TETRA TECH

RUNWAY 12-30 EXTENSION PRE-DESIGN REPORT

ALBERNI VALLEY REGIONAL AIRPORT (AVRA)

PRESENTED TO

ALBERNI CLAYOQUOT REGIONAL DISTRICT

SEPTEMBER 2014
ISSUED FOR USE
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ACRONYMS

ACRD	Alberni Clayoquot Regional District
AFM	Aircraft Flight Manual
ALR	Agricultural Land Reserve
ARCAL	Aircraft Radio Controlled Airfield Lighting System
AVRA	Alberni Valley Regional Airport
AVSA	Alberni Valley Soaring Association
AWOS	Automated Weather Observation Station
CARs	Canadian Aviation Regulations
CEAA	Canadian Environmental Assessment Act
CFS	Canada Flight Supplement
EA	Environmental Assessment
EBA	Tetra Tech EBA Inc.
ES	Environmental Screening
FEC	Field Electrical Centre
GPS	Global Positioning System
IAP	Instrument Approach Procedure
IFR	Instrument Flight Rules
ILS	Instrument Landing System
LWIS	Limited Weather Information System
NDB	Non-Directional Beacon
OLS	Obstacle Limitation Surfaces
PAPI	Precision Approach Path Indicator Lights
PLR	Pavement Load Rating
RESA	Runway End Safety Area
RILS	Runway Identification Lights
TC	Transport Canada
VFR	Visual Flight Rules
VOR	Very High Frequency Omni-directional Range

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1.0 INTRODUCTION

1.1 Background

The runway (12-30) at the Alberni Valley Regional Airport (AVRA) is currently published in the Canada Flight Supplement (CFS) as 3,952 ft. long and 75 ft. wide. No Instrument Approach Procedure (IAP) is currently authorized or published for this runway. An increased runway length would allow air operators to utilize larger, faster aircraft, including the Lockheed L-100 Hercules and the Bombardier Lear 45 jet.

The Alberni Clayoquot Regional District (ACRD) has discussed with some stakeholders the potential extension of Runway 12-30 from the current 3,952 ft. (1,204.6 m) to approximately 5,000 ft. (1,524.0 m). The proposed runway length of 5,000 ft. has been based, initially, on requirements for the operation of the aircraft noted above: the L-100 Hercules and the Lear 45 jet. These stakeholders have indicated that the length of the runway is their concern, and that the width of the present runway and taxiways are not an issue for them.

Tetra Tech EBA Inc. (EBA) was retained by the ACRD in June 2014 to prepare a pre-design report to assess the runway length requirement for the specified aircraft; examine the infrastructure and operational system requirements, as well as pertinent collateral issues, and develop runway extension options. These options would include whether it may be better to extend only one or the other end of the runway, or provide for appropriate extensions of both ends of the runway. Also, the report was to include estimates of probable cost for each option described.

1.2 Study Methodology

Development of the pre-design report involved a number of components:

- Aeronautical requirements: confirmation of required runway length for the design aircraft and reviewing standards and regulations.
- Planning objectives: defining the planning principles to guide development and subsequent evaluation of the extension options.
- Social and environmental considerations: potential environmental impacts, economic benefits, community support, etc.
- Land constraints: availability of land for runway extension; current property boundaries, land use in the airport vicinity, future runway end safety areas (RESA), terrain and natural growth, etc.
- Operations and maintenance requirements: operations during construction, post-construction responsibilities, airfield lighting considerations, provision of weather information, etc.
- Estimate of probable construction costs of each runway extension option provided.
- Provide basic illustrations showing each option.

In support of EBA for the preparation of the report, ACRD provided record drawings for the original airfield project (McGill and Associates 1993); a summary of material testing services report (HBT AGRA Limited 1993); and, recent obstacle limitation survey data (SNC 2014), for the areas around the current runway.

Please note that the use of both metric and imperial measurements is at times used interchangeably in this report. The aviation industry uses imperial when discussing runway lengths, visibility, etc., and to minimize conversion requirements we may refer to runway extensions and total runway lengths in imperial.

2.0 AERONAUTICAL REQUIREMENTS

2.1 Obstacle Limitation Surfaces (OLS)

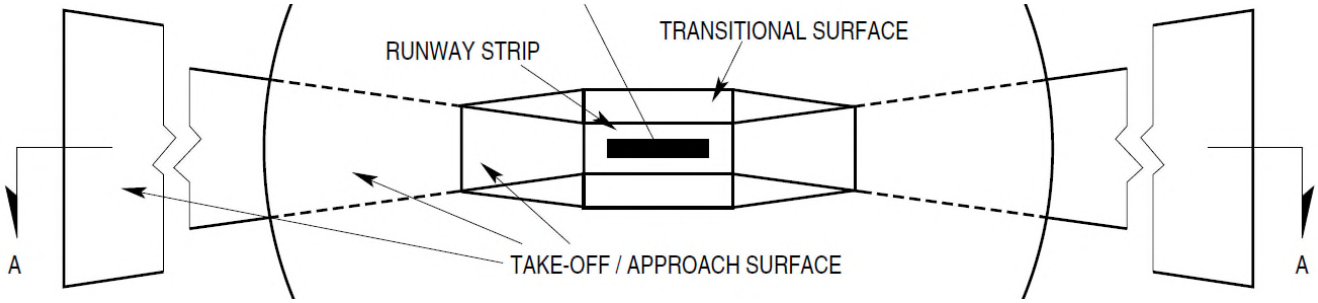
Obstacle Limitation Surfaces (OLS) are protective areas for take-off/approach slopes and transition slopes that surround the runways of regulated "certified" airports, as well as aerodromes with published Instrument Approach Procedures (IAP). This latter category is applicable to AVRA as the pursuit of an approved and published IAP is presently underway.

Dimensions of the OLS required to publish an IAP for a non-certified aerodrome are detailed in Transport Canada Aerodrome Circular (AC) 301-001: *Procedure to be followed in order to support Instrument Approach Procedures (IAP) at a Non-certified Aerodrome*. The dimensions of the OLS vary depending on the wing span of the aircraft intended to use the IAP, as well as the minimum limits authorized for the IAP (i.e. descent altitude and minimum visibility allowed). These criteria must be met in order to publish the IAP in official Canadian Aeronautical Information Publications, for use by aircraft operators.

Examples of an OLS for an IAP with non-instrument limits are illustrated in Table 2-1 below. Non-instrument IAP limits include decision heights more than 500' above the aerodrome elevation. The variation in the OLS descriptors (strip width, slope, length and divergence) also depend on the wingspan of the aircraft served (those anticipated to use the IAP).

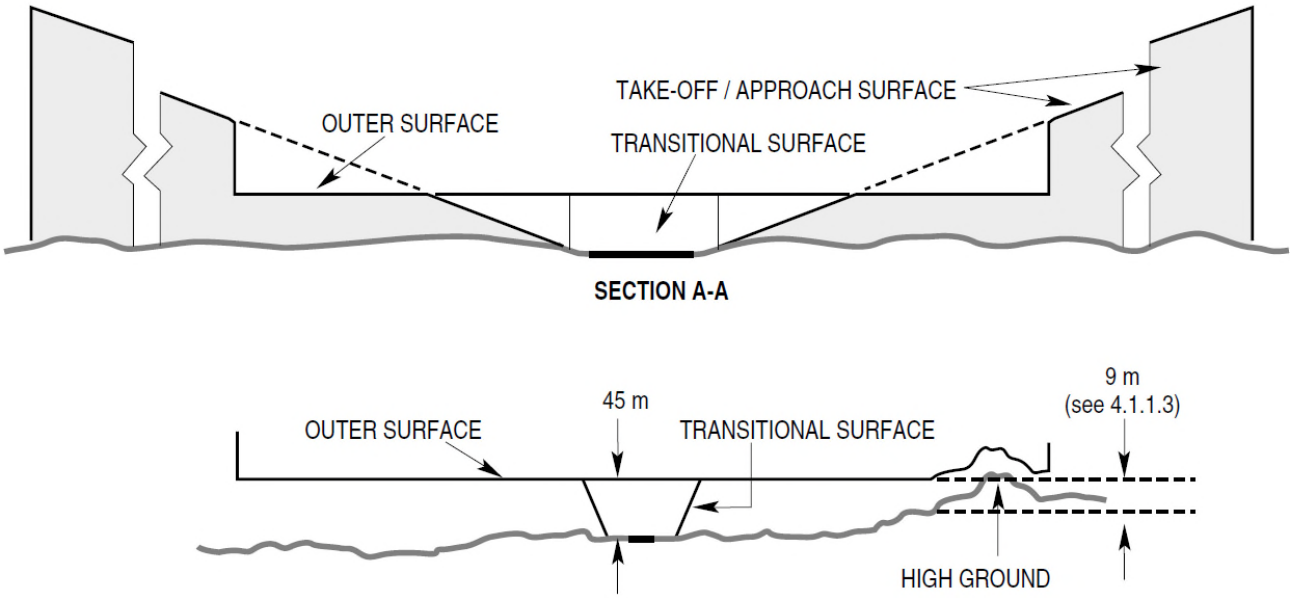
Table 2-1

Runway Strip	60 m beyond each threshold end, and from 30 to 150 m either side of the Runway centerline, along its entire length, extended to the end of the strip (i.e. 60 m beyond each threshold).
Take-off and Approach Surface	From 60 to 150 m wide, starting at the end of the strip and rising from the runway threshold elevation on a slope of 1:20 to 1:40 (4% to 2.5%) until reaching a distance of 2,500 m from the starting point and diverging at 10% from the start.
Transition Surface	Commencing along both runway strip edges, the surfaces rises at a slope of 1:7 (14.3%) until reaching 45 m above the aerodrome elevation.



OVERHEAD VIEW – Obstacle Limitation Surfaces around the Runway.

PROFILE VIEWS:



The prospective OLS for an IAP on the extended runway is illustrated in Figure 7, attached in Appendix A to this report. The inset profile drawings show the difference between the slope for the IAP presently being considered and the prospective OLS for an IAP on the extended runway.

2.2 Zoning Regulations

Some airports in Canada have zoning regulations enacted pursuant to Section 5.5 of the Aeronautics Act. These zoning regulations would apply to all land, including public road allowances, adjacent to or in the vicinity of the airport. AVRA does not have any zoning regulations enacted to protect the airport from development, or natural growth that may encroach or penetrate the OLS (i.e. approach surfaces, outer surface or transitional surfaces) of the runway, beyond the AVRA boundaries.

The ACRD, as owner and operator of the airport, is responsible for ensuring the OLS required for safe aircraft operations are maintained, in order that any future IAP can remain certified and published for use. An attestation, pursuant to AC301-001, noted in Section 2.1 above, would be required from the ACRD in this regard, when pursuing the IAP certification.

2.3 Design Aircraft

The design aircraft for the purpose of the pre-design report is the Lockheed L-100 Hercules (C-130 designation is the military version of the aircraft). According to Transport Canada publication TP312 4th Edition – Aerodrome Standards and Recommended Practices, this is a Code D aircraft, since it has a wingspan of 40.41 m. Some consideration has also been given to operational requirements for the Bombardier Learjet 45 for planning purposes, which has a shorter wingspan, but comparable runway length requirements for operation, due to its approach speed.

2.4 Runway Size Options Review

The runway length requirement for the Lockheed L-100 Hercules was determined using Lockheed aircraft take-off requirement charts for general airport planning purposes. These requirements were examined with reference to aircraft performance between sea level and 1,000 ft. above sea level at maximum take-off weight, zero runway gradient, zero wind and dry runway. These are ideal conditions and do not necessarily reflect day to day realities, including ambient air temperature, wind, etc.

The runway length determined to be optimal, based on the design aircraft, is between 4,500 and 5,200 ft. The airport design manual for this aircraft bases its length requirements on the distance needed to take off a fully loaded version between sea level and 1,000 ft. above sea level. Currently, the runway is 75 ft. wide, and could be widened for use by larger code aircraft like the L-100 Hercules. Various scenarios for lengthening and, potentially, widening Runway 12-30 at AVRA are discussed later in this report. Commercial operators determine length and width requirements for their aircraft and state them in the applicable Aircraft Flight Manual (AFM).

In summary, a 5,000 ft. runway would accommodate the design aircraft operations; while a wider runway (100 or 150 ft. wide) would surely provide a safer area for the landing and take-off operations of larger Code C or D aircraft (those with wingspans from 24-52 m (79 to 171 ft. and wider gear spans). This includes larger, faster, business jets, as well as larger turbo-prop aircraft such as the Dash 8, as well as the L-100 Hercules.

The ultimate runway length and width would depend on the actual aircraft intended to operate at AVRA, as well as the availability of capital funding to accomplish the airfield expansion. The ACRD should confirm individual aircraft operator requirements prior to finalizing plans to extend the runway. The runway length assessment in this report is provided as a guideline in order to assess various runway extension options and the implications of those options on the physical characteristics and operational requirements of the aerodrome.

2.5 Runway End Safety Area (RESA) Requirements

At the present time, Transport Canada publication TP312 Aerodrome Standards & Recommended Practices (4th Edition) recommends that airports provide a 90m Runway End Safety Area (RESA) at the end of the 60m runway strip. This recommendation is to provide a graded area capable of supporting an aircraft departing the runway surface in dry conditions with a total length of 150m beyond the runway end and the same width as the graded areas along the edges of the runway. RESA recommendations do not presently apply to registered aerodromes (like AVRA), or for IAPs published for non-certified aerodromes.

Based on discussions with Transport Canada regarding the upcoming publication of TP312, 5th Edition, EBA anticipates this recommendation may become a mandatory “Standard” requirement for certified airports. The proposed requirement is undergoing a risk assessment exercise at present, so any further regulation is not imminent.

2.5.1 Declared Distance Summary

The following table provides declared distances for the current runway length and anticipated declared distances for the options presented in this report. Displaced thresholds are not anticipated.

OPTION / RUNWAY LENGTH	DECLARED DISTANCES (FT)	
EXISTING RUNWAY – 3,952 ft. x 75 ft.	**RWY 12**	**RWY 30**
TORA – Take-off Run Available	3,952	3,952
TODA – Take-off Distance Available	4,452	4,452
ASDA – Accelerated Stop Distance Available	3,952	3,952
LDA – Landing Distance Available	3,952	3,952
OPTION 1 – 5,000 ft. x 75 ft. (1,063 ft. extend Runway 12 end)	**RWY 12**	**RWY 30**
TORA	5,000	5,000
TODA	5,000	5,000
ASDA	5,000	5,000
LDA	5,000	5,000
OPTION 2 – 5,000 ft. x 75 ft. (1,063 ft. extend Runway 30 end)	**RWY 12**	**RWY 30**
TORA	5,000	5,000
TODA	5,000	5,000
ASDA	5,000	5,000
LDA	5,000	5,000
OPTION 3 – 5,000 ft. x 75 ft. (531.5 ft. extend each end of Runway 12 & 30)	**RWY 12**	**RWY 30**
TORA	5,000	5,000
TODA	5,000	5,000
ASDA	5,000	5,000
LDA	5,000	5,000
OPTION 4 – 5,000 ft. x 100 ft. (widened)	**RWY 12**	**RWY 30**
TORA	5,000	5,000
TODA	5,000	5,000
ASDA	5,000	5,000
LDA	5,000	5,000
OPTION 5 - 5,000 ft. x 150 ft. (widened)	**RWY 12**	**RWY 30**
TORA	5,000	5,000
TODA	5,000	5,000
ASDA	5,000	5,000
LDA	5,000	5,000

3.0 AERODROME ACTIVITY - AVIATION

AVRA accommodates a unique mix of aviation (aircraft) operations on a year round basis. Fixed wing and rotary wing aircraft movements are supplemented by non-powered fixed wing (glider) activity. At present, the frequency of movements of these various types of aircraft is low enough that they co-exist without difficulty.

3.1 Rotary Wing Aircraft

A significant number of aircraft movements at AVRA include rotary wing (helicopters) operating to and from the field. A maintenance base for helicopters is located at AVRA, which accounts for some of those movements. Itinerant helicopter activity is common at AVRA, some contracted for forestry purposes, as well as a number of other activities.

Increasing the length or width of the runway at AVRA in the future would not likely affect rotary wing aircraft activity either negatively or positively.

3.2 Non-powered Fixed Wing Aircraft

Gliders based at AVRA include those belonging to the Alberni Valley Island Soaring Association (AVSA), the Vancouver Island Soaring Centre (VISC) and private owners. Glider activity is generally a fair weather activity, and the activity at AVRA is no exception. In addition to the recreational gliding activity that takes place at AVRA, the VISC does glider pilot training as well. Gliding activity generally can be accommodated within the current airfield dimensions, i.e. the current runway length/width is more than adequate for the present glider operations.

There are issues related to the prospective airfield expansion that may be of concern to the soaring community. One is the prospect of permanent runway lighting being installed on the AVRA airfield. It is important to them that lighting (edge, end and threshold) units are removable or at least installed as low to the surface as possible. A prospective airfield lighting system will be described later in the report, but typical installation includes units that are designed to be frangible as they are installed within the runway strip.

Another issue relates to the width of the strip, in terms of having an alternative landing area adjacent to the runway itself. This presently exists on the north side of the runway. Widening the runway surface would include ensuring an appropriate strip width, consistent with the intended instrument approach procedure as well. This may be an on-going issue, depending on the runway width chosen for the future.

3.3 Fixed Wing Aircraft

Current fixed wing aircraft activity at AVRA is a combination of locally based, privately owned, small aircraft and itinerant aircraft passing through, usually to re-fuel at the aerodrome's self-serve facility.

Fixed wing aircraft movements do not currently constitute a large percentage of the aviation activity at AVRA. However, if the airfield dimensions are increased, the aerodrome will be able to accommodate larger aircraft, and this may increase the movements over time.

As noted earlier, stakeholder discussions have introduced the possibility of the aerodrome being used for Lockheed L-100 Hercules and Lear 45 business jets. It is possible that other aircraft operators may also take advantage of the increased airfield capacity and use the aerodrome as well. Some aircraft operate to and from AVRA in order to re-fuel; a longer runway may attract larger aircraft for that same purpose.

Larger aircraft as a consideration for instrument approach procedures introduces the possibility of a larger strip around the runway. This may be an issue for tree removal to the north of the runway and vertical development limitations to the south of the runway.

Scheduled air service was mentioned at the stakeholder consultation as a future possible use of AVRA. There is no indication, at present, that scheduled air carriers are considering services at AVRA. This may be due to the current services available at airports in proximity. Presently, scheduled air services necessitate certification of an airport: a very expensive transition from operating and maintaining a registered aerodrome. Standards and

regulations for certified airports include mandatory planning, training and operations provisions that would add materially to the annual costs to keep AVRA open. These costs would be comparable to the costs the ACRD pays to operate Long Beach Airport annually.

4.0 AERODROME ACTIVITY - NON-AVIATION

Some of the activity at AVRA is not necessarily tied to aviation particularly. There are seasonal activities located at AVRA for reasons of convenience, or because the size and location of the aerodrome lends itself to those particular functions.

4.1 Drag Racing

Annually, the Alberni Valley Drag Race – "Thunder in the Valley" event is conducted at AVRA. This four day event closes the aerodrome for the duration, as the drag races take place on the runway itself and the infield of the aerodrome serves as the locale for staging vehicles, etc.

Changes to the configuration of the airfield may well impact the annual race event, especially if all or part of the runway extension was completed on the threshold of Runway 30 (SE runway end). As this is the starting point for the drag races, it could necessitate changes to the way the competition is conducted. If the runway is widened, there will be implications for the concrete raceways constructed to help return vehicles from the runway during an event. Also, if air traffic increases, over time, due to the larger capacity airfield, closing the aerodrome for two days or longer each year may be have to be re-visited.

4.2 Forestry Crew Base

The BC Forest Service has their Mid Island Zone Fire Base located at AVRA, which includes a fire fighting crew. Although some helicopter activity is associated with this base, it does not serve as a water bomber base, with fixed wing aircraft based or operating from the aerodrome.

It is not clear from discussions to date that an extended runway would result in fixed wing water bomber activity based at AVRA, so it is assumed that such an impact is not likely in the near future.

5.0 LAND USE IN THE VICINITY OF THE AERODROME

5.1 Gravel Resources

An active gravel pit operation is located immediately north of the threshold of Runway 12 at AVRA, at a distance of about 200' from the runway edge. The pit operation is secured under a Licence of Occupation (L149008) with the Province. In addition to the extension gravel extraction, screening and storage at the site, regular truck traffic hauls the gravel away from the pit.

The crown of the haul road crosses the approach to Runway 12 approximately 1,087' (331.2m) NW of the threshold and is 14' (4.3 m) higher than the threshold. The OLS at this point is 32.8' (10 m) above the threshold elevation. This provides 18.7' (5.7 m) of clearance between the crown of the roadway and the OLS where it crosses the road directly along the extended runway centreline. The minimum acceptable, according to current Aerodrome Standards, is 14.1' (4.3 m).

The haul road also falls under portions of the Transitional Surface of the OLS for the runway.

Present operations appear to fit within (under) the OLS that the ACRD would want to protect in order to design and certify an IAP at AVRA. In the event the runway is extended, the location and extent of the extension will

determine the impacts of the gravel pit operations and transportation routes on future airport operations. This will be determined more definitively during the detailed design stage.

5.2 Forest Resources

Forest resource interests in the vicinity of AVRA feel the potential impacts of airfield expansion on them may be significant. A wide variety of forestry resource interests exist around AVRA: occupation licenses, road permits, forest tenure (woodlot licenses), license of use agreements, etc. Apparently, some of these tenures/licences contain compensation clauses, while others do not.

Much of this forest resource activity has been going on for many years, and includes both revenue producing activity, as well as educational programs. In both regards, the forest resource industry sees their activity as providing many benefits to the community.

They have reiterated their support for airport activities, including consulting with the ACRD for AVRA operations and development. Also, they have clearly asked that any expansion at AVRA be properly assessed and that adverse impacts on business, as well as business benefits, be considered before final decisions are taken.

It was noted that the process to consider a runway extension for AVRA is moving forward quickly, without the benefit of any strategic plan, short or longer term, being in place for the Aerodrome. Also, there is considerable interest in being consulted again before the final decisions are taken by the ACRD. Interest was expressed in discussing land use, including what uses are complementary to aviation operations, as well as AVRA development impacts on current land uses surrounding AVRA.

One of the important issues to be discussed, relative to land use in the vicinity of the AVRA, is what the best use of the land the affects or is affected by the aerodrome in the future.

5.3 Agriculture

5.3.1 Agricultural Land Reserve

A portion of the AVRA is located within the Agricultural Land Reserve (ALR), and is therefore governed by the applicable legislation and oversight. Projects planned for portions of the airport lands that fall within the ALR may require permission of the Agricultural Land Commission before they are undertaken.

As plans are formulated for any potential runway extension project at AVRA, enquiries will be made regarding the need for a formal application, as required.

5.3.2 Christmas Tree Farms

Three Christmas Tree Licences are presently in force in the vicinity of AVRA. All are located directly off the end of the runways, outside the property boundary. These licenses are term certain, with provisions for renewal. The operators of these businesses are interested in any consideration of changes to the facilities at AVRA that may impact them, whether in a positive or negative way.

Although the cultivation of these trees is compatible with maintaining or even protecting an OLS at an airport, because it controls the height of growth in critical areas near the runway, extension of the runway will need to consider any potential impacts. If the OLS profile changes, an examination of how that happens over the tree farm areas will be noted later in this report.

Another concern of those with tree farm licences was any potential impact on the planted trees that may come from propwash, jet blast or emissions from the engines of aircraft that may operate from an extended runway. Anecdotally, there is no reason to expect any adverse impacts on the tree farms from larger aircraft taking off or landing from the aerodrome after a runway extension is completed.

Concerns for tree farm operators include the economic losses that may result from restrictions to use of the tenured land, or impacts on the planted trees from increased aircraft activity.

Overall, Christmas tree farm operations are quite compatible with airport operations. Where the current licenced areas lay within an expanded airfield will be detailed in drawings attached to this report.

5.3.3 Haying Operations

The opportunity for local farming (haying) operations, within the airfield areas surrounding the runway, has been pursued in recent years. Levelling and over seeding areas near the runway is beginning to produce enough growth to potentially warrant haying operations in the coming seasons. The focus has been on the north side of the runway, to this point, but it does help to ensure the runway strip integrity there is maintained.

5.4 Birds & Wildlife

There does appear to be some issues with beavers in the vicinity of AVRA that have led to flooding on the property. Management of this problem is currently part of the routine for airport operations staff. No other bird or wildlife issue of significance was noted at AVRA, either naturally or as a result of land uses in the vicinity: landfills; wildlife refuges; bird sanctuaries; farms, sewage lagoons, etc.

5.5 Noise

Given that AVRA is situated away from built-up residential or commercial development, noise from the aerodrome operations does not appear to be an issue. It was not a concern raised at the stakeholder consultation. If runway expansion occurs, and larger aircraft operations or more frequent aircraft operations result, the noise will certainly increase at AVRA.

5.6 Water Courses

The runway extension options provided in this report would likely not impact current water flow provisions at AVRA. Water is moved to the east, south of the runway, and also under the current runway. It then flows, whether above or below ground, generally north to northeast from the airfield.

Proper handling of water courses, to meet any applicable regulations, would be clearly described in the detailed design phase for this project, if a runway extension option is chosen by the ACRD Board.

6.0 AIR NAVIGATION

6.1 Instrument Approach Procedure (IAP)

The ACRD is interested in pursuing an Instrument Approach Procedure (IAP) for the aerodrome, and has taken some initial steps in that regard. Publishing an approved public or restricted IAP requires a number of steps be completed, and comes with on-going responsibilities. IAPs may need to be revised when new facilities are installed or changes to existing facilities are completed: such as a runway extension. Other things that need to be monitored are new obstacles or changes to standards or criteria that may affect flight safety.

Development of any IAP requires the aerodrome operator mark and/or light obstructions (buildings, structures and objects, including objects of natural growth) in accordance with Canadian Aviation Regulation (CAR) 621.19. There is also a need for an approved altimeter setting source; communications capability with an Air Traffic Services facility; and, a flight check of the procedure must be done. All approved instrument approach procedures shall be periodically checked to verify the governing obstacle for each segment.

Operators of non-certified aerodromes are provided with specific instructions with regard to getting an IAP approved. These are found in Transport Canada's Advisory Circular AC 301-001 - Procedure to be followed in order to support Instrument Approach Procedures (IAP) at a non-certified aerodrome.

This advisory circular outlines the responsibilities of the aerodrome operator including ensuring an assessment of the "Aerodrome Physical Characteristics" is conducted for each runway for which an IAP is published. The assessment is based on the minimum requirements for the critical aircraft specified in the advisory circular. It is expected that a qualified person will conduct the assessment.

An aerodrome attestation form is required to support public IAPs at non-certified aerodromes; and this attestation is also required to obtain landing limits lower than 500 ft. for restricted IAPs. This information and the attestation provides the IAP designer with the documentation to confirm compliance with the requirements set out in paragraph 120(a) of Transport Canada publication TP 308 Criteria for the Development of Instrument Approach Procedures.

In addition, the aerodrome operator has an ongoing responsibility to advise NavCanada of any change or modification to the information submitted in the Attestation.

6.2 Aids to Navigation

Aids to navigation, or NavAids, generally come in two forms: Electronic aids; and visual aids.

Electronic navaids include those installations that emit radio signals to assist pilots in guiding their aircraft while enroute or in the process of landing and taking off. These equipment installations include instrument landing systems (ILS), which combine a localizer signal and glide path signal to guide aircraft operators on approaches to land; non-directional beacons (NDBs), VHF omni-directional range (VOR); and, the Global Positioning System (GPS).

Visual aids to navigation include airfield surface edge lighting; approach lighting, rotating beacons, pavement markings, lighted or retro-reflective signage, retro-reflective markers, etc.

Another important aid to those navigating aircraft into and out of an aerodrome is local aviation weather information and forecasts, which is discussed in Section 6.3 below.

6.2.1 Electronic NavAids

Presently, there are no ground based electronic NavAids associated with AVRA. With the prevalence of GPS navigation, including GPS based IAP, consideration of ground based navigational aids is not recommended.

Pursuit of IAPs for the aerodrome is likely to include some form of GPS based procedure, which will require consideration of obstacles in the vicinity: trees, terrain and constructed development. Obstacle limitation and control was discussed in Section 2.1 of this report.

6.2.2 Visual NavAids

Currently, the permanent visual aids to navigation at AVRA consist of airfield pavement markings and retro-reflective signs. The signs are located on the apron and two taxiways at present.

A string of portable airfield lighting units surround the runway, sitting on top of the ground – including the cabling. It is unclear whether these lights are being used; however, the Canada Flight Supplement (official aeronautical publication for aviation facilities) does not list airfield lighting as one of the facilities at AVRA.

The runway extension options presented in this report include the provision of new pavement markings, airfield lighting (aerodrome beacon, edge, runway threshold/end, approach and system controls), as well as lighted airside signage and system controls. Details of the lighting package are described in Section 8.0 of this report.

6.3 Aviation Weather Information

Weather data related to cloud height (ceiling) and horizontal visibility at the aerodrome, as well as prevailing wind characteristics (direction/speed), average ambient air and dew point temperatures, as well as the altimeter setting, are valuable for safe aircraft operations. This information is apparently being provided through NavCanada's Automated Weather Observation Station (AWOS) equipment at AVRA to NavCanada operations exclusively, at present. It is not published hourly, along with other airports/aerodromes weather across Canada.

There are two internet connected cameras at AVRA showing current conditions, to the east and the west, 24 hours per day. These camera views can be accessed through the NavCanada website.

An LWIS (Limited Weather Information System) installation, owned by the ACRD, is in place at the aerodrome, located near the NavCanada equipment. It is presently not in service, and will need some investment to bring it back on line.

Only one, reliable and accessible weather information system is really needed for the aerodrome. Ideally, this system would have the capability to broadcast conditions over a radio frequency, ensuring the information is available to all aviation users. This might require the ACRD to work with NavCanada on a solution, as opposed to financing the repair of the current ACRD owned equipment.

A critical piece of data is the altimeter setting at the aerodrome. This will ensure that pilots of arriving aircraft have an accurate reading of their altitude during their approach and prior to departure. Pilots operating aircraft under Instrument Flight Rules (IFR) will need to have an altimeter setting, as well as current wind condition, in order to make use of any future IAP to AVRA.

An appropriately equipped AWOS can have the capacity to provide, automatically and continuously, the current airport weather conditions: wind speed, wind direction, temperature, dew point, altimeter, horizontal visibility, precipitation, and cloud base height, as needed.

7.0 AIRPORT OPERATIONS & MAINTENANCE

Currently, the aerodrome is owned by the ACRD and maintenance is completed, in the general use areas and buildings, by a caretaker, under the general supervision of the ACRD and the Airport Superintendent. The Airport Superintendent routinely works out of the Tofino/Long Beach Airport. In addition to oversight functions, the Airport Superintendent manages project work at AVRA, such as the recent line marking project and the aerodrome obstacle survey completed in the summer of 2014.

7.1 Operations & Maintenance

It is assumed that all runway, taxiway, and apron maintenance (including seasonal work), building maintenance, and electrical maintenance will be provided by ACRD personnel and equipment, or through a qualified contractor. Details of how these activities will be safely discharged, to ensure the operational integrity of the aerodrome, can be included in an AVRA Airport Operations Manual. This manual would be developed after the detailed design stage and prior to the commencement of expanded aerodrome operations, once the configuration and extent of airside facilities is determined.

7.2 Aerodrome Inspection

The runway, taxiway, and apron should be inspected before aircraft operations commence, on those days when such operations are planned. This inspection would normally include surface condition, i.e., surface contaminants like garbage, rocks, standing water, ice, and the presence of birds or wildlife or any other unauthorized access to airside. This information could be reported to aircraft operators using the aerodrome, prior to take-off or landing.

7.3 Airside Maintenance

Airside areas include those used for the movement and maneuvering of aircraft, as well as the approved movement of vehicles and pedestrians. A variety of airfield operations and maintenance tasks may need to be undertaken (or considered) on a routine and/or periodic basis:

- Airfield surface marking (painting);
- Surface maintenance: sweeping, crack sealing and shouldering for example;
- Apron safety inspection/monitoring: aircraft parking area maintenance;
- Clean up of discharged deleterious materials, such as fuel, de-icing fluids, etc.;
- Ensure adequate lighting in critical areas;
- Workplace Hazardous Materials Information System;
- Foreign Object Damage Control (Inspection/clean-up);
- Dealing with unauthorized incursions by vehicles or persons;
- Approved airside vehicle operations, including training (airport staff and others);
- Bird and wildlife management; and
- Accident/incident investigations (airside).

Rubber removal will be an ongoing issue as long as the drag racing event continues at AVRA. In addition, the number of large aircraft, and turbine powered aircraft, movements at the aerodrome may determine the need to examine other areas of the runway for monitoring rubber accumulation and, potentially, removal.

Persons on airside for maintenance duties, or other approved purposes, will communicate with aircraft operators using AVRA through the Air Traffic Frequency (123.0 MHz) by radio, when on the airside. Radio communications equipment with the capacity to operate on the assigned frequencies will be required. Vehicles operated on the

airside of the aerodrome should be equipped with reliable two-way mobile radios with the appropriate frequencies installed.

All vehicles and persons must be off the runway (i.e. 200' on the perpendicular from the runway edge) and taxiway when these surfaces are being used by fixed wing powered aircraft.

Only airport maintenance vehicles should normally operate on the taxiways and runway. Other vehicles, as approved by AVRA management, are restricted to the apron area, except for the recovery of disabled aircraft on the runway or taxiway, and then only with the express permission of ARVA management.

7.4 Electrical Systems Operation and Maintenance (O&M)

If an airfield lighting system is installed, it will allow aircraft operators to use AVRA 24 hours per day, depending on weather conditions and future IAP limits.

Lighted (electrical) visual aids installed at the aerodrome would need to be checked each day that aircraft operate, to ensure the lights are operational. In addition, periodic system inspections and preventative maintenance routines must be completed to ensure the integrity of the system. Some specific tasks include the calibration/levelling of Precision Approach Path Indicator (PAPI) lights and periodic inspections. PAPI, for instance, are considered unserviceable if only one of the many lamps in the structures is not working. Annual inspections of edge lighting, lighting control systems, regulators and power systems would need to be completed as well.

Section 8.0, below, provides more detailed information on airfield lighting system recommendations.

8.0 AERODROME LIGHTING

If the ACRD wishes to provide an aerodrome capable of handling aircraft day and night, and if there is interest in pursuing an IAP, as described in Section 2.1 above, airfield lighting is recommended. The specifications for the airfield lighting described in this report, and the estimates of probable cost are attached, as described in Transport Canada publication TP312E 4th Edition - Standards and Recommended Practices. The package described includes a number of key elements:

- Medium intensity runway edge lights
- Precision Approach Path Indicator lights (PAPI)
- Taxiway and Apron edge lights
- Aerodrome Rotating (or Strobe) Beacon and Lighted Windcones
- Light airside signs (mandatory instruction, guidance, location and information)
- Field Electrical Centre (FEC) - to house regulators and switchgear
- Aircraft Controlled Aerodrome Lighting System (ARCAL) – located in the FEC

8.1 Airfield Edge Lights

Runway edge lights are placed along the full length of the runway in two parallel rows equidistant from the centre line. The runway lighting system proposed meets Transport Canada standards (TP312 4th Edition).

Edge lights are also installed along the edges of the taxiway and around the apron perimeter.

The 5,000 foot runway designed would require 12 runway end/threshold light fixtures, 49 runway edge light fixtures, 41 taxiway edge light fixtures and 12 apron edge light fixtures. All lights planned are LED fixtures, which require low voltage, consume less power than conventional lights and have a much longer useful life.

8.2 Precision Approach Path Indicator (PAPI) Lights

PAPI lights are located on one side of each runway end, normally the left (or pilot's) side. PAPI provide a visual indication of the aircraft angle of descent position on the approach to a runway. They consist of four light boxes containing lamps covered by split clear/red lenses. This is a conventional aid at airports being regularly served by large aircraft, and is required equipment at certified airports. They are especially useful in mountainous terrain, in helping the pilot to maintain a good visual approach to the runway.

8.3 Aerodrome Beacon

An aerodrome beacon should be provided for use at night, or during periods of reduced visibility. The beacon should be located on top of a tower to ensure 360º of unobstructed visibility. The capacitor discharge unit (strobe) is commonly used now, since it eliminates the need for moving parts and power consumption is lower than conventional rotating beacons.

8.4 Wind Direction Indicators

Adjacent to and near the each end of the runway, a wind direction indicator (windcone) should be installed. TP 312 4th Edition recommends this configuration for runways 3,937' (1200 m) or longer. The windcones should be mounted on hinged towers to enable maintenance access to the cone and light. The lights for the windcones can be connected to the aerodrome lighting regulator system, with one additional constant brightness transformer installed, to ensure the windcone is visible in conditions where the edge lights are set to lower than full intensity.

8.5 Field Electrical Centre

The Field Electrical Centre (FEC) proposed is intended to facilitate the connection of commercial power to the aerodrome lighting system and its associated equipment. The FEC should be wired for electrical and able to accommodate the equipment proposed, as well as all recommended spares for the facility.

The airfield lighting regulators and the Aircraft Controlled Aerodrome Lighting System (ARCAL) equipment would be installed in the FEC.

Although supplementary power might be considered, to cover times when commercial power is not available, it is not specified for lighting systems that support IAPs with non-instrument landing limits. Therefore, it has not been included in the estimate of probable costs attached to this report.

9.0 RUNWAY EXTENSION ANALYSIS

9.1 General

Essentially three options for the Runway 12-30 extension have been examined, although the third option comes with three width variations. Depending on funding and the need to limit obstacle penetrations, the ACRD will decide to pursue the construction of only one of the Runway extensions options for length, and consider widening the runway at some point as well.

For clarification purposes, the options to lengthen Runway 12-30 include an extension at the 12 (NW) end, or an extension to the 30 (SE) end, or an extension at each end; totalling the proposed 5000' (1.524 m) runway length as per Section 2.4.

The rationale for the proposed runway extension lengths is primarily based on the interest by local business to accommodate larger, and faster, aircraft in the near future. The design aircraft for the purposes of this pre-design report is the Lockheed L-100 Hercules, as noted in Section 2.3. Consideration has also been given to the desire to operate Lear 45 business jet aircraft at AVRA, which would also benefit from greater runway length.

A summary of the options to attain an operating runway length of 5,000' (1,524 m) are noted in the following table.

Current Runway Length 3,952' (1,204.6 m)	Proposed Runway 12 Extension	Proposed Runway 30 Extension	Proposed Runway Width
Option 1	1,063' (324 m)	-	75' (22.9 m)
Option 2	-	1,063' (324 m)	75' (22.9 m)
Option 3	531.5' (162 m)	531.5' (162 m)	75' (22.9 m)
Option 4	531.5' (162 m)	531.5' (162 m)	100' (30 m)
Option 5	531.5' (162 m)	531.5' (162 m)	150' (45 m)

9.2 Airfield Stormwater Drainage

The aerodrome is located in a low flat area surrounded by slightly higher ground. It does not appear at first to be situated in a location that would foster the movement of stormwater away from the runway surroundings.

Although there are natural water courses in the vicinity of the airfield, it is apparent that much of the storm water that runs off the runway seeps into the surrounding ground. What does not percolate into the ground flows into two storage ponds northeast of the airfield. These ponds, in turn, drain into the Stamp River.

The cost estimates prepared for this pre-design report do not include provision for subsurface drainage measures (i.e. runway edge subdrain system) however, it does include provision for surface grading and drainage ditches to encourage surface flow adjacent the runway extensions. This is predicated on stormwater running off the runway and seeping into the ground around the airfield.

9.3 Options to Extend Runway 12-30

Three options have been prepared for the extension of the Runway 12-30 to achieve an operating length of 5,000' (1,524). These include extending either end the full 1,063' (324 m), or extending each end by approximately half the total additional length, 531.5' (162 m).

For all options the runway pavement structure and shoulders will match the existing (23 m wide runway with 3.5 m wide gravel shoulders). The existing runway threshold(s) will be relocated to the new runway end(s). The existing threshold, runway designation numbers, and other pavement markings will be eradicated, as needed, and re-applied to relate to the new threshold location(s).

The runway extensions include a 200' (60 m) long and 150 m wide obstruction free Runway Strip at the extremities of both extended runway ends. This will be constituted of the undisturbed ground at each end of the runway extension construction, providing it is reasonably level and obstruction free. Some cut and fill grading exercises can be expected based on the conceptual topographic information available.

As noted in Section 2.5, RESAs are not presently standard requirements for airports in Canada. Transport Canada is presently conducting a risk assessment exercise to help them make a decision on the implementation

of a standard for RESAs. There may be more clarity on this issue by the time final design has commenced on this initiative; but, because there are no standards in place now, no provision has been made in the cost estimates included in this pre-design report for RESAs at AVRA.

9.3.1 Pavement Design

Final design of the pavement structure for the runway extension will need to include confirmation of the subgrade strength. Soil test pit investigations in the area where the extension work will be done, as well as non-invasive (Heavy Weight Deflectometer) testing along the existing runway, will provide data that can be used to determine the pavement structure needed to accommodate the design aircraft.

For the purposes of this pre-design report, the pavement design for the existing runway has been used to calculate estimated costs for the runway extension options.

The pavement structures for aircraft travelled areas will be designed to a Pavement Load Rating (PLR) of at least 10.0, which allows unlimited use by the design aircraft. The proposed runway, taxiway and shoulder structures will match the existing and generally be constructed as noted in the following table.

	Runway	**Shoulders**
Hot Mix Asphalt Concrete	90 mm	
		90 mm granular top
Granular Base Course	230 mm	230 mm
Granular Sub-base Course	600 mm	600 mm
Total Structure	**920 mm**	**920 mm**

At this time, OLS surveys have been completed for the current runway configuration, to accommodate smaller aircraft (Code A/B) to anticipated IAP limits. Survey to verify any conflicts with the extended runway options that relocate the thresholds, and for the use of larger aircraft (Code C/D) have not been done. OLS have been illustrated in Figure 7, attached to this report in Appendix A.

The conceptual drawing Figures 1 to 5, for the runway extension and widening options, are attached to this report in Appendix A; the Class D estimate of probable costs are located in Appendix B.

9.3.2 Option 1 – 1,063’ (324 m) Extension of Runway 12

The extension of Runway 12 by 1,063’ (324 m) results in a total runway length of 5,000’ (1,524 m). This option provides all construction activity at the NW end of the airfield, and does not impact the drag racing installations on the threshold of Runway 30. Unfortunately, it also brings the threshold of Runway 12 to within 155’ (50 m) of the gravel pit haul road. This would prevent the establishment of a 200’ (60 m) strip off the end of the runway (an obstruction free area), without relocation of the road.

Figure 1, attached in Appendix A to this report, shows the limit of the runway strip for this option, and the OLS that would commence from that point.

Pavement markings for Runway 12 would have to be changed to accommodate the location of new threshold, designation and aiming point markings, as well as the addition of touchdown zone markings.

Cost forecast details are included in Appendix B.

9.3.3 Option 2 – 1,063' (324 M) Extension of Runway 30

The extension of Runway 30 by 1,063' (324 m) results in a total runway length of 5,000' (1,524 m). This option provides all construction activity at the SE end of the airfield. It would require removal of the drag racing installations on the threshold, and takes the runway edge right to the boundary separating AVRA from the Christmas tree permitted land (C00935). Establishing a 200' (60 m) strip off the end of the runway (an obstruction free area) would require access and modification to the permitted property.

Figure 2, attached in Appendix A to this report, shows the limit of the runway strip for this option, and the OLS that would commence from that point, on the permitted land. The OLS then slopes gradually up across a permitted road and another Christmas tree permitted property (C00404).

Pavement markings for Runway 30 would have to be changed to accommodate the location of new threshold, designation and aiming point markings, as well as the addition of touchdown zone markings.

Cost forecast details are included in Appendix B.

9.3.4 Option 3 – 531.5' (162 m) Extension of both ends of Runway 12-30

This option includes extending each end of the runway by an equal amount (531.5' or 162 m) to accomplish the 5,000' (324 m) extension. Extending each end mitigates some of the issues noted in the first two options, i.e. proximity to the gravel pit haul road, or imposing the runway strip on land permitted for other purposes. The drag racing installation on Runway 30 threshold would still be impacted.

Providing for the necessary OLS beyond the ends of the runway strips will still be a challenge, but not as great as if the entire extension was done at one end or the other. Construction mobilization would have to include setting up in two different locations, potentially, for each phase of the project. This issue could be mitigated somewhat if a central mobilization spot on the aerodrome was determined instead. Figure 3, attached in Appendix A to this report, illustrates this option.

Surveys conducted during the detailed design phase of this potential project would confirm the take-off and approach issues related to OLS, as well as the impacts of a longer transitional area (i.e. 5,000' instead of the present 3,937').

Pavement markings for Runway 12-30 would have to be changed to accommodate the location of new threshold, designation and aiming point markings, as well as the addition of touchdown zone markings.

Cost forecast details are included in Appendix B.

9.3.5 Option 4 – Extending and Widening Runway 12-30 100' (30m)

This additional option includes the extension of runway length, as noted in Option 3, augmented by a widening of the runway, along its full length, to 100' (30 m). This option is considered pertinent because of the size of design aircraft that has been specified. The distance between the outer reaches of the propellers on the L-100 Hercules (it is a four engine aircraft) exceeds 70'. On a 75' wide runway this does not leave a great deal of space to the outer edges of the runway pavement during landing and take-off. Also, the design aircraft requires 77 ft. to turn around, with a maximum steering angle of 60º.

Cost forecast details are included in Appendix B.

9.3.6 Option 5 – Extending and Widening Runway 12-30 by 150’ (45m)

This additional option includes the extension of runway length, as noted in Option 3, augmented by a widening of the runway, along its full length, to 150’ (45 m). This option is considered pertinent because of the size of design aircraft that has been specified. The distance between the outer reaches of the propellers on the L-100 Hercules (it is a four engine aircraft) exceeds 70’. On a 75’ wide runway this does not leave a great deal of space to the outer edges of the runway pavement during landing and take-off.

The design aircraft is considered a Code D aircraft, as noted in TP 312 4th Edition Section 1, Table 1-2, because its wingspan is 40.41 m. Also, TP 312 recommends in Section 3.1.1.9 that runways serving Code D aircraft should be 150’ (45 m) wide if they are between 3,937’ (1200) and 5,905’ (1799 m) long.

Cost forecast details are included in Appendix B.

9.4 Airfield Lighting and Electrical System

An airfield lighting system has been specified to meet the needs of an IAP, depending on what is developed for the AVRA. This prospective airfield lighting scheme is consistent with the elements specified in Section 8.0 above. It includes medium intensity runway end/threshold and edge lights, simple approach lighting systems, lighted wind cones, lighted signs, an aerodrome beacon and a Field Electrical Centre (FEC) to house the airfield regulators.

A drawing of this prospective airfield lighting system has been included in Appendix A as Figure 6. Estimate of the probable cost of this system has been included in Appendix B.

9.5 NavCanada

Although it does not seem there is any likely conflict with NavCanada services or facilities related to this prospective airfield improvement at AVRA, a formal land use application submission to them will need to be completed in advance of the project.

NavCanada must assess and approve all proposals for land use near airports and air navigation infrastructure before construction begins. These proposals must be submitted to NavCanada using their Land Use Submission Form.

Processing times vary, but NavCanada attempts to respond within 8 to 12 weeks of receiving a complete proposal. The accuracy and completeness of the initial documentation, as well the prompt remedying of deficiencies or inaccuracies, will help to expedite the review process.

Any omissions of required data and supporting documentation, such as maps or site location/coordinate discrepancies, will cause delays in processing the application.

Consideration of this process would be necessary during the detailed design phase, and in any case, prior to the commencement of construction.

10.0 ENVIRONMENTAL CONSIDERATIONS

The federal environmental assessment process is applied whenever a federal authority has a specified decision-making responsibility in relation to a project, also known as a "trigger" for an environmental assessment.

Specifically, it is when a federal authority:

- Proposes a project;
- Provides financial assistance to a proponent to enable a project to be carried out;
- Sells, leases, or otherwise transfers control or administration of federal land to enable a project to be carried out; and/or
- Provides a license, permit or an approval that is listed in the Law List Regulations that enables a project to be carried out.

If the federal government is included in the project, the Canadian Environmental Assessment Act (CEAA) will apply. The proposed runway extension (1,063 ft. [324 m]) itself will not trigger a Comprehensive Study. The Comprehensive Study List identifies runway extensions of 1,500 m or more as a trigger.

The airport may be required to prepare an Environmental Screening (ES). On federal projects, the Responsible Authority (RA) is normally a government agency (e.g., Transport Canada) with interest in the project. The RA determines how the environmental assessment will be conducted and which other departments will be included in the Environmental Assessment (EA) process.

The RA normally identifies the:

- Scope of the proposed project;
- Scope of the factors that must be considered in the environmental assessment; and
- Timelines.

The project ES must then consider the following factors:

- The environmental effects of the project, including the environmental effects of malfunctions or accidents that may occur in connection with the project and any cumulative environmental effects that are likely to result from the project;
- The significance of the environmental effects;
- How ACRD will manage public comments. ACRD will have to determine an appropriate public forum for announcing the runway extension project (e.g., an open house);
- Measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project; and
- Any matter relevant to the screening such as the need for the project and alternatives to the project.

Although no environmental concerns that would trigger the ES process have been identified in relation to the runway extension project, should federal funds form part of the funding arrangement for future works at AVRA, an ES could be required.

11.0 CONSTRUCTION CONSIDERATIONS

Construction activities at an active aerodrome are normally planned to minimize disruptions to aircraft operations. The objective is to reduce the impact of the planned construction program, as much as possible, on aircraft operations. Timing the work based on seasonal activity, weather and other pertinent factors will be important.

11.1 Runway Availability

Construction planning will have to consider a number of factors related to regular runway use at AVRA. Among them are the activities of the soaring association and school, as well as other routine or regular fixed wing aircraft activity. Also, the annual race event will need to be factored into the prospective construction schedule.

Although the construction season is longer in the Alberni Valley than many places in Canada, it would be wise to avoid the typically wettest and coldest period of the year.

Runway extension activity at either end of the AVRA field does not necessarily require the runway to closed completely (i.e. NOTAM'd as closed for the duration of construction). The threshold may be temporarily displaced, at either end, as appropriate, to accommodate construction and continued aircraft movement. Another alternative is to schedule construction for a particular period of each day or night, and only NOTAM the runway closed for those specified periods each day.

11.1.1 Low Ceilings and Reduced Visibilities

Construction activities during periods of low cloud or reduced visibility should not adversely impact aircraft operations, since at this point, the aerodrome is really only active during periods of Visual Flight Rules (VFR) conditions throughout the year.

11.2 Geotechnical Investigation

Geotechnical information available for this pre-design report included a report completed in 1993 that details the quality assurance work done during the construction of the current runway at AVRA. There is no information presently available that confirms the subgrade strength under or around the runway. At this point only an estimated PLR could be determined, based on the designed structure for the layers of pavement installed in 1993, and assumptions about the subgrade composition.

Prior to the completion of detailed design for the selected runway extension option, a formal geotechnical examination and analysis of the subgrade on which the runway is (and the extension will be) built will need to be completed. This will ensure the pavement design will be sufficient to support the anticipated types and frequencies of design aircraft at AVRA in the future. This work is estimated to cost $4,500.00

11.3 Topographic Survey

In attempting to establish the existing topography on-site, multiple sources were reviewed including the McGill and Associates Engineering Ltd. drawings (1993), Google Earth Pro topography, topographic contours provided by the ACRD and limited ground elevations taken during the OLS survey completed by SNC Lavalin (2014). In comparing these sources, variability of the topography was encountered to the magnitude of +/-10 metres between sources. Using the topography of these multiple sources with this much variability would yield an unreliable representation of the existing topography in comparison to runway design grades and elevations. This variability is not uncommon when comparing multiple survey sources especially when an unknown or scarce number of ground elevations are recorded.

In preparation of a detailed design, it is recommended that a comprehensive topographic survey of the existing topography on the runway strips and approaches be completed in order to accurately establish runway profiles and estimate the amount of cut and fill required to provide safe and functional runway extensions. For the purposes of this assignment, conservative estimates based on the information available have been used to estimate cut, fill and grading requirements for the various runway extension options.

11.4 Project Phasing

It is feasible to construct a runway extension project of this magnitude in one construction season, assuming the contractor has full access to the work site from early spring until late fall. All activities would be predicated on adequate funding being in place prior to commencement.

A number of phases need to be completed as part of this prospective project:

- Update and complete a topographic survey of the runway and surrounding areas.
- Remove obstacles, such as trees, where necessary and possible.
    - Consultation and permission from landowners and licensees
    - Development of a management plan for the maintenance of natural growth on AVRA lands
- Submit a Land Use Proposal to NavCanada for their review of the proposed works.
- Complete a full Geotechnical study and report to establish subgrade conditions.
- Conduct an Environmental Screening, as required. See Section 11.0 below.
- Complete Runway Extension Detailed Design.
- Project Tendering, Assessment & Award.
- Project Management and Quality Assurance during construction.
    - Construct structural and graded area fills between the new and existing runway thresholds and bring grades to subgrade level.
    - Install all future underground airfield electrical facilities including pull pits, ducts, concrete sign bases, wind direction indicator bases and approach lighting bases.
    - Install all drainage facilities related to the runway area drainage, as applicable.
    - Complete remaining sub-base and base gravels.
    - Complete remaining runway drainage works.
    - Complete all electrical, lighting and signage installations for the runway extension.
    - Asphalt paving and shouldering of the runway extension.
    - Pavement markings and remaining signage
- ACRD to amend the AVRA service to increase the spending limit to accommodate the full extent of any borrowing or annual maintenance and operating costs

- Commissioning of the runway extension and taxiway
- Development of an Airport Operations Manual, including training as required

12.0 CLASS 'D' ESTIMATES OF PROBABLE COSTS

Class 'D' estimates of probable costs for the various options, summarized below, are detailed in Appendix B.

All cost forecasts are in 2014 dollars. They are based on information provided by contractors and recent historical prices, and include contingencies for Standby Time, Insurance, Engineering and General Contingencies. Taxes are not included.

Option 1 – Extend Runway 12 End	$2,831,300
Option 2 – Extend Runway 30 End	$2,962,850
Option 3 – Extend both Runway ends	$3,011,100
Option 4 – Extend and Widen Runway to 100'	$4,305,200
Option 5 – Extend and Widen Runway to 150'	$7,528,150
Medium Intensity Airfield Lighting System	$1,867,890

13.0 SUMMARY

The Alberni Clayoquot Regional District (ACRD) contracted Tetra Tech EBA Inc. (EBA) to prepare this pre-design report to examine runway extension options and implications for the Alberni Valley Regional Airport (AVRA). Using the Lockheed L-100 Hercules as the design aircraft, EBA was to examine operational and navigational aid considerations, as well as stakeholder input, and then develop runway extension options for Runway 12-30 at AVRA. Estimates of probable costs were to be developed for each option.

The review determined that a runway length of 5,000 ft. would provide the suitable length to accommodate the design aircraft, although 5,200' was preferred by the stakeholder interested in operating the aircraft at AVRA. Unfortunately, terrain and obstacle limitation issues that arise in this examination of a runway extension are considerable, and would be exacerbated by an additional 200'. The runway length, and extension scenario, recommended in this report is based on a combination of physical property boundary constraints and operational requirements, including rising terrain and obstacles (namely trees) in the vicinity of AVRA.

A number of extension options were developed in the study to try to achieve the objective of ensuring the runway length and width would safely accommodate the design aircraft. Stakeholder input indicated that the current width would be acceptable to them, should the design aircraft be operated at AVRA. However, the standard means of determining runway sizing requirements, examined in Section 2.4, above, indicates that a wider runway would provide a safer solution for larger aircraft, such as the design aircraft proposed.

It should also be noted that the estimate of probable costs provided in this report do not include consideration of increasing the size of connecting taxiways or associated aprons. Information on the scope and probable cost of a medium intensity airfield lighting system to accompany a future instrument approach procedure, has been provided for information as well.

Stakeholder input, as noted earlier, includes some that suggests the current runway width of 75' is sufficient for the purposes of today's aircraft activity, as well as future activity with the design aircraft noted above. As noted in Section 2.4 above, there are some safety reasons to consider widening the runway, although that admittedly comes with a higher cost than merely an extension. However, Transport Canada (TP 312) recommends that aircraft with wingspans greater than 24 m (L-100 Hercules have a 40.41 m wingspan) should be provided with runways that are at least 30 m (100') wide.

Obstacle limitation considerations are a major issue in the current consideration of obtaining an instrument approach procedure (IAP) at AVRA; a registered aerodrome. There are areas around the aerodrome that will need attention to limit obstacles, especially natural growth. Lengthening the runway and pursuing an IAP will exacerbate this situation. The key reason for this is that a non-instrument limit IAP for the current runway requires take-off/approach slopes of 4% with 10% divergence, while the same type of approach for a 5,000' runway has take-off/approach slopes that start further to the east and west, and may require slopes that are 2.5% with a 10% divergence. This means more terrain and more natural growth comes into play: the longer the runway the greater the impact in this regard. A comparative illustration is included in Appendix A – Figure 7, attached.

It was the objective to provide this report as a basis for discussion on the options for a potential extension of the runway at AVRA to accommodate larger, faster aircraft: namely the design aircraft described in Section 2.3 above. Based on that, it would seem that a 5,000' extension is possible, but there may be considerable obstacle reduction necessary in the vicinity of the aerodrome. Option 3, extending each end of the runway, would offer the least severe scenario for dealing with tree and terrain issues. The estimated probable costs are considerable, so funding will need to be sourced. Further, consideration of widening for safety reasons is recommended, although it impacts on both estimated cost and, potentially other activities at AVRA: glider activities; drag race event infrastructure, etc.

14.0 CLOSURE

We appreciate the assistance and supporting documentation provided by the Alberni Clayoquot Regional District staff in the completion of this pre-design report. We trust that this information meets your present requirements. If you have any questions or require anything further, please contact the undersigned.

Respectfully submitted,
Tetra Tech EBA Inc.

