ENVIRONMENTAL AND SOCIO-ECONOMIC EFFECTS ASSESSMENT

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6.0 ENVIRONMENTAL AND SOCIO-ECONOMIC EFFECTS ASSESSMENT

The description of the environmental and socio-economic setting, and current state of the environment within the Project area (Section 5.0 of this EA), are compared in this section of the EA against the Project Description (Section 2.0 of this EA) to identify potential effects that might be caused by the Proposed EOG Pipeline Project. The environmental and socio-economic effects assessment uses the information provided in the environmental and socio-economic setting to:

- evaluate the environmental and socio-economic elements of importance in the Project area;
- formulate appropriate site-specific mitigative measures that are technically and economically feasible;
- identify and evaluate Project residual effects associated with each environmental and socio-economic element of importance; and
- identify the effects of the environment on the Project.

In addition, the environmental and socio-economic effects assessment has determined the significance of potential adverse residual effects resulting from construction and operation activities after taking into consideration proposed mitigation and, where warranted, compensation measures.

6.1 Methodology

The assessment evaluated the environmental and socio-economic effects of the construction, operation, decommissioning and abandonment phases of each component of the Project (*i.e.,* pipelines, pump additions, tanks, temporary facilities for construction). The assessment method included the following components:

- determination of spatial and temporal boundaries for this assessment;
- identification of biophysical and socio-economic elements;
- identification of potential environmental and socio-economic impacts;
- development of technically and economically feasible mitigation and, where appropriate, compensation measures;
- identification of anticipated residual effects; and
- determination of the significance of adverse residual effects.

This environmental and socio-economic effects assessment methodology has been developed based in part on the CEA Agency's *Cumulative Effects Assessment Practitioners Guide* (Hegmann *et al.* 1999) and the *CEