the expedition. Also included in the risk plan will be contact information for emergency services on Denali and a point of contact for each expedition member.

4.1.3.4 Itinerary

The expedition itinerary will be a day by day plan for the expedition. This will include camp location and cache location. Included in the itinerary are maps of the route and key risks by day.

4.1.3.5 Equipment and Supply List

The equipment and supply lists will be developed through analysis of current guide companies and interviews with climbers. The equipment and supply list will be detailed and thorough in order eliminate excess waste through unnecessary equipment. The equipment and supply list will allow the expedition to strike a balance between fast and light “alpine style” mountaineering, and classic heavy and

slow “siege” mountaineering. Expedition members will be able to compare their current equipment to the expedition equipment list and identify shortages.

4.1.3.6 Contracts and Permits

The expedition will have at least two necessary contracts and two permits. The contracts will be for flight service from Talkeetna, AK to the Kahiltna glacier and for satellite phone service. Permits will be necessary for Denali and for backcountry camping.

4.1.4 Research Methods

4.1.4.1 Comparative Study

There are six authorized guiding companies currently providing guide services on Denali. I will compare each company with the other on their day-by-day itineraries; equipment lists and recommended fitness plans. I will generate a single document that will include elements from all lists and plans. This single document will be further enhanced in later stages and modified to fit our expedition needs.

Guide Companies:

- Alaska Mountaineering School
- Mountain Trip LLC
- Alpine Ascents International
- National Outdoor Leader School
- American Alpine Institute
- Rainier Mountaineering, Inc.

4.1.4.2 Survey

Surveys will be used to poll expedition members following overnight training that incorporates any expedition activity. The surveys will be used to measure effectiveness of expedition climbing techniques, rigging and nutrition. They will be used to provide improvements to the expedition plan.

The survey format can be found in Appendix N.

4.1.4.3 Interview

Interviews will be used to gather requirements from expedition members. I will also use interviews to gather prior climber experience from at least two previous climbers who have summited the mountain. Interviews with experienced mountaineers will serve to enhance general mountaineering requirements for the expedition. General interview questions can be found in Appendix O.

Short List of Interviewees:

- Dylan Van Rozeboom (Expedition Member, prior climber)
- Matt McGinnis (Expedition Member, Medic)
- ~~Aaron Ramsey (Expedition Member, Physical Trainer)~~

- Matt Hickey (Mountaineer, prior climber)
- Adam Schoffstall (Mountaineer)
- Matt Cauda (Mountaineer)
- Gary Tucker (Mountaineer, prior climber)

4.1.4.4 Statistical Analysis

Statistical analysis will be used to analyze data from previous climbing seasons and common accidents in North American mountaineering. The National Park Service provides data on all mountaineering seasons in the Alaska Range. The American Alpine Club maintains a database of climbing accidents and releases an annual publication dedicated to analyzing accident trends. By understanding trends, we can better prepare for emergencies.

National Park Service – Database will provide historical data for Denali and the Alaskan Range

- Best summit windows
- Weather patterns
- Reason for summit failure
- Accidents
- Average bad weather for each camp

American Alpine Club – Database will provide data on accident trends over the past decade.

- Climbing accidents and rates of failure
- Mountaineering accidents

4.1.4.5 Literary Review

Book research will provide a bulk of information for this project. Books will be used to develop best practices, gear checklists and to assist with mountaineering knowledge and training. Books will supplement experience and training. Books on nutrition and backpacking recipes will be used to provide a complete list of nutrition for the expedition. A complete list of books used is included in the references.

4.1.4.6 Method Testing and Experimentation

The shakedown run conducted in March will be an exercise using all of the knowledge practiced and gathered in preparation for Denali. The shakedown run will allow the team to practice methods developed during the project in a similar environment and assess team preparedness.

4.1.5 Work Reporting

Work completed on tasks will be reported to the project manager on a weekly basis. The project manager will record reported time in the project timesheet (Appendix F). Work will not start on a task until its predecessor is complete. If resources need to work on a task before the predecessor is completed, they must request permission from the project manager.

4.1.6 Baselines
The project baseline will be established upon acceptance of the project management plan. Interim baselines will be recorded monthly, or as necessary. If the project is re-baselined, the project schedule will be saved in the archives folder with an "as of" date in the name. The new baseline will use a copy of the previous schedule.

4.1.7 Deliverables
Deliverables will be completed in the order appearing on the schedule. Work on the deliverables will progress as described in the WBS dictionary (Appendix E).

4.1.8 Critical Chain Management
This project utilizes critical chain management in the form of a project buffer and feeder path buffers. The project buffer was calculated at the 50% likely estimate of tasks. The project manager will utilize a work completion versus buffer expenditure graph in order to manage the project buffer.

4.2 Information Distribution
4.2.1 Project Kick-off
The project kick-off will take place following acceptance of the project management plan at a time and place to be determined. The kick-off will include a presentation of project expectations, a run through of the schedule, deliverables, and management techniques. The kick-off meeting will set the tone of the project and serve to establish a common operating picture for all project team members.

4.2.2 Bi-weekly Meetings
The project team will meet every other week as necessary to go over any project issues, execution of deliverables, risks, and changes to assumptions or constraints. There is no format for these meeting and they are flexible to fit with project team member schedules.

4.2.3 Weekly Update
The project manager will send a weekly update to the project team in order to discuss progress on the project, gain input and insight that project team member shave on deliverables and to maintain congruence among project staff. There is no format for the weekly update other than use of email.

4.3 Acceptance of Deliverables
Project deliverables will be accepted formally by the project sponsor after review by all project team members. The project deliverables must adhere to the requirements in the requirements traceability matrix unless a change to requirements is annotated in the change log. Detailed acceptance criteria is logged in the requirements traceability matrix (Appendix B).

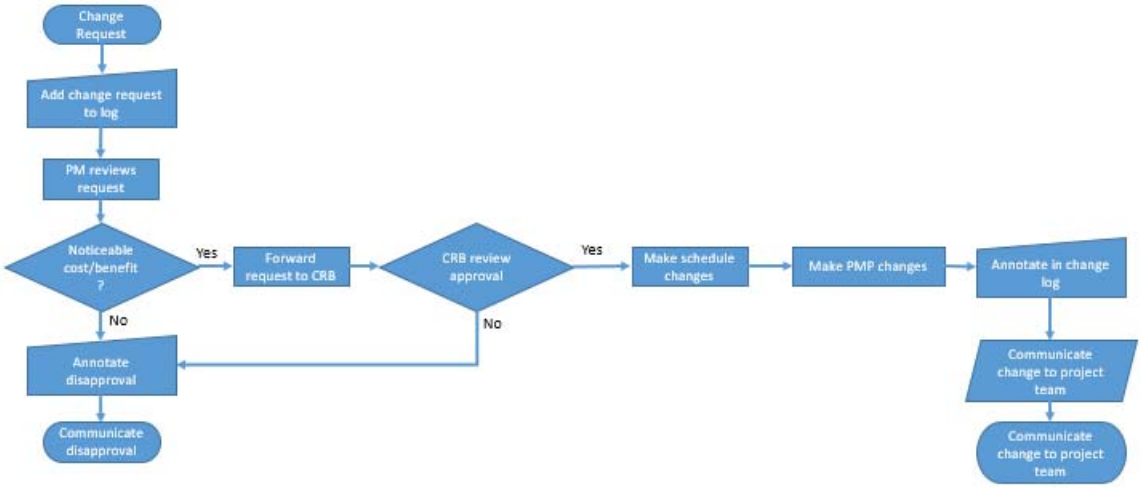
5 Project Monitoring and Controlling

Details for changes to the project are found in the Change Management Plan, and the Scope Management Plan.