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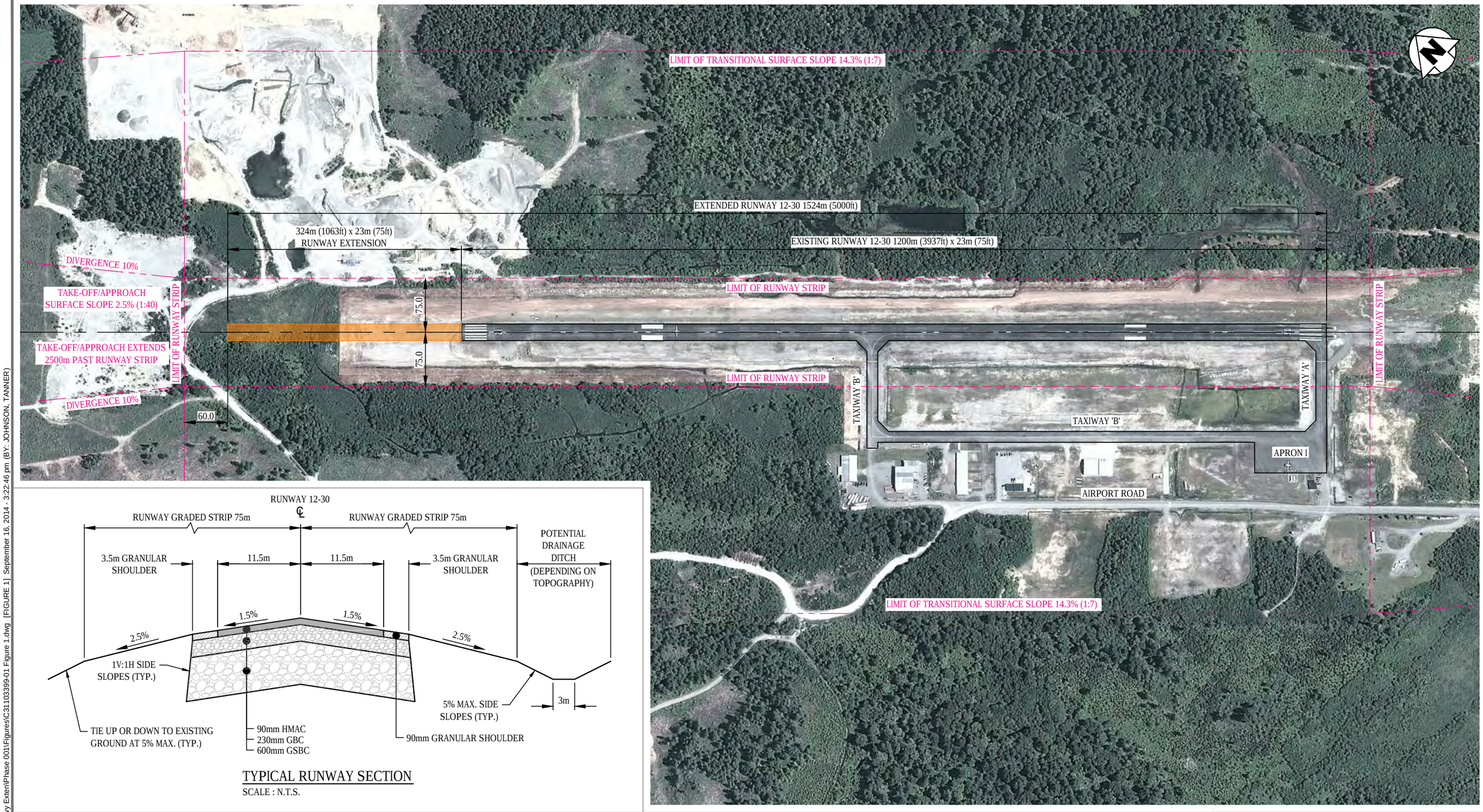
APPENDIX A
FIGURES



TYPICAL RUNWAY SECTION

SCALE : N.T.S.

LEGEND:

- RUNWAY EXTENSION/WIDENING FOOTPRINT
- GRANULAR BASE COURSE (GBC)
- GRANULAR SUB BASE COURSE (GSBC)

0 50 100 150 200 250

Scale 1:5000 (metres)

CLIENT

Alberni-Clayoquot Regional District

RUNWAY EXTENSION PRE-DESIGN REPORT
ALBERNI VALLEY REGIONAL AIRPORT

OPTION 1: RUNWAY 12 EXTENSION
324m (1063ft)

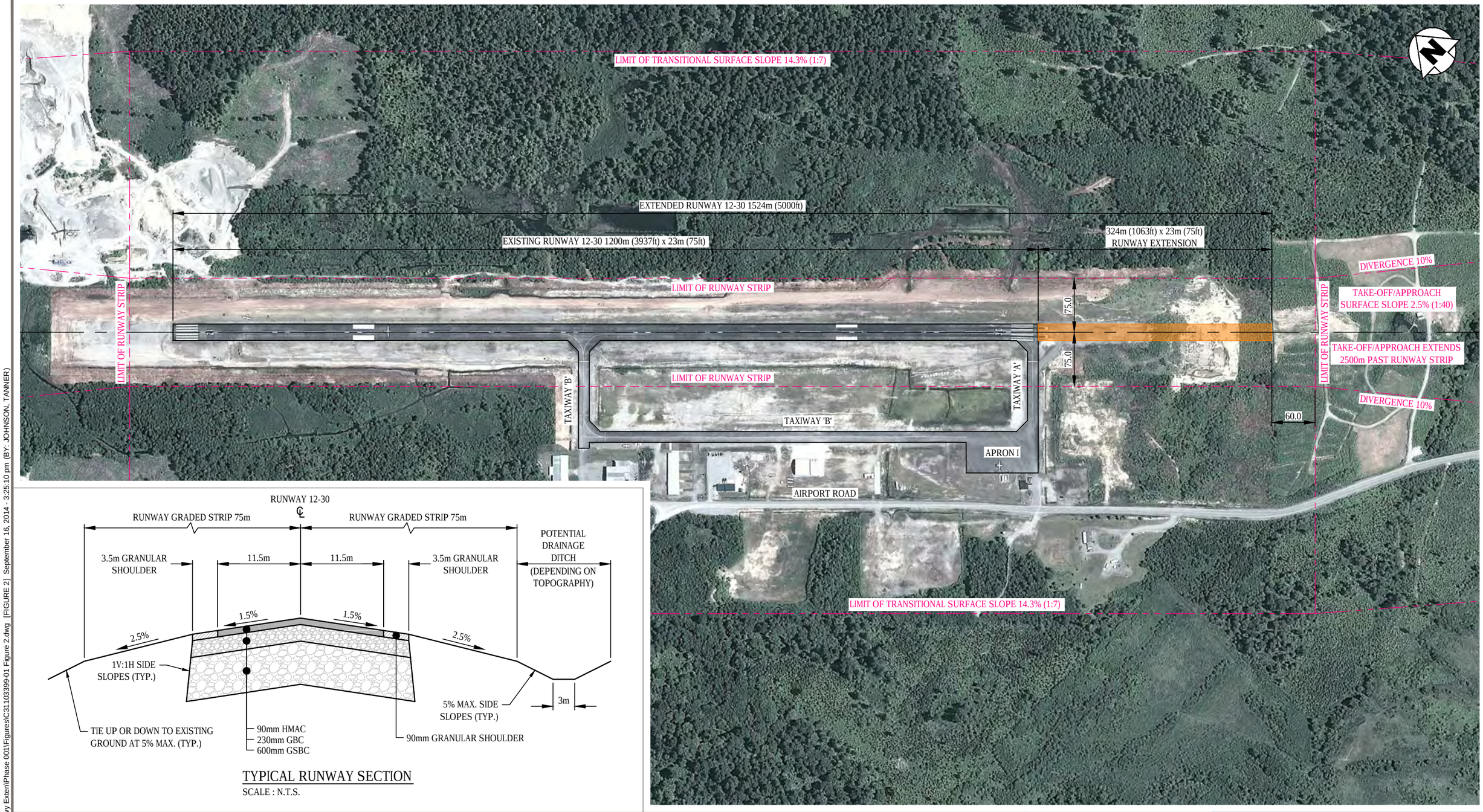
TETRA TECH EBA

PROJECT NO.	DWN	CKD	REV
C31103399-01	T.J.	R.B./S.S.	1

OFFICE: Calgary

DATE: September 17, 2014

Figure 1



TYPICAL RUNWAY SECTION

SCALE : N.T.S.

LEGEND:

- RUNWAY EXTENSION/WIDENING FOOTPRINT
- GRANULAR BASE COURSE (GBC)
- GRANULAR SUB BASE COURSE (GSBC)

0 50 100 150 200 250

Scale 1:5000 (metres)

CLIENT

Alberni-Clayoquot Regional District

RUNWAY EXTENSION PRE-DESIGN REPORT ALBERNI VALLEY REGIONAL AIRPORT

OPTION 2: RUNWAY 30 EXTENSION 324m (1063ft)

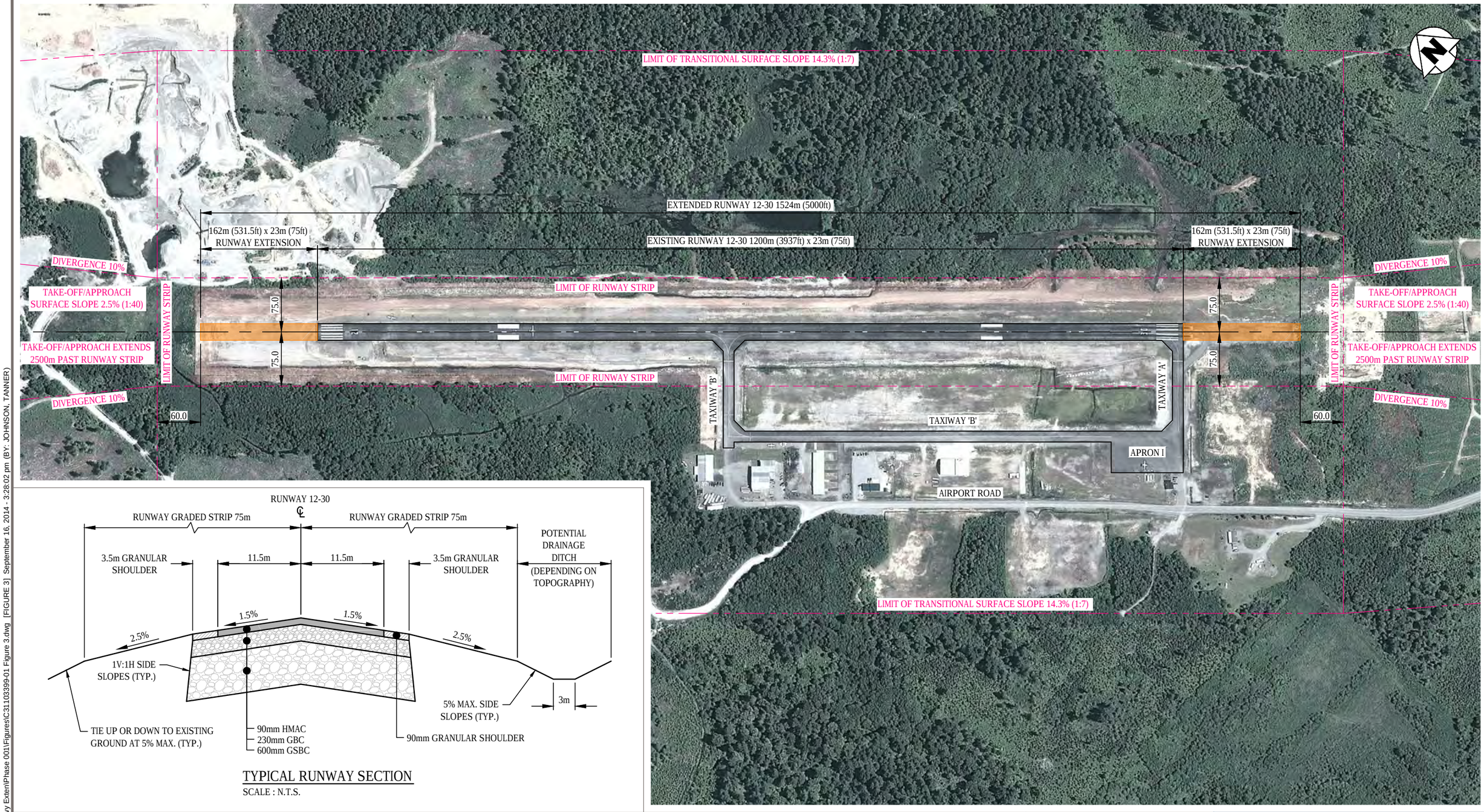
TETRA TECH EBA

PROJECT NO.	DWN	CKD	REV
C31103399-01	T.J.	R.B./S.S.	1

OFFICE: Calgary

DATE: September 17, 2014

Figure 2



TYPICAL RUNWAY SECTION

SCALE : N.T.S.

LEGEND:

- RUNWAY EXTENSION/WIDENING FOOTPRINT
- GRANULAR BASE COURSE (GBC)
- GRANULAR SUB BASE COURSE (GSBC)

0 50 100 150 200 250

Scale 1:5000 (metres)

CLIENT

Alberni-Clayoquot Regional District

RUNWAY EXTENSION PRE-DESIGN REPORT ALBERNI VALLEY REGIONAL AIRPORT

OPTION 3: RUNWAY 12 & 30 EXTENSIONS 2x162m (531.5ft)

TETRA TECH EBA

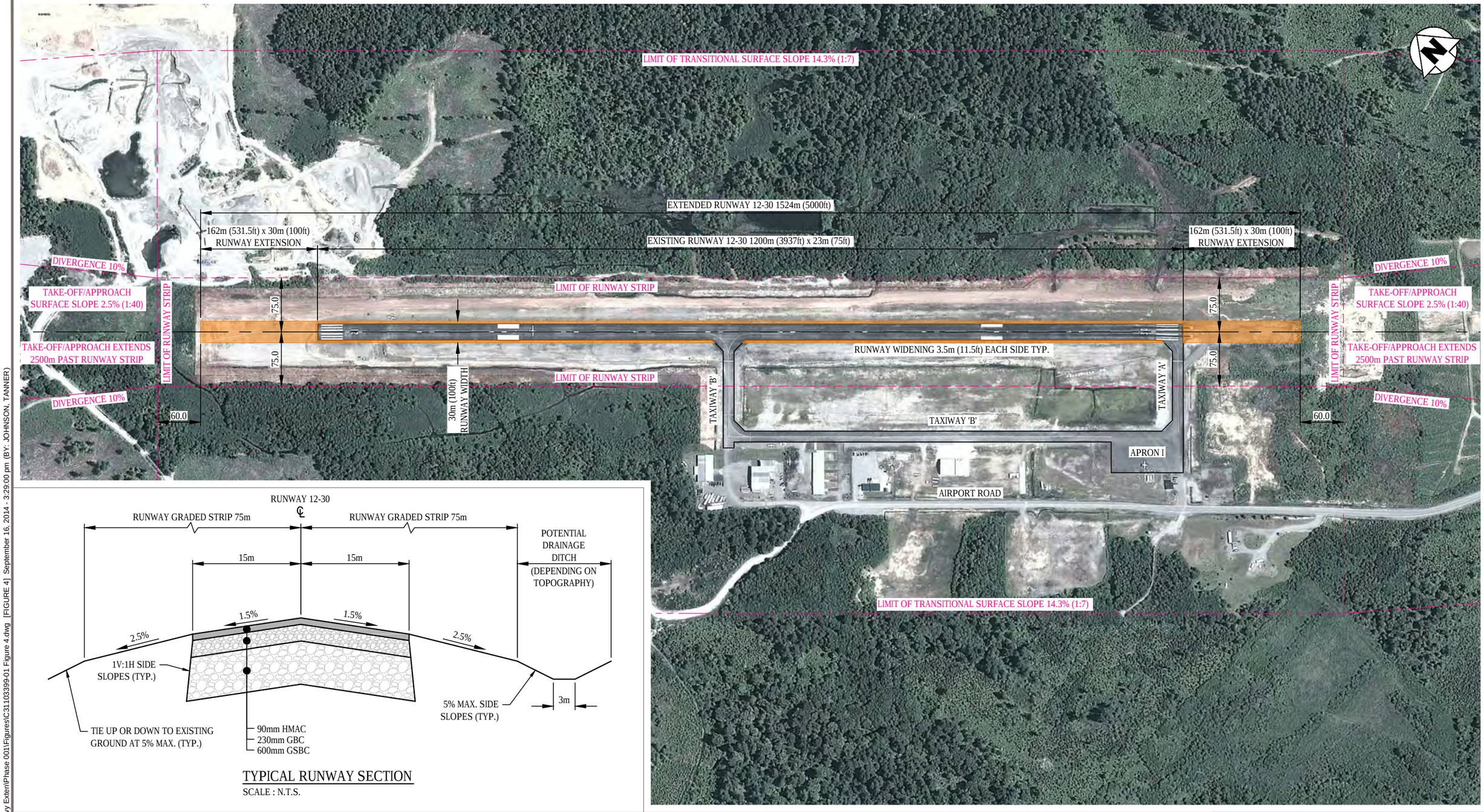
PROJECT NO.	DWN	CKD	REV
C31103399-01	T.J.	R.B./S.S.	1

OFFICE: Calgary

DATE: September 17, 2014

Figure 3

G:\C311\C31103399-01 Alberni Valley Rwy Exten\Phase 001\Figures\C31103399-01 Figure 3.dwg, [FIGURE 3], September 16, 2014 - 3:28:02 pm (BY: JOHNSON, TANNER)



TYPICAL RUNWAY SECTION

SCALE : N.T.S.

LEGEND:

- RUNWAY EXTENSION/WIDENING FOOTPRINT
- GRANULAR BASE COURSE (GBC)
- GRANULAR SUB BASE COURSE (GSBC)

0 50 100 150 200 250

Scale 1:5000 (metres)

CLIENT

Alberni-Clayoquot Regional District

RUNWAY EXTENSION PRE-DESIGN REPORT
ALBERNI VALLEY REGIONAL AIRPORT

OPTION 4: RUNWAY 12 & 30 EXTENSIONS 2x162m (531.5ft) C/W WIDENING TO 30m (100ft)

TETRA TECH EBA

PROJECT NO.	DWN	CKD	REV
C31103399-01	T.J.	R.B./S.S.	1

OFFICE: Calgary

DATE: September 17, 2014

Figure 4

G:\C311\C31103399-01 Alberni Valley Rwy Exten\Phase 001\Figures\C31103399-01 Figure 4.dwg, [FIGURE 4], September 16, 2014 - 3:29:00 pm (BY: JOHNSON, TANNER)

LIMIT OF TRANSITIONAL SURFACE SLOPE 14.3% (1:7)

EXTENDED RUNWAY 12-30 1524m (5000ft)

162m (531.5ft) x 45m (150ft) RUNWAY EXTENSION

EXISTING RUNWAY 12-30 1200m (3937ft) x 23m (75ft)

162m (531.5ft) x 45m (150ft) RUNWAY EXTENSION

DIVERGENCE 10%

TAKE-OFF/APPROACH SURFACE SLOPE 2.5% (1:40)

TAKE-OFF/APPROACH EXTENDS 2500m PAST RUNWAY STRIP

LIMIT OF RUNWAY STRIP

75.0

45m (150ft) RUNWAY WIDTH

RUNWAY WIDENING 11m (36ft) EACH SIDE TYP.

TAXIWAY 'A'

TAXIWAY 'B'

APRON I

AIRPORT ROAD

60.0

RUNWAY 12-30

RUNWAY GRADED STRIP 75m

22.5m

POTENTIAL DRAINAGE DITCH (DEPENDING ON TOPOGRAPHY)

1.5%

2.5%

1V:1H SIDE SLOPES (TYP.)

5% MAX. SIDE SLOPES (TYP.)

3m

TIE UP OR DOWN TO EXISTING GROUND AT 5% MAX. (TYP.)

90mm HMAC
230mm GBC
600mm GSBC

TYPICAL RUNWAY SECTION

SCALE : N.T.S.

LEGEND:

- RUNWAY EXTENSION/WIDENING FOOTPRINT
- GRANULAR BASE COURSE (GBC)
- GRANULAR SUB BASE COURSE (GSBC)

0 50 100 150 200 250

Scale 1:5000 (metres)

CLIENT: Alberni-Clayoquot Regional District

RUNWAY EXTENSION PRE-DESIGN REPORT ALBERNI VALLEY REGIONAL AIRPORT

OPTION 5: RUNWAY 12 & 30 EXTENSIONS 2x162m (531.5ft) C/W WIDENING TO 45m (150ft)

TETRA TECH EBA

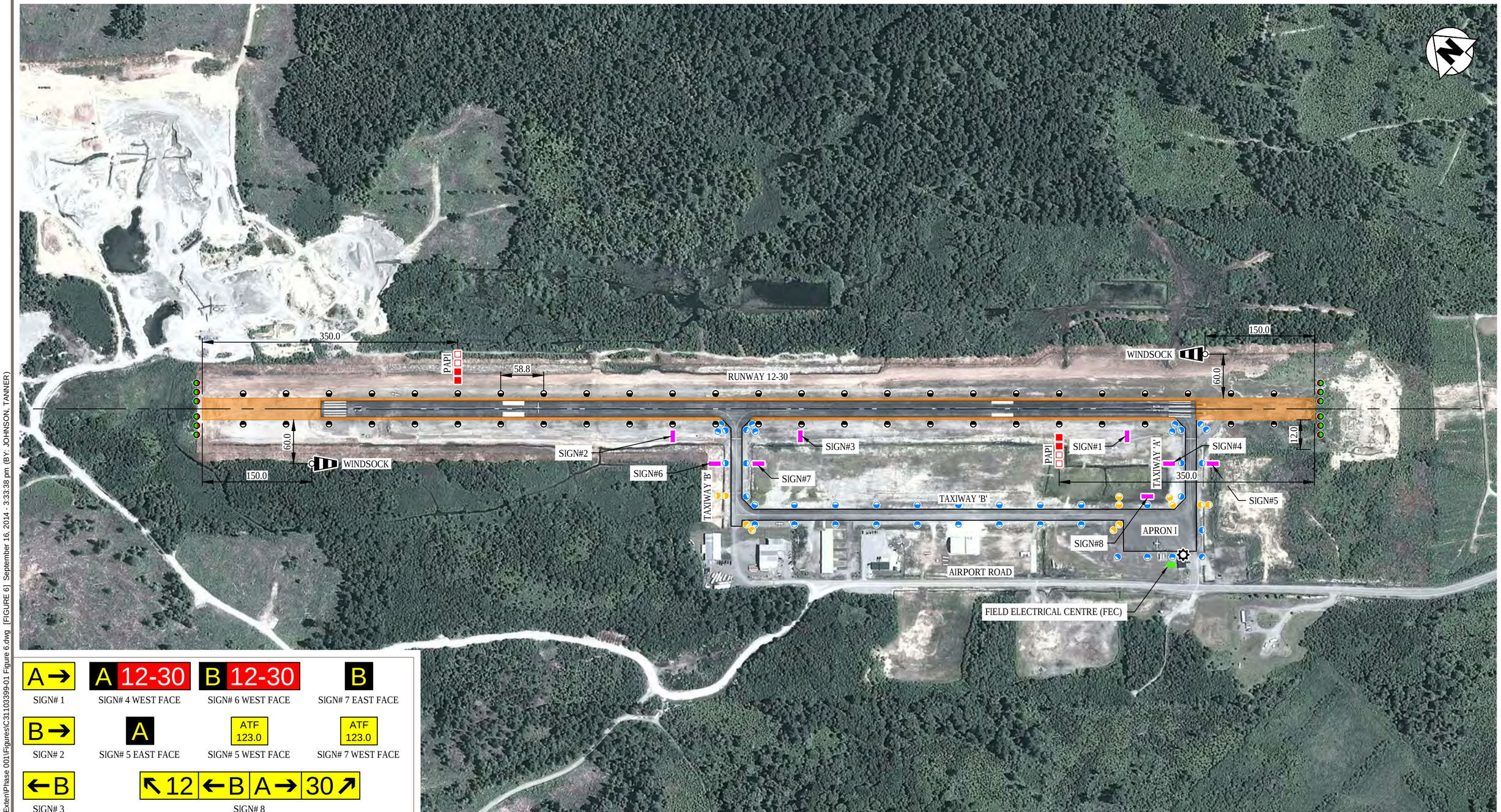
PROJECT NO.	DWN	CKD	REV
C31103399-01	T.J.	R.B./S.S.	1

OFFICE: Calgary

DATE: September 17, 2014

Figure 5

G:\C311\C31103399-01 Alberni Valley Rwy Exten\Phase 001\Figures\C31103399-01 Figure 5.dwg [FIGURE 5] September 16, 2014 - 3:30:00 pm (BY: JOHNSON, TANNER)



A →	A 12-30	B 12-30	B
SIGN# 1	SIGN# 4 WEST FACE	SIGN# 6 WEST FACE	SIGN# 7 EAST FACE
B →	A	ATF 123.0	ATF 123.0
SIGN# 2	SIGN# 5 EAST FACE	SIGN# 5 WEST FACE	SIGN# 7 WEST FACE
← B	↖ 12 ← B A → 30 ↗		
SIGN# 3	SIGN# 8		

LEGEND:

- RUNWAY EXTENSION/WIDENING FOOTPRINT
- WHITE RUNWAY EDGE LIGHT
- RED/GREEN THRESHOLD/RUNWAY END LIGHT
- BLUE APRON/TAXIWAY EDGE LIGHT
- YELLOW APRON ENTRANCE LIGHT
- PRECISION APPROACH PATH INDICATOR (PAPI)
- AIRPORT ROTATING BEACON
- ILLUMINATED WINDSOCK
- ILLUMINATED SIGN

0 50 100 150 200 250

Scale 1:5000 (metres)

CLIENT

Alberni-Clayoquot Regional District

RUNWAY EXTENSION PRE-DESIGN REPORT ALBERNI VALLEY REGIONAL AIRPORT

OPTION 4: RUNWAY 12 & 30 EXTENSIONS 2x162m (531.5ft) C/W WIDENING TO 30m (100ft) LIGHTING LAYOUT

TETRA TECH EBA

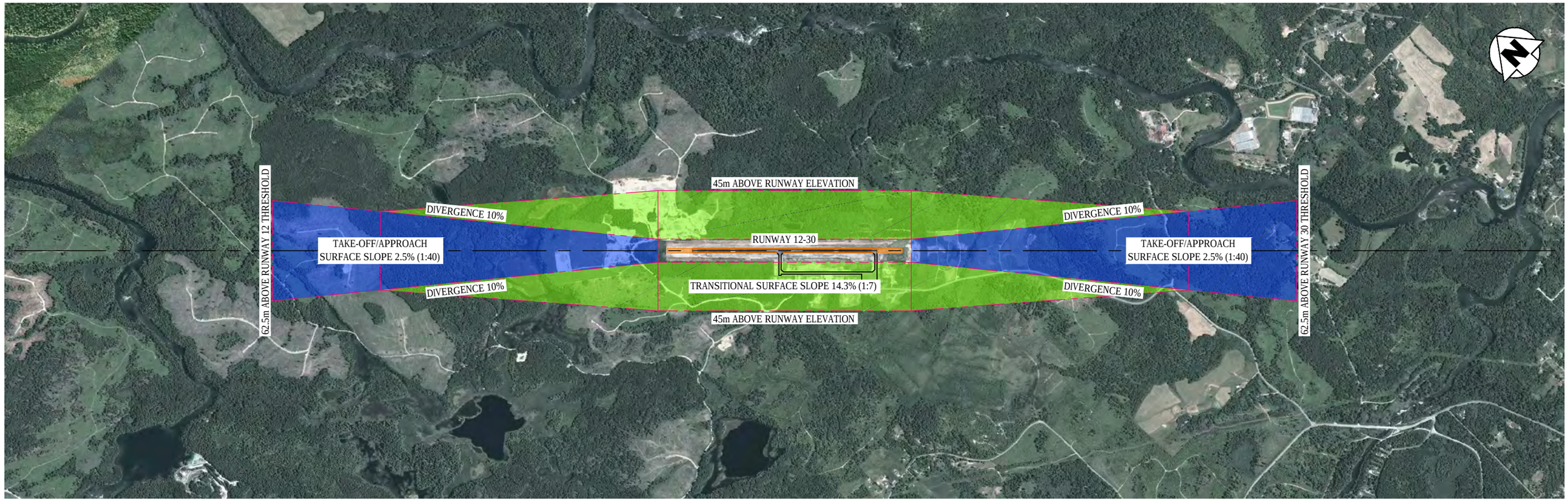
PROJECT NO.	DWN	CKD	REV
C31103399-01	T.J.	R.B./S.S.	1