5.1 Integrated Change Control

The change control process is outlines in the Change Management Plan. The following steps take place during a change request.

1. Change initiator submits change request to PM.
2. PM reviews request (within 24 hours).
    a. Conducts analysis of cost / benefit.
    b. Submits to CRB.
3. Change review board approves or disapproves (within 24 hours).
4. PM documents approval / disapproval (immediately).
5. PM makes necessary changes to schedule and plan (immediately).
6. PM communicates change to project team members (within 12 hours).



5.2 Scope Change Control

Changes to project scope will follow the above integrated change control process. Changes to scope will require a re-baseline of the project schedule.

5.3 Schedule Control

The schedule will be updated on a weekly basis each Friday in order to capture work progress.

5.3.1 Risks

Risk responses will be added to the schedule with the label "!XX123!" with XX123 being the risk ID from the risk register.

Opportunities will be added to the schedule in the form of a note to the activity affected.

5.3.2 Changes

Changes to the project schedule will be annotated in the task notes with the change number. Tasks that are removed as a result of a change will be inactivated with "Δ123" with 123 being the change number.

5.3.3 Timesheet

The project uses a timesheet format to track work completed on various project tasks. The amount of time spent on each task is recorded for each week and added to the project schedule at the end of the week.

5.3.4 Monitoring and Controlling Documents

The project team will use the following documents to monitor and control this project during execution.

- Timesheet and Narrative (Appendix F)
- Stakeholder Register (Appendix G)
- Risk Register (Appendix H)
- Risk Realization Matrix (Appendix I)
- Change Control Log (Appendix M)

6 Unanticipated Tasks

Tasks may occur that are not on the schedule. If a task is identified that is not on the schedule, the resource must submit a change request to add the task. If the task is deemed crucial for completion of deliverables, the resource will continue work on the task and await formal change approval, otherwise the resource will cease work on the task.

7 Project Closeout and Lessons Learned

Project closeout will formally close the expedition planning portion of the project and allow the project team to move into operations, the expedition.

7.1 Conducting Formal Lessons Learned

At the end of the project, project members will conduct a formal lessons learned. Lessons learned will focus on process improvement. The format for lessons learned will be:

- Issue:
- Discussion:
- Triggers / signs:
- Recommendations:

7.2 Administrative Closure

The project manager will archive all documents in an easily searchable and legible repository. Documents that will be included are:

- Original project materials (starting from formal acceptance of PMP).
- All communications in regards to the project.
- Risk realization matrix
- Project narrative
- Deliverables
- Change log
- Change requests
- All versions of project materials (latest version will be placed in a non-archive folder for ease of access.
- Any other materials related to project.

7.3 Contract Closure

Contracts will remain in place from this project until the end of the operational period. Hand-off of contracts will not be necessary unless the project team changes.

7.4 Closing Checklist

The project will follow the closing checklist provided in Appendix P in order to ensure all tasks associated with closing the project are followed prior to project termination.

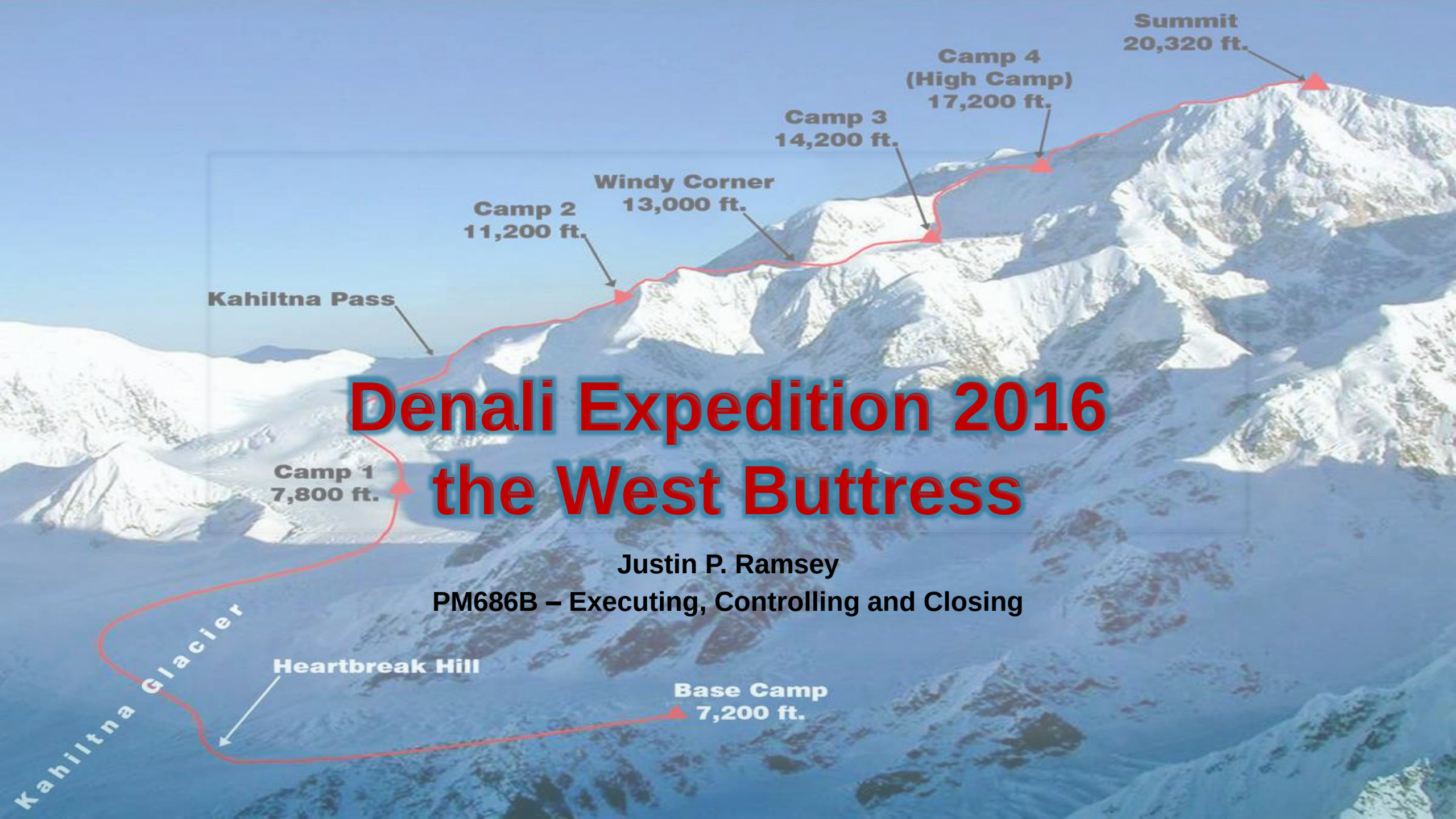
List of Appendices

Appendix A – Charter
Appendix B – Requirements Traceability Matrix
Appendix C – Schedule
Appendix D – Work Breakdown Structure
Appendix E – WBS Dictionary
Appendix F – Timesheet and Narrative
Appendix G – Stakeholder Register
Appendix H – Risk Register
Appendix I – Risk Realization Matrix and Issue Log
Appendix J – Budget Sheet
Appendix K – Status Update
Appendix L – Change Request
Appendix M – Change Log
Appendix N – Survey
Appendix O – Interview Questions
Appendix P – Closing Checklist
Appendix Q – References