OFFICE: Calgary

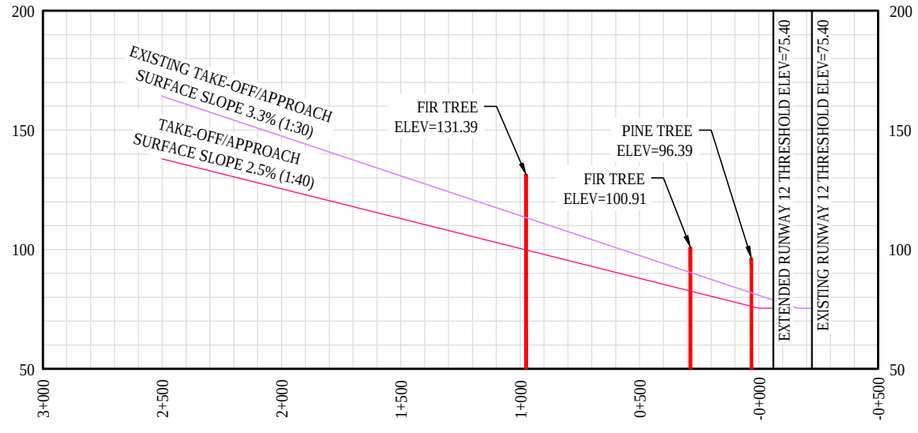
DATE: September 17, 2014

Figure 6

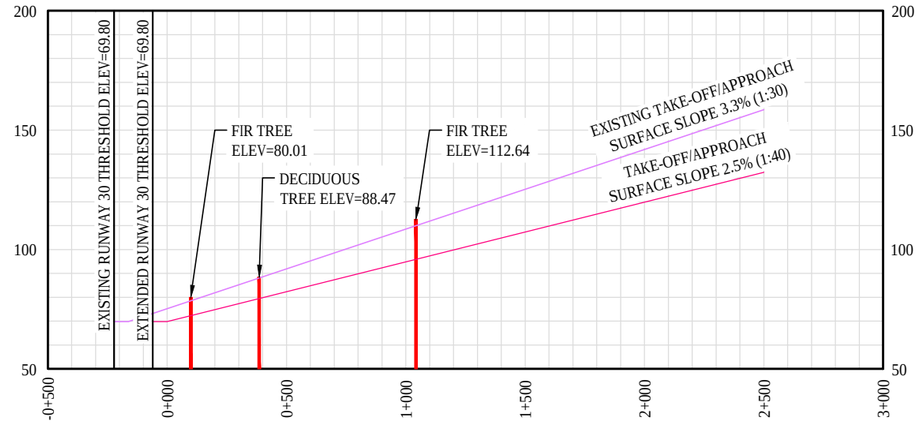
G:\C311\C31103399-01 Alberni Valley Rwy Exten\Phase 001\Figures\C31103399-01 Figure 6.dwg [FIGURE 6] September 16, 2014 - 3:33:38 pm (BY: JOHNSON, TANNER)



AIRFIELD OLS PLAN



RUNWAY 12 TAKE-OFF/APPROACH SURFACE PROFILE



RUNWAY 30 TAKE-OFF/APPROACH SURFACE PROFILE

LEGEND:

- RUNWAY EXTENSION/WIDENING FOOTPRINT
- TAKE-OFF/APPROACH SURFACE FOOTPRINT
- TRANSITIONAL SURFACE FOOTPRINT
- TAKE-OFF/APPROACH SURFACE OBSTACLE

NOTES:

OBSTACLES SHOWN IN RUNWAY TAKE-OFF/APPROACH SURFACE PROFILES ARE FROM OLS DRAWINGS COMPLETED ON JULY 29, 2014 BY SNC LAVALIN.

0 0.25 0.5 0.75 1 1.25

Scale 1:25,000 (kilometres)

CLIENT

Alberni-Clayoquot Regional District

RUNWAY EXTENSION PRE-DESIGN REPORT
ALBERNI VALLEY REGIONAL AIRPORT

OPTION 4: RUNWAY 12 & 30 EXTENSIONS
2x162m (531.5ft) C/W WIDENING TO 30m (100ft)
OBSTACLE LIMITATION SURFACE (OLS)

TETRA TECH EBA

PROJECT NO.	DWN	CKD	REV
C31103399-01	T.J.	R.B./S.S.	1

OFFICE: Calgary

DATE: September 17, 2014

Figure 7

APPENDIX B
CLASS D ESTIMATES OF PROBALE COSTS

Alberni Valley Regional Airport (CBS8)
Runway Extension Pre-Design Report
Class 'D' Estimate of Probable Costs

Option 1: Runway 12 Extension 324m (1063 ft)

September 15, 2014

Item	Estimate of Probable Costs Summary				Total
1.00	General Requirements				$ 467,000
2.00	Civil Site Works				$ 1,485,600
	Total Estimate of Probable Construction Costs				**$ 1,952,600**
3.00	Estimated Engineering Costs - Design, Construction Inspection (rounded)			10%	$ 195,300
4.00	Project Contingencies (rounded)			35%	$ 683,400
	Total Estimate of Probable Project Costs				**$ 2,831,300**

Item	Description	Unit	Est Quantity	Unit Price	Total Price
1.00	**General Requirements**				
1.01	Temporary Facilities - Mob / Demob, Survey etc.	Lump Sum	1	$ 75,000	$ 75,000
1.02	Tree Clearing/Felling for Obstacle Limitation Surface (OLS) Compliance	Hectare	50	$ 3,700	$ 185,000
1.03	Remove Existing 6' Wildlife Fencing (North, East, West) and Replace with New 10' Wildlife at Revised Locations to Accommodate Proposed Runway Strip/OLS Distances	Lin.m.	2,300	$ 90	$ 207,000
				Subtotal General Requirements	**$ 467,000**
2.00	**Civil Site Works**				
2.01	Clearing, Grubbing for Rwy Strip	m^2	35,000	$ 7	$ 245,000
2.02	Common Excavation and Dispose On-Site - Runway Footprint - Approx. 1000mm Depth	m^3	10,000	$ 13	$ 130,000
2.03	Common Excavation/Grading and Dispose On-Site - Runway Strip/Graded Strip - Varying Depths incl. Potential Drainage Ditches	m^2	48,800	$ 7	$ 341,600
2.04	Granular Subbase Course (GSBC) - 600mm thick	m^3	6,000	$ 55	$ 330,000
2.05	Granular Base Course (GBC) - 230mm thick	m^3	2,300	$ 60	$ 138,000
2.06	3.5m Granular Shoulder - 90mm thick	m^3	225	$ 60	$ 13,500
2.07	Hot-Mix Asphalt Concrete Paving (HMAC) - 90mm thick	Tonne	1,750	$ 160	$ 280,000
2.08	Eradicate Existing Pavement Markings	Lump Sum	1	$ 2,500	$ 2,500
2.09	New Pavement Markings	Lump Sum	1	$ 5,000	$ 5,000
				Subtotal Civil Site Works	**$ 1,485,600**

Notes:

1.0 This estimate of probable costs is based on a conceptual design and provided for budgetary purposes only. Costs noted above are estimates based on similar works completed over the past five years. It is not to be interpreted as a guarantee by Tetra Tech of the actual project costs. The actual project cost shall be determined by the tender and construction process.

2.0 The estimated quantities shown above are based on limited topographic data and shall be validated by way of topographic survey during the design phases. The estimates include 2-5% contingency to account for fluctuations between assumptions made and actual ground conditions.

3.0 Quantity under item 1.02 is an estimate to cover costs associated with clearing OLS protrusions as surveyed by SNC Lavalin. It has been extrapolated to include additional clearing for the runway extension options. Some localized clearing efforts may be required for areas of taller trees outside the main clearing footrpint.

4.0 Item 1.03 is intended to estimate the cost of replacing the existing deteriorated wildlife fence along the north, east and west of the airfield. Should a chain link security fence be explored, the lineal metre unit cost per metre is estimated at $ 140 per lineal metre. The fencing (chain link and/or wildlife) along the south side of the airfield is expected to remain unless otherwise specified.

5.0 Temporary Facilities have been estimated at 5%(rounded) of the Subtotal Civil Site Works

Alberni Valley Regional Airport (CBS8)
Runway Extension Pre-Design Report
Class 'D' Estimate of Probable Costs

Option 2: Runway 30 Extension 324m (1063 ft)

September 15, 2014

Item	Estimate of Probable Costs Summary				Total
1.00	General Requirements				$ 472,000
2.00	Civil Site Works				$ 1,571,350
	Total Estimate of Probable Construction Costs				**$ 2,043,350**
3.00	Estimated Engineering Costs - Design, Construction Inspection (rounded)			10%	$ 204,300
4.00	Project Contingencies (rounded)			35%	$ 715,200
	Total Estimate of Probable Project Costs				**$ 2,962,850**

Item	Description	Unit	Est Quantity	Unit Price	Total Price
1.00	**General Requirements**				
1.01	Temporary Facilities - Mob / Demob, Survey etc.	Lump Sum	1	$ 80,000	$ 80,000
1.02	Tree Clearing/Felling for Obstacle Limitation Surface (OLS) Compliance	Hectare	50	$ 3,700	$ 185,000
1.03	Remove Existing 6' Wildlife Fencing (North, East, West) and Replace with New 10' Wildlife at Revised Locations to Accommodate Proposed Runway Strip/OLS Distances	Lin.m.	2,300	$ 90	$ 207,000
				Subtotal General Requirements	**$ 472,000**
2.00	**Civil Site Works**				
2.01	Clearing, Grubbing for Rwy Strip	m^2	47,250	$ 7	$ 330,750
2.02	Common Excavation and Dispose On-Site - Runway Footprint - Approx. 1000mm Depth	m^3	10,000	$ 13	$ 130,000
2.03	Common Excavation/Grading and Dispose On-Site - Runway Strip/Graded Strip - Varying Depths incl. Potential Drainage Ditches	m^2	48,800	$ 7	$ 341,600
2.04	Granular Subbase Course (GSBC) - 600mm thick	m^3	6,000	$ 55	$ 330,000
2.05	Granular Base Course (GBC) - 230mm thick	m^3	2,300	$ 60	$ 138,000
2.06	3.5m Granular Shoulder - 90mm thick	m^3	225	$ 60	$ 13,500
2.07	Hot-Mix Asphalt Concrete Paving (HMAC) - 90mm thick	Tonne	1,750	$ 160	$ 280,000
2.08	Eradicate Existing Pavement Markings	Lump Sum	1	$ 2,500	$ 2,500
2.09	New Pavement Markings	Lump Sum	1	$ 5,000	$ 5,000
				Subtotal Civil Site Works	**$ 1,571,350**

Notes:

1.0 This estimate of probable costs is based on a conceptual design and provided for budgetary purposes only. Costs noted above are estimates based on similar works completed over the past five years. It is not to be interpreted as a guarantee by Tetra Tech of the actual project costs. The actual project cost shall be determined by the tender and construction process.

2.0 The estimated quantities shown above are based on limited topographic data and shall be validated by way of topographic survey during the design phases. The estimates include 2-5% contingency to account for fluctuations between assumptions made and actual ground conditions.

3.0 Quantity under item 1.02 is an estimate to cover costs associated with clearing OLS protrusions as surveyed by SNC Lavalin. It has been extrapolated to include additional clearing for the runway extension options. Some localized clearing efforts may be required for areas of taller trees outside the main clearing footrpint.

4.0 Item 1.03 is intended to estimate the cost of replacing the existing deteriorated wildlife fence along the north, east and west of the airfield. Should a chain link security fence be explored, the lineal metre unit cost per metre is estimated at $ 140 per lineal metre. The fencing (chain link and/or wildlife) along the south side of the airfield is expected to remain unless otherwise specified.

5.0 Temporary Facilities have been estimated at 5%(rounded) of the Subtotal Civil Site Works

Alberni Valley Regional Airport (CBS8)
Runway Extension Pre-Design Report
Class 'D' Estimate of Probable Costs

Option 3: Runway 12 and 30 Extensions 2 x 162m (531.5ft)

September 15, 2014

Item	Estimate of Probable Costs Summary				Total
1.00	General Requirements				$ 517,000
2.00	Civil Site Works				$ 1,559,600
	Total Estimate of Probable Construction Costs				**$ 2,076,600**
3.00	Estimated Engineering Costs - Design, Construction Inspection (rounded)			10%	$ 207,700
4.00	Project Contingencies (rounded)			35%	$ 726,800
	Total Estimate of Probable Project Costs				**$ 3,011,100**

Item	Description	Unit	Est Quantity	Unit Price	Total Price
1.00	**General Requirements**				
1.01	Temporary Facilities - Mob / Demob, Survey etc.	Lump Sum	1	$ 125,000	$ 125,000
1.02	Tree Clearing/Felling for Obstacle Limitation Surface (OLS) Compliance	Hectare	50	$ 3,700	$ 185,000
1.03	Remove Existing 6' Wildlife Fencing (North, East, West) and Replace with New 10' Wildlife at Revised Locations to Accommodate Proposed Runway Strip/OLS Distances	Lin.m.	2,300	$ 90	$ 207,000
				Subtotal General Requirements	**$ 517,000**
2.00	**Civil Site Works**				
	Runway 12 Extension				
2.01	Clearing, Grubbing for Rwy Strip	m^2	9,200	$ 7	$ 64,400
2.02	Common Excavation and Dispose On-Site - Runway Footprint - Approx. 1000mm Depth	m^3	5,000	$ 13	$ 65,000
2.03	Common Excavation/Grading and Dispose On-Site - Runway Strip/Graded Strip - Varying Depths incl. Potential Drainage Ditches	m^2	29,000	$ 7	$ 203,000
2.04	Granular Subbase Course (GSBC) - 600mm thick	m^3	3,000	$ 55	$ 165,000
2.05	Granular Base Course (GBC) - 230mm thick	m^3	1,150	$ 60	$ 69,000
2.06	3.5m Granular Shoulder - 90mm thick	m^3	110	$ 60	$ 6,600
2.07	Hot-Mix Asphalt Concrete Paving (HMAC) - 90mm thick	Tonne	900	$ 160	$ 144,000
2.08	Eradicate Existing Pavement Markings	Lump Sum	1	$ 2,500	$ 2,500
2.09	New Pavement Markings	Lump Sum	1	$ 5,000	$ 5,000
	Runway 30 Extension				
2.10	Clearing, Grubbing for Rwy Strip	m^2	25,000	$ 7	$ 175,000
2.11	Common Excavation and Dispose On-Site - Runway Footprint - Approx. 1000mm Depth	m^3	5,000	$ 13	$ 65,000
2.12	Common Excavation/Grading and Dispose On-Site - Runway Strip/Graded Strip - Varying Depths incl. Potential Drainage Ditches	m^2	29,000	$ 7	$ 203,000
2.13	Granular Subbase Course (GSBC) - 600mm thick	m^3	3,000	$ 55	$ 165,000
2.14	Granular Base Course (GBC) - 230mm thick	m^3	1,150	$ 60	$ 69,000
2.15	3.5m Granular Shoulder - 90mm thick	m^3	110	$ 60	$ 6,600
2.16	Hot-Mix Asphalt Concrete Paving (HMAC) - 90mm thick	Tonne	900	$ 160	$ 144,000
2.17	Eradicate Existing Pavement Markings	Lump Sum	1	$ 2,500	$ 2,500
2.18	New Pavement Markings	Lump Sum	1	$ 5,000	$ 5,000
				Subtotal Civil Site Works	**$ 1,559,600**

Notes:

1.0 This estimate of probable costs is based on a conceptual design and provided for budgetary purposes only. Costs noted above are estimates based on similar works completed over the past five years. It is not to be interpreted as a guarantee by Tetra Tech of the

2.0 The estimated quantities shown above are based on limited topographic data and shall be validated by way of topographic survey during the design phases. The estimates include 2-5% contingency to account for fluctuations between assumptions made and actual ground conditions.

3.0 Quantity under item 1.02 is an estimate to cover costs associated with clearing OLS protrusions as surveyed by SNC Lavalin. It has been extrapolated to include additional clearing for the runway extension options. Some localized clearing efforts may be required for areas of taller trees outside the main clearing footrpint.