Appendix A	Charter	Version 1.1 11/19/15	Denali 2016 Charter.docx
Appendix B	Requirements Traceability Matrix	Version 1.1 11/19/15	Requirements Traceability Matrix.xl
Appendix C	Schedule	Version 2.4 02/26/16	Denali Expedition 2016_26APR16.mpp
Appendix D	Work Breakdown Structure	Version 2.3 11/20/15	14 - WBS v2.3.wbs
Appendix E	WBS Dictionary	Version 1.0 11/09/15	WBS Dictionary.xlsx
Appendix F	Timesheet and Narrative	Version 1.0 10/27/15	Timesheet and Narrative.xlsx
Appendix G	Stakeholder Register	Version 1.1 11/16/15	7 - Stakeholder Register.xlsx
Appendix H	Risk Register	Version 1.1 10/26/15	6 - Risk Register.xlsx
Appendix I	Risk Realization Matrix and Issue Log	Version 1.0 10/26/15	9 - Risk Realization and Issue Log.xlsx
Appendix J	Budget Sheet	Version 1.0 10/30/15	Budget Sheet v1.0.xlsx
Appendix K	Status Update	Version 1.0 9/20/15	Ramsey_Status Report 3.docx
Appendix L	Change Request	Version 1.0 10/27/15	0 - Change Request Template.dotx

Appendix M	Change Control Log	Version 1.0 10/27/15	8 - Change Control Log.xlsx
Appendix N	Survey	Version 1.0 11/20/15	Qualtrics Link
Appendix O	Interview Questions	Version 1.0 11/20/15	Interview Questions.docx
Appendix P	Closing Checklist	Version 1.0 11/20/15	Closing Checklist.docx

Appendix Q – References



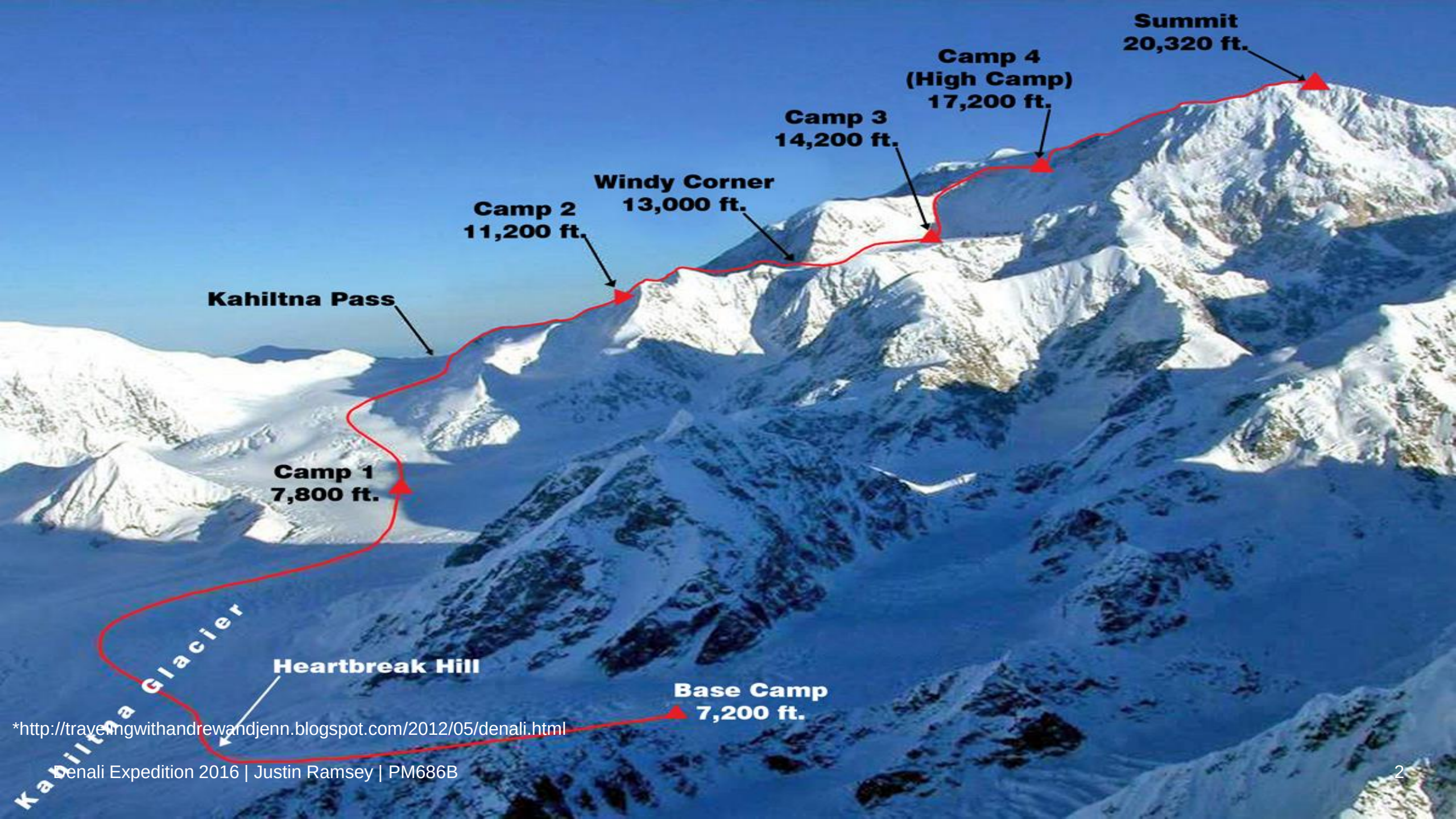
Denali Expedition 2016
the West Buttress

Justin P. Ramsey

PM686B – Executing, Controlling and Closing

Agenda

- What was the project?
- Why this project?
- What was accomplished?
- Was it successful?
- How was success measured?
- Lessons learned



*http://travelingwithandrewandjenn.blogspot.com/2012/05/denali.html

Project Deliverables

Pre-Expedition

- Fitness
- Training
- Permits
- Procurement
  - Contracts
  - Equipment and supplies
- Equipment Checks
- Packing

For Expedition

- Permits
- Contracts
- Itinerary
- Risk decision matrix
- Termination criteria

Detail of Deliverables

- Expedition physical training plan
  - From current fitness to required fitness.
- Expedition mountaineering training guidelines
  - Expedition member training focus, and pre-expedition criteria.
- Expedition nutrition plan
  - What are we eating, how much does it weigh, and will it be enough?
- Expedition itinerary
  - Acclimatization.
  - Weather delays.
- Expedition equipment list
  - Sweet spot, not too much and not too little.
- Expedition risk plan
  - What can happen, and how are we going to deal with it?
- Permitting
- Procurement of expedition supplies and resources
  - Food, fuel, equipment, transportation, communications.

Why an expedition?

Status of climbing Denali today

- Success rate
- Fatality rate

Shortfalls in current expedition approach

- Opinion versus fact
- “Summit fever”
- Experience driven planning

Expedition safety a concern?

- Is mountaineering an extreme sport?

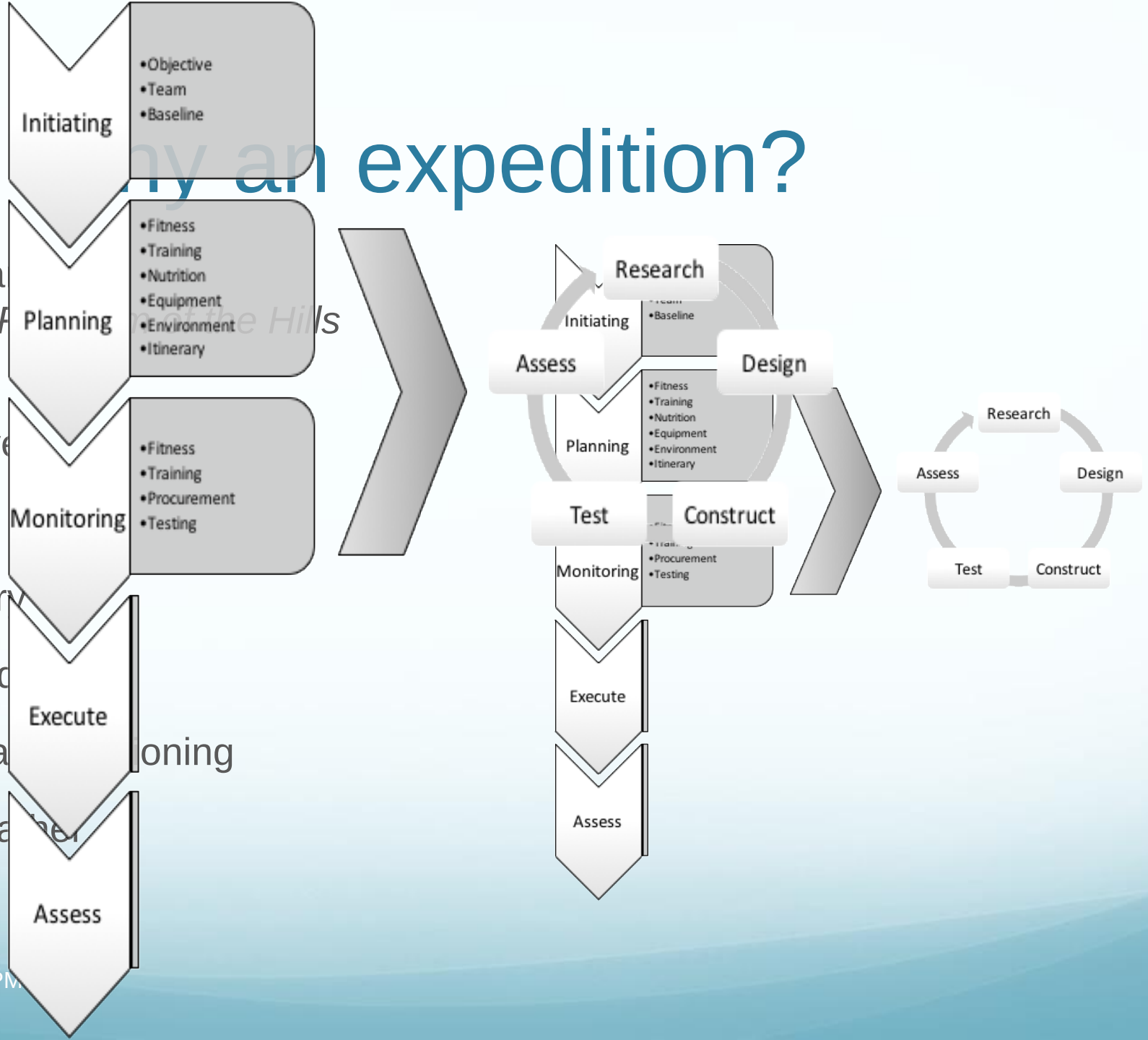
Current approach

- Alpine style
- Expedition ‘siege’ style

hy an expedition?

Current Expedition Pla
(*Mountaineering: The F* *Rainier Hills*
(Eng, 2010))

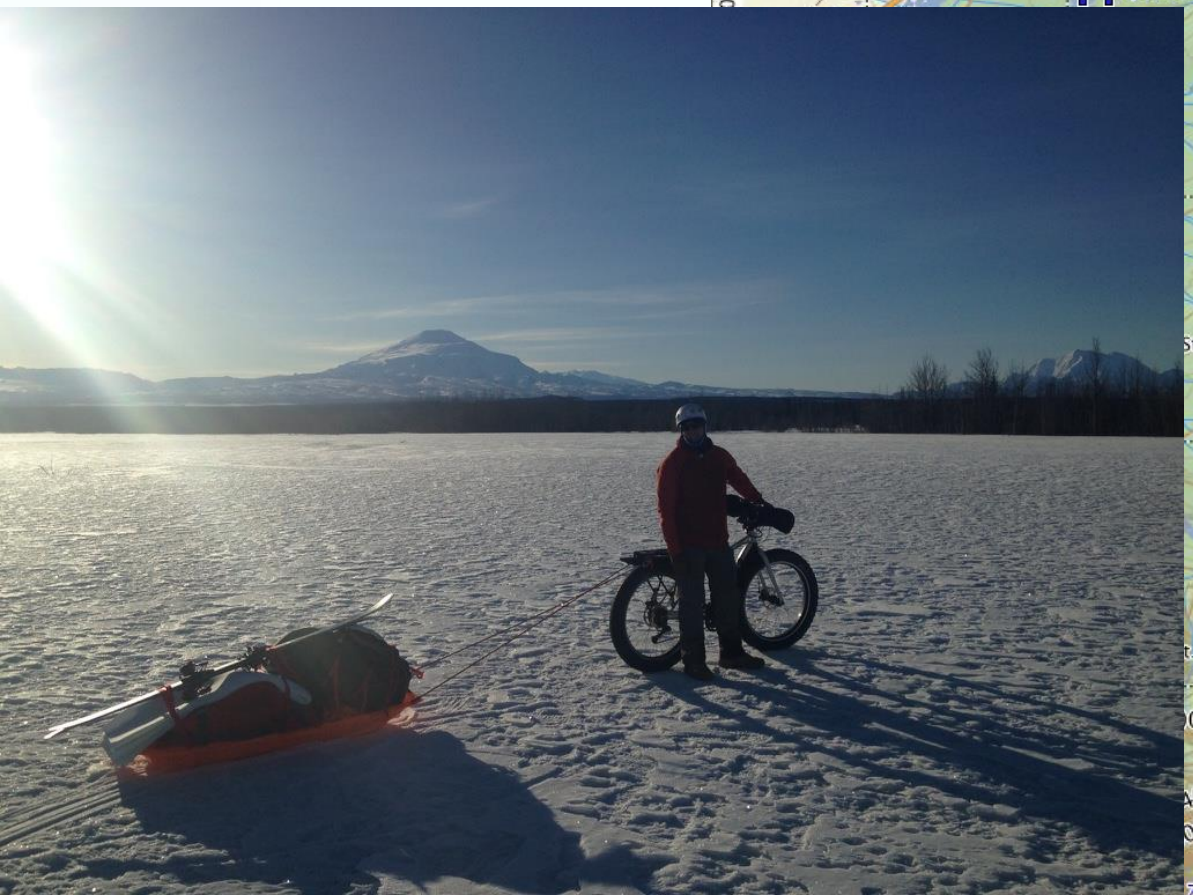
- Choose an objective
- Choose the team
- Develop the itinerary
- Gather supplies and
- Physical and menta oning
- Understand the wea her