4.0 Item 1.03 is intended to estimate the cost of replacing the existing deteriorated wildlife fence along the north, east and west of the airfield. Should a chain link security fence be explored, the lineal metre unit cost per metre is estimated at $ 140 per lineal metre. The fencing (chain link and/or wildlife) along the south side of the airfield is expected to remain unless otherwise specified.

5.0 Temporary Facilities have been estimated at 8%(rounded) of the Subtotal Civil Site Works due to two construction locations on site.

Alberni Valley Regional Airport (CBS8)
Runway Extension Pre-Design Report
Class 'D' Estimate of Probable Costs

Option 4: Runway 12 and 30 Extensions 2 x 162m (531.5ft) c.w. Widening to 30m

September 15, 2014

Item	Estimate of Probable Costs Summary				Total
1.00	General Requirements				$ 517,000
2.00	Civil Site Works				$ 2,452,100
	Total Estimate of Probable Construction Costs				**$ 2,969,100**
3.00	Estimated Engineering Costs - Design,Construction Inspection (rounded)			10%	$ 296,900
4.00	Project Contingencies (rounded)			35%	$ 1,039,200
	Total Estimate of Probable Project Costs				**$ 4,305,200**

Item	Description	Unit	Est Quantity	Unit Price	Total Price
1.00	**General Requirements**				
1.01	Temporary Facilities - Mob / Demob, Survey etc.	Lump Sum	1	$ 125,000	$ 125,000
1.02	Tree Clearing/Felling for Obstacle Limitation Surface (OLS) Compliance	Hectare	50	$ 3,700	$ 185,000
1.03	Remove Existing 6' Wildlife Fencing (North, East, West) and Replace with New 10' Wildlife at Revised Locations to Accommodate Proposed Runway Strip/OLS Distances	Lin.m.	2,300	$ 90	$ 207,000
				Subtotal General Requirements	**$ 517,000**
2.00	**Civil Site Works**				
	Runway 12 Extension				
2.01	Clearing, Grubbing for Rwy Strip	m^2	9,200	$ 7	$ 64,400
2.02	Common Excavation and Dispose On-Site - Runway Footprint - Approx. 1000mm Depth	m^3	5,000	$ 13	$ 65,000
2.03	Common Excavation/Grading and Dispose On-Site - Runway Strip/Graded Strip - Varying Depths incl. Potential Drainage Ditches	m^2	29,000	$ 7	$ 203,000
2.04	Granular Subbase Course (GSBC) - 600mm thick	m^3	3,000	$ 55	$ 165,000
2.05	Granular Base Course (GBC) - 230mm thick	m^3	1,150	$ 60	$ 69,000
2.06	Hot-Mix Asphalt Concrete Paving (HMAC) - 90mm thick	Tonne	1,150	$ 160	$ 184,000
2.07	Eradicate Existing Pavement Markings	Lump Sum	1	$ 2,500	$ 2,500
2.08	New Pavement Markings	Lump Sum	1	$ 5,000	$ 5,000
	Runway 30 Extension				
2.09	Clearing, Grubbing for Rwy Strip	m^2	25,000	$ 7	$ 175,000
2.10	Common Excavation and Dispose On-Site - Runway Footprint - Approx. 1000mm Depth	m^3	5,000	$ 13	$ 65,000
2.11	Common Excavation/Grading and Dispose On-Site - Runway Strip/Graded Strip - Varying Depths incl. Potential Drainage Ditches	m^2	29,000	$ 7	$ 203,000
2.12	Granular Subbase Course (GSBC) - 600mm thick	m^3	3,000	$ 55	$ 165,000
2.13	Granular Base Course (GBC) - 230mm thick	m^3	1,150	$ 60	$ 69,000
2.14	Hot-Mix Asphalt Concrete Paving (HMAC) - 90mm thick	Tonne	1,150	$ 160	$ 184,000
2.15	Eradicate Existing Pavement Markings	Lump Sum	1	$ 2,500	$ 2,500
2.16	New Pavement Markings	Lump Sum	1	$ 5,000	$ 5,000
	3.5m Runway Widening Each Side				
2.17	Common Excavation and Dispose On-Site - Runway Footprint - Approx. 1000mm Depth	m^3	8,650	$ 13	$ 112,450
2.18	Granular Subbase Course (GSBC) - 600mm thick	m^3	5,150	$ 55	$ 283,250
2.19	Granular Base Course (GBC) - 230mm thick	m^3	1,800	$ 60	$ 108,000
2.20	Hot-Mix Asphalt Concrete Paving (HMAC) - 90mm thick	Tonne	2,000	$ 160	$ 320,000
2.21	New Pavement Markings (Edge Marking)	Lump Sum	1	$ 2,000	$ 2,000
				Subtotal Civil Site Works	**$ 2,452,100**

Notes:

1.0 This estimate of probable costs is based on a conceptual design and provided for budgetary purposes only. Costs noted above are estimates based on similar works completed over the past five years. It is not to be interpreted as a guarantee by Tetra Tech of the

2.0 The estimated quantities shown above are based on limited topographic data and shall be validated by way of topographic survey during the design phases. The estimates include 2-5% contingency to account for fluctuations between assumptions made and actual ground conditions.

3.0 Quantity under item 1.02 is an estimate to cover costs associated with clearing OLS protrusions as surveyed by SNC Lavalin. It has been extrapolated to include additional clearing for the runway extension options. Some localized clearing efforts may be required for areas of taller trees outside the main clearing footrpint.

4.0 Item 1.03 is intended to esimate the cost of replacing the existing deteriorated wildlife fence along the north, east and west of the airfield. Should a chain link security fence be explored, the lineal metre unit cost per metre is esimated at $ 140 per lineal metre. The fencing (chain link and/or wildlife) along the south side of the airfield is expected to remain unless otherwise specified.

5.0 Temporary Facilities have been estimated at 5%(rounded) of the Subtotal Civil Site Works

Alberni Valley Regional Airport (CBS8)
Runway Extension Pre-Design Report
Class 'D' Estimate of Probable Costs

Option 5: Runway 12 and 30 Extensions 2 x 162m (531.5ft) c.w. Widening to 45m

September 15, 2014

Item	Estimate of Probable Costs Summary				Total
1.00	General Requirements				$ 517,000
2.00	Civil Site Works				$ 4,674,850
	Total Estimate of Probable Construction Costs				**$ 5,191,850**
3.00	Estimated Engineering Costs - Design,Construction Inspection (rounded)			10%	$ 519,200
4.00	Project Contingencies (rounded)			35%	$ 1,817,100
	Total Estimate of Probable Project Costs				**$ 7,528,150**

Item	Description	Unit	Est Quantity	Unit Price	Total Price
1.00	**General Requirements**				
1.01	Temporary Facilities - Mob / Demob, Survey etc.	Lump Sum	1	$ 125,000	$ 125,000
1.02	Tree Clearing/Felling for Obstacle Limitation Surface (OLS) Compliance	Hectare	50	$ 3,700	$ 185,000
1.03	Remove Existing 6' Wildlife Fencing (North, East, West) and Replace with New 10' Wildlife at Revised Locations to Accommodate Proposed Runway Strip/OLS Distances	Lin.m.	2,300	$ 90	$ 207,000
				Subtotal General Requirements	**$ 517,000**
2.00	**Civil Site Works**				
	Runway 12 Extension				
2.01	Clearing, Grubbing for Rwy Strip	m^2	9,200	$ 7	$ 64,400
2.02	Common Excavation and Dispose On-Site - Runway Footprint - Approx. 1000mm Depth	m^3	7,500	$ 13	$ 97,500
2.03	Common Excavation/Grading and Dispose On-Site - Runway Strip/Graded Strip - Varying Depths incl. Potential Drainage Ditches	m^2	26,500	$ 7	$ 185,500
2.04	Granular Subbase Course (GSBC) - 600mm thick	m^3	4,500	$ 55	$ 247,500
2.05	Granular Base Course (GBC) - 230mm thick	m^3	1,750	$ 60	$ 105,000
2.06	Hot-Mix Asphalt Concrete Paving (HMAC) - 90mm thick	Tonne	1,725	$ 160	$ 276,000
2.07	Eradicate Existing Pavement Markings	Lump Sum	1	$ 2,500	$ 2,500
2.08	New Pavement Markings	Lump Sum	1	$ 5,000	$ 5,000
	Runway 30 Extension				
2.09	Clearing, Grubbing for Rwy Strip	m^2	25,000	$ 7	$ 175,000
2.10	Common Excavation and Dispose On-Site - Runway Footprint - Approx. 1000mm Depth	m^3	7,500	$ 13	$ 97,500
2.11	Common Excavation/Grading and Dispose On-Site - Runway Strip/Graded Strip - Varying Depths incl. Potential Drainage Ditches	m^2	26,500	$ 7	$ 185,500
2.12	Granular Subbase Course (GSBC) - 600mm thick	m^3	4,500	$ 55	$ 247,500
2.13	Granular Base Course (GBC) - 230mm thick	m^3	1,750	$ 60	$ 105,000
2.14	Hot-Mix Asphalt Concrete Paving (HMAC) - 90mm thick	Tonne	1,725	$ 160	$ 276,000
2.15	Eradicate Existing Pavement Markings	Lump Sum	1	$ 2,500	$ 2,500
2.16	New Pavement Markings	Lump Sum	1	$ 5,000	$ 5,000
	11m Runway Widening Each Side				
2.17	Common Excavation and Dispose On-Site - Runway Footprint - Approx. 1000mm Depth	m^3	26,400	$ 13	$ 343,200
2.18	Granular Subbase Course (GSBC) - 600mm thick	m^3	16,150	$ 55	$ 888,250
2.19	Granular Base Course (GBC) - 230mm thick	m^3	6,200	$ 60	$ 372,000
2.20	Hot-Mix Asphalt Concrete Paving (HMAC) - 90mm thick	Tonne	6,200	$ 160	$ 992,000
2.21	New Pavement Markings (Edge Marking)	Lump Sum	1	$ 2,000	$ 2,000
				Subtotal Civil Site Works	**$ 4,674,850**

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2.0 The estimated quantities shown above are based on limited topographic data and shall be validated by way of topographic survey during the design phases. The estimates include 2-5% contingency to account for fluctuations between assumptions made and actual ground conditions.

3.0 Quantity under item 1.02 is an estimate to cover costs associated with clearing OLS protrusions as surveyed by SNC Lavalin. It has been extrapolated to include additional clearing for the runway extension options. Some localized clearing efforts may be required for areas of taller trees outside the main clearing footrpint.

4.0 Item 1.03 is intended to estimate the cost of replacing the existing deteriorated wildlife fence along the north, east and west of the airfield. Should a chain link security fence be explored, the lineal metre unit cost per metre is estimated at $ 140 per lineal metre. The fencing (chain link and/or wildlife) along the south side of the airfield is expected to remain unless otherwise specified.

5.0 Temporary Facilities have been estimated at $125,000.

Alberni Valley Regional Airport (CBS8)
Runway Extension Pre-Design Report
Class 'D' Estimate of Probable Costs

Airfield Lighting Layout c.w. Option 3: Runway 12 and 30 Extensions and Widening to 30m (100ft)

September 15, 2014

Item	Estimate of Probable Costs Summary				Total
1.00	General Requirements				$ 70,000
2.00	Electrical Site Works				$ 1,218,200
	Total Estimate of Probable Construction Costs				**$ 1,288,200**
3.00	Estimated Engineering Costs - Design and Construction Inspection			10%	$ 128,820
4.00	Project Contingencies (rounded)			35%	$ 450,870
	Total Estimate of Probable Project Costs				**$ 1,867,890**

Item	Description	Unit	Est Quantity	Unit Price	Total Price
1.00	**General Requirements**				
1.01	Temporary Facilities - Mob / Demob, Survey, Insurance, Bonding etc.	Lump Sum	1	$ 60,000	$ 60,000
1.02	Conduct Testing and Commissioning	Lump Sum	1	$ 2,500	$ 2,500
1.03	Supply of Operations and Maintenance Manuals, Spare Parts	Lump Sum	1	$ 7,500	$ 7,500
				Subtotal General Requirements	**$ 70,000**
2.00	**Electrical Site Works**				
	Rwy 12 Precision Approach Path Indicators (PAPI)				
2.01	Trenching, RPVC Ducts, #8 ASLC Power Cable etc.	Lin.m.	50	$ 100	$ 5,000
2.02	New Pull Pits (Junction Boxes)	Each	5	$ 600	$ 3,000
2.03	PAPI Fixtures, Concrete Bases etc.	Lump Sum	1	$ 40,000	$ 40,000
	Rwy 30 Precision Approach Path Indicators (PAPI)				
2.04	Trenching, RPVC Ducts, #8 ASLC Power Cable etc.	Lin.m.	50	$ 100	$ 5,000
2.05	New Pull Pits (Junction Boxes)	Each	5	$ 600	$ 3,000
2.06	PAPI Fixtures, Concrete Bases etc.	Lump Sum	1	$ 40,000	$ 40,000
	Airfield Lighting, Signage and Windsocks				
2.07	Trenching, RPVC Ducts, #8 ASLC Power Cables etc.	Lin.m.	5,400	$ 120	$ 648,000
2.08	New Pull Pits (Junction Boxes)	Each	130	$ 600	$ 78,000
2.09	Illuminated Windsock Assemblies c.w. Concrete Base	Each	2	$ 10,000	$ 20,000
2.10	Single Sided Illuminated LED Airfield Signage c.w. Concrete Base	Each	6	$ 10,000	$ 60,000
2.11	Two Sided Illuminated LED Airfield Signage c.w. Concrete Base	Each	2	$ 11,000	$ 22,000
2.12	LED Threshold/Runway End Light Fixtures	Each	12	$ 1,400	$ 16,800
2.13	LED Runway Edge Light Fixtures	Each	49	$ 1,200	$ 58,800
2.14	LED Taxiway Edge Light Fixtures	Each	41	$ 1,200	$ 49,200
2.15	LED Apron Edge Light Fixtures	Each	12	$ 1,200	$ 14,400
	Field Electrical Centre (FEC) and Lighting Control				
2.16	New Field Electrical Centre Building c.w. Three (3) Constant Current Regulators, Aerodrome Beacon	Lump Sum	1	$ 150,000	$ 150,000
2.17	Aircraft Control of Aerodrome Lighting (ARCAL) System	Lump Sum	1	$ 5,000	$ 5,000
				Subtotal Electrical Site Works	**$ 1,218,200**

Notes:

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2.0 Temporary Facilities have been estimated at 5%(rounded) of the Subtotal Electrical Site Works

3.0 Trenching, RPVC ducts and cabling for each system have been included under the respective headings except for quantities of duct and cable required to route back to the FEC. These have been included under item 2.07 as these trench runs will be common trenched.

4.0 The FEC location is envisioned to be adjacent to Apron I. This location has been used for trench and duct quantities.

5.0 The current electrical power feeds to the airport site should be reviewed and confirmed for capacity and phasing.