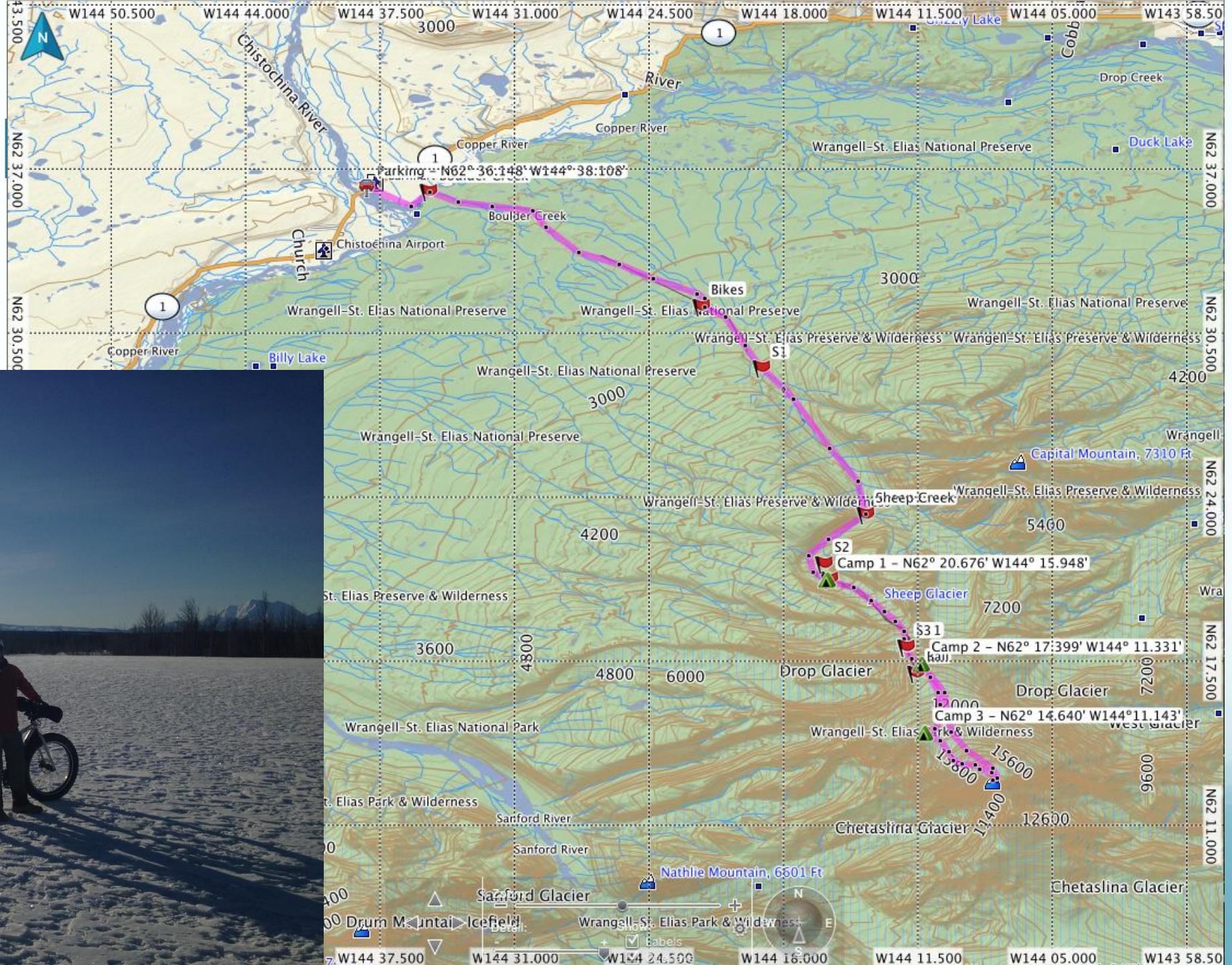


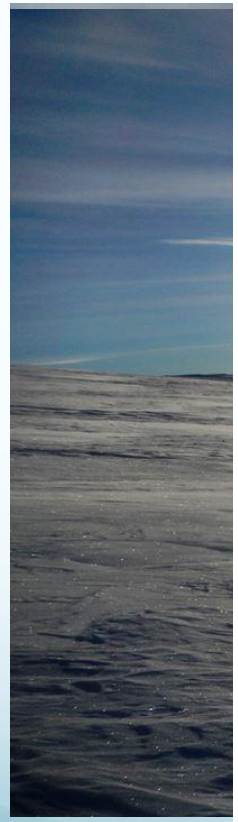
What was accomplished?

- ~2,400 work hours (between 3 team members)
- 10 equipment modifications and testing
- 18 pound gear weight reduction
- Food weight less than 2 ppppd, providing 3500 kCal ppppd
- Physical ability to climb 10-12 hours per day
- Contracts and permits for Denali
- Procurement (gear and expendables)
- Itinerary and risk planning
- Field test

W




W144 50.500
W144 44.000
W144 37.500
W144 31.000
W144 24.500
W144 18.000
W144 11.500
W144 05.000
W143 58.50
N62 37.000
N62 30.500
N62 24.000
N62 17.500
N62 11.000
Chistochina River
River
Copper River
Drop Creek
Duck Lake
Wrangell-St. Elias National Preserve
Parking - N62° 36.148' W144° 38.108'
Boulder Creek
Chistochina Airport
Church
Bikes
Wrangell-St. Elias Preserve & Wilderness
S1
Billy Lake
Capital Mountain, 7310 Ft
Sheep Creek
S2
Camp 1 - N62° 20.676' W144° 15.948'
Sheep Glacier
S3 1
Camp 2 - N62° 17.399' W144° 11.331'
Drop Glacier
Camp 3 - N62° 14.640' W144°11.143'
Wrangell-St. Elias National Park
Sanford River
Nathlie Mountain, 6501 Ft
Sanford Glacier
Chetaslina Glacier
Drum Mountain Icefield
3000
4200
5400
7200
3600
4800
6000
9600
11400
12600
15600

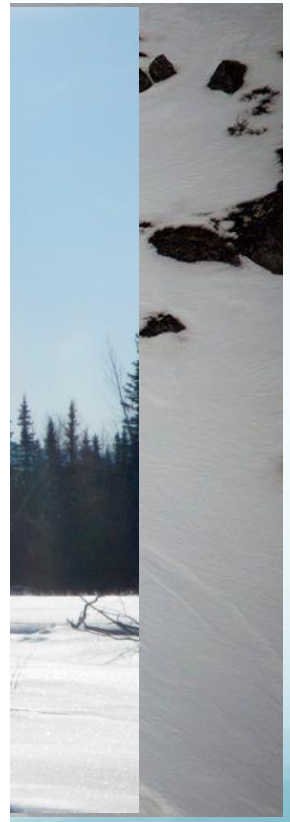


March (3 days cardio, 3 days strength, 2 day stairs, 1 day pack) – 2 months to expedition

- Cardio: Elevated heart rate for over an hour (this should be in the upper regime of around 150-170 bpm)
- Stairs: Walk stairs without weight for 90 minutes
- Strength: Three sets of pushups, pullups, and abdominal exercises. Core workouts will strengthen your back for when the time comes and you're lugging up a baby whale on your back day after day. Make sure to increase repetitions periodically as you gain strength.
- Pack: Carry a 45 lbs pack for 2 hours
- Recreation: Climbing, skiing, hiking, etc.
- Rest days: Take them when you need, you know your body better than anyone. Don't push yourself to injury.
- Technique: Basic crampon work, self-arrest, passing fixed gear on a rope team, fixed line ascension, crevasse rescue, etc. (should be done as a team at least once a month)

	Sunday	*Monday*	*Tuesday*	*Wednesday*	*Thursday*	*Friday*	*Saturday*
Cardio		X	X		X		
Stairs				X		X	
Strength		X		X		X	
Pack	X						
Recreation			X		X		X

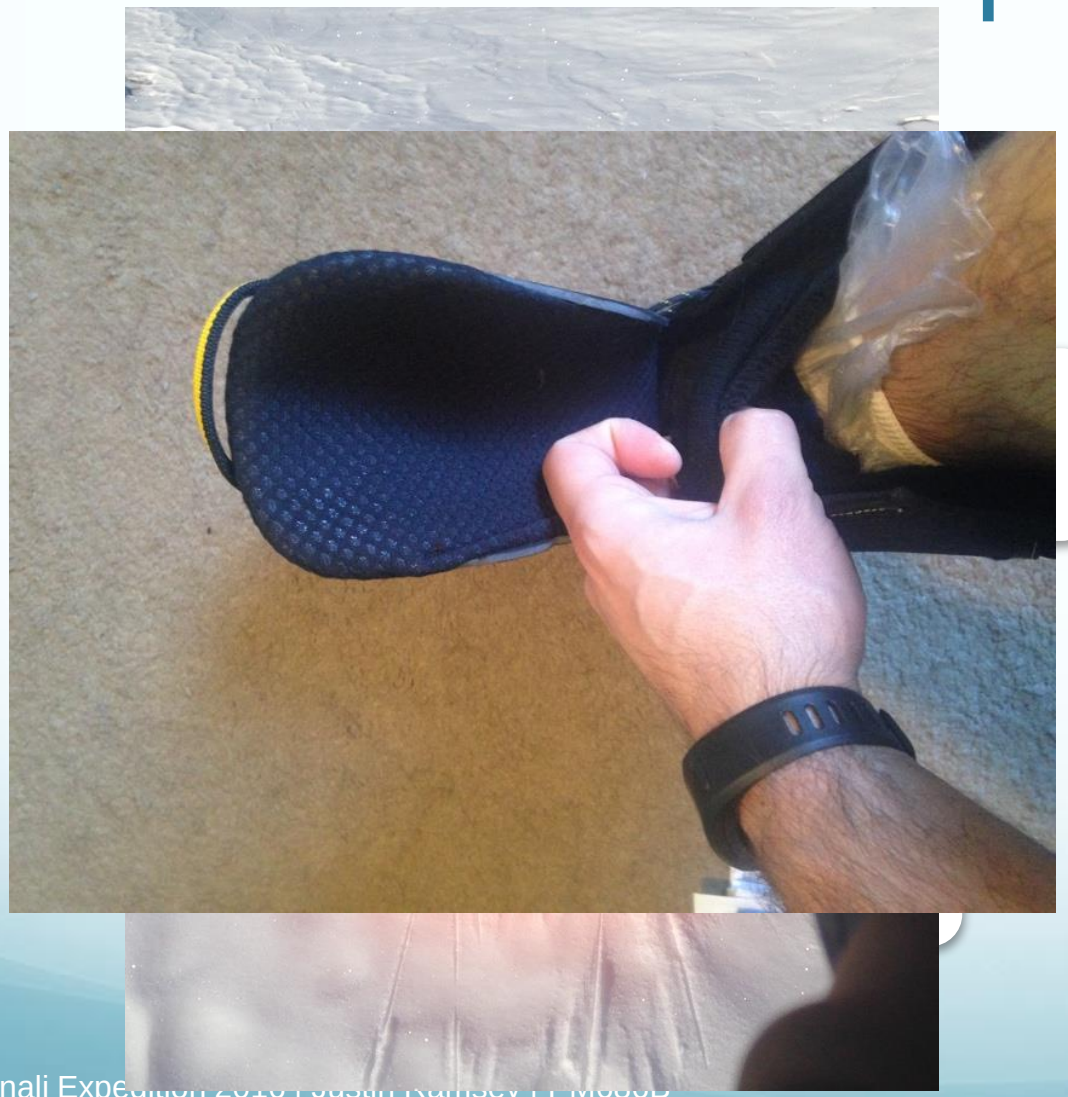
**Example schedule

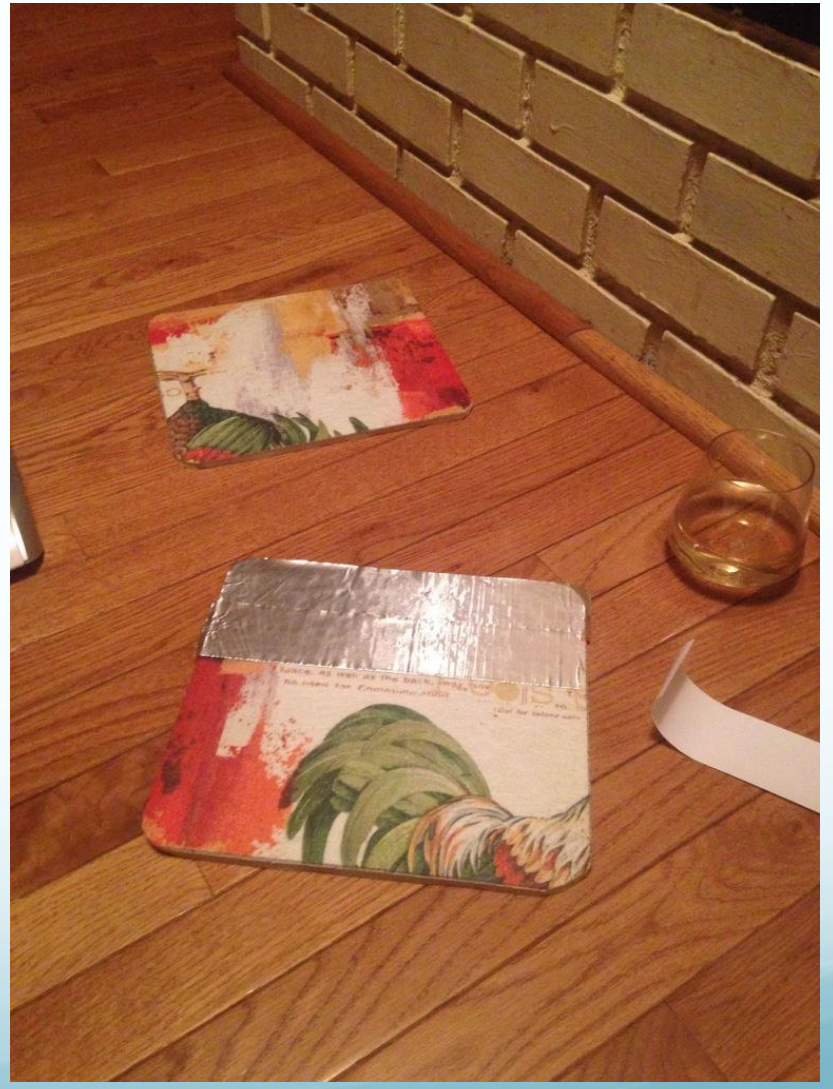


Meal Plan

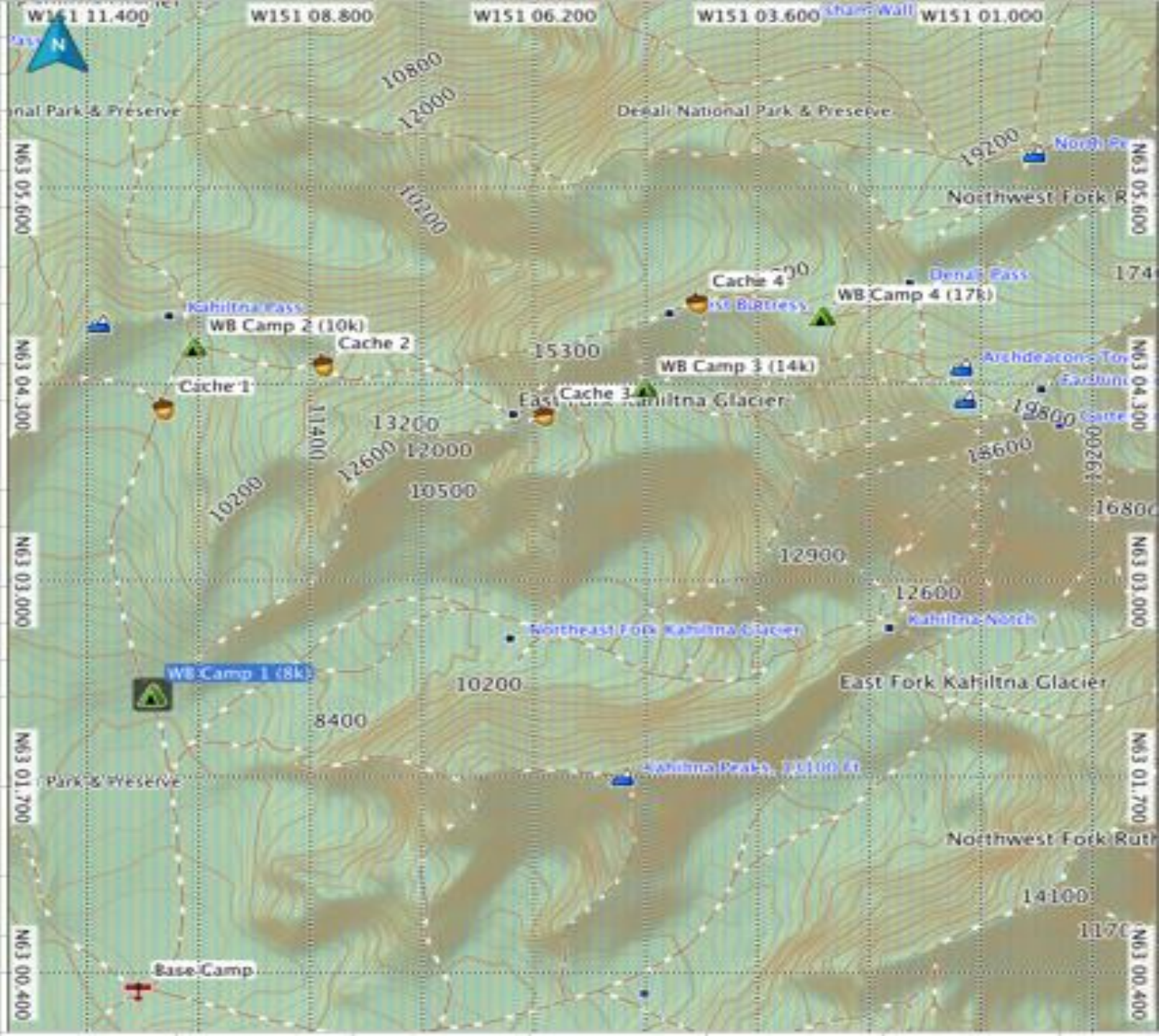
5 Days			4 Days		
Low Glacier Recovery			**Pre-Summit**		
		1			
		1			
		1			
		2			
		2			
		5			
		3			
		1			
		2			
		1			
		1			
Soup	150	5			
Dessert	200	5			

Equipment

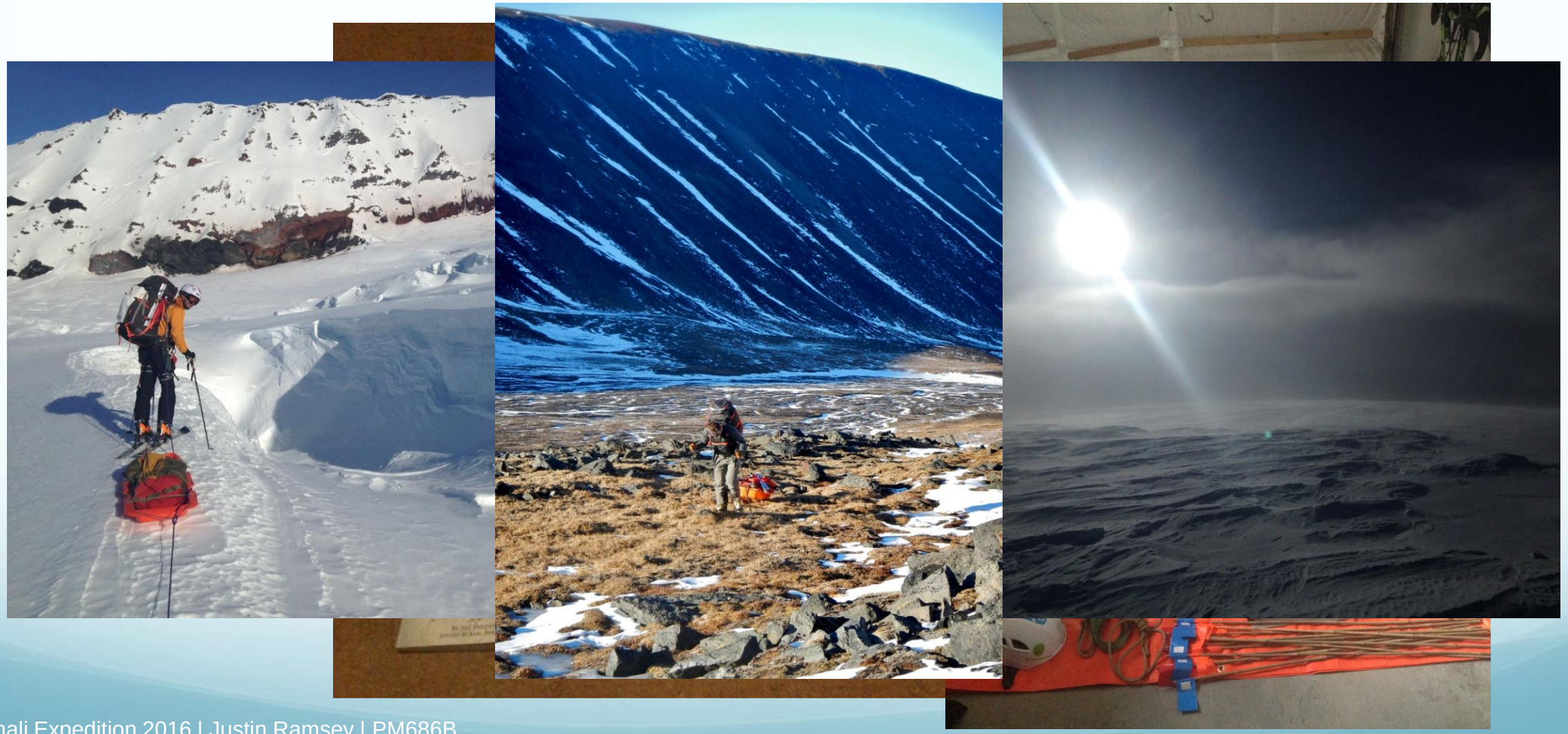




Day	Camp	Altitude	Activity
1	Kahiltna Base Camp	7,200-feet	Fly-in
2	Move to Camp 1	7,800-feet	Move camp
3	Camp 1	7,800-feet	Carry to 9,700-feet
4	Move to Camp 2	9,700-feet	Move camp
5	Camp 2	9,700-feet	Carry to 11,000-feet
6	Camp 2	9,700-feet	Rest
7	Camp 2	9,700-feet	Carry to 13,500-feet
8	Move to Camp 3	14,200-feet	Move camp
9	Camp 3	14,200-feet	Retrieve 13,500-feet cache
10	Camp 3	14,200-feet	Rest
11	Camp 3	14,200-feet	Carry to 16,200-feet
12	Camp 3	14,200-feet	Rest
13	Move to Camp 4	17,200-feet	Move camp
14	Camp 4	17,200-feet	Rest
15	Camp 4	17,200-feet	Summit day, or retrieve cache
16-19	Camp 4	17,200-feet	Summit days (inclement weather)
20	Camp 3	14,200-feet	Return post-summit
21	Kahiltna Base Camp	7,200-feet	Return flight
22-23	Kahiltna Base Camp	7,200-feet	Return weather days



Risk Planning



Success

Critical Success Factors:

- Thorough expedition risk plan.
- Consistent communication with team members.
- Timely delivery of deliverables.
- Athleticism. Ability to carry mountaineering load through steep terrain for multiple days.
- Teamwork. Expedition members must work together to accomplish pre-expedition work.

Changes for Denali

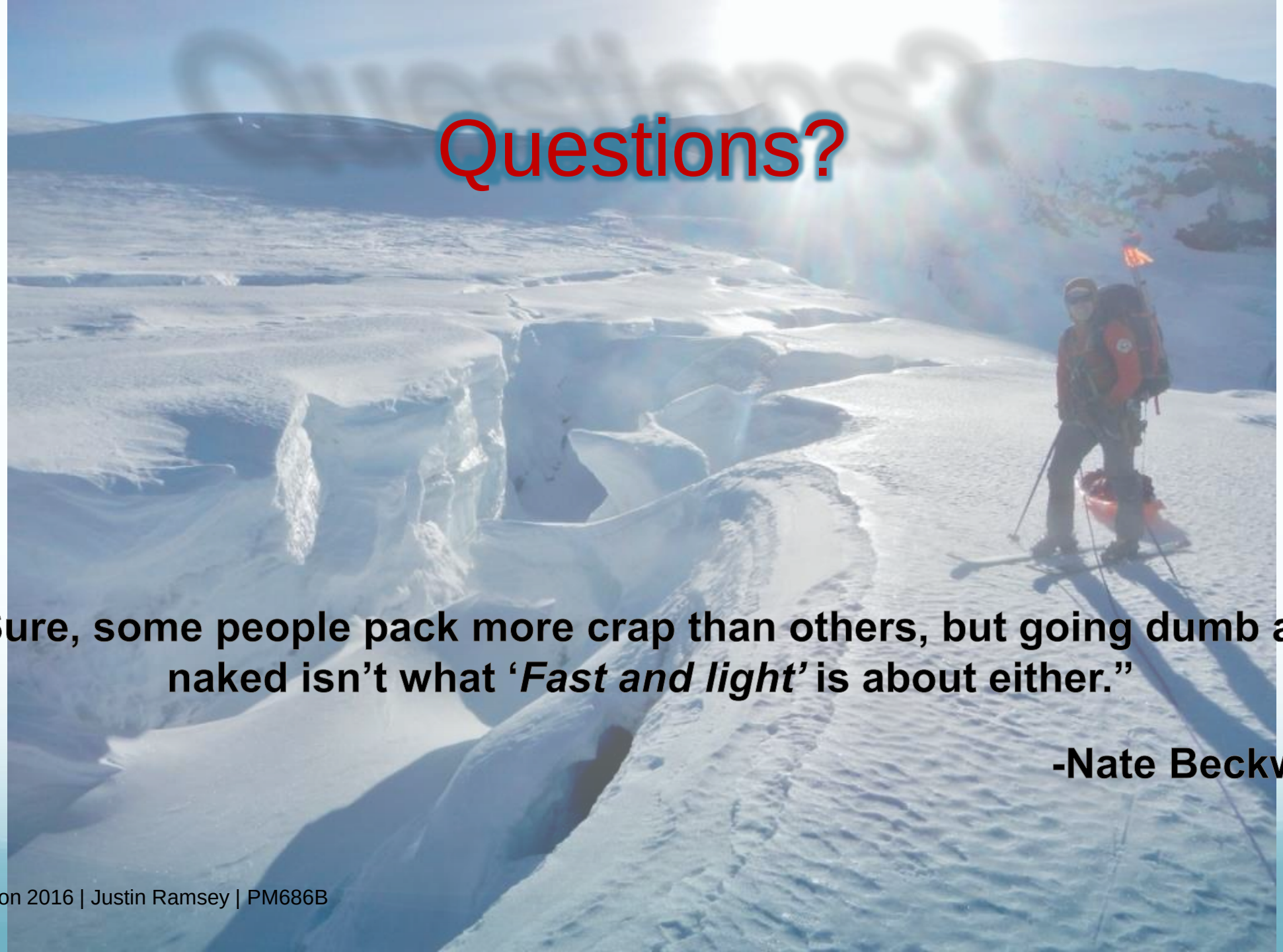
- Equipment –
  - Sled modifications – failure on Day 2
  - Tent floor – extra weight, little gain
- Lose menu “side dishes”
- Equipment sharing with certain safety gear
- Go or No-Go?

Takeaways

- Planning process. Side by side comparison of normal planning method with planning system
- Iterative research, testing and assessments. Establishes basis for estimates
- Communication. The glue that holds everything together
- Mother nature ALWAYS has her say

Future Research

- Further sub-system development
  - Endurance sports nutrition
- Refine and test planning system further
- Adapt planning system for objective-oriented activities
- Business model for consulting utilizing planning system



Questions?

“Sure, some people pack more crap than others, but going dumb and naked isn’t what ‘*Fast and light’* is about either.”

-Nate Beckwith

References


DENALI BREWING
VARIETY PACK
TALKEETNA, ALASKA
GEAR GUIDE
ACCIDENTS
Stakeholder Relationship Management
Project Management
GRAIN POWER
Dehydrator bible
RACING WEIGHT COOKBOOK
COOKING the One-Burner Way
COOKERY
ULTRALIGHT BACKPACKIN' TIPS
BACKCOUNTRY SKI
GLACIER MOUNTAINEERING
DENALI'S HOWL
Training for Climbing
MOUNTAINEERING

Schedule Summary

- Start
  - 8 September 2015
- End
  - 30 April 2016
- Hours
  - 1,243 resource hours
- Cost
  - $11,643

Resources

- Expedition members
- Food and food packaging
- Equipment (clothing, individual, group)
- Permit
- Medical (First Aid Kit, physical)
- Aviation Services
- Satellite Phone Service
- Plane Tickets
- Lodging

Aaron Ramsey
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September 10, 2015

Dear Ms. Piccard,

It is a pleasure to write in support of Justin Ramsey's final MSPM project to plan an expedition to climb Denali's West Buttress and compare the approach used to the Army Military Decision Making Process.

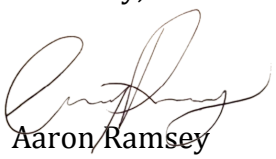
This topic is relevant to me as an expedition member, and is a high priority for my family and me. I am eager to see how a scientific approach to expedition planning will differ from approaches that I have seen. Justin's plan to illustrate how this method can be used to approach problems outside of typical project management roles is intriguing.

Justin's project addresses many challenges in expedition planning and pre-expedition support. This will be a useful approach for not only expeditions, but also any activity that will have little to no external support over a long period of time.

I am very appreciative for all you have accomplished with UAA's MSPM program, and I have great expectations for the contributions of Justin's project to your program body of knowledge.

Please feel free to contact me at anytime concerning this project.

Sincerely,



Aaron Ramsey
O.S., N.A.S.M., A.C.E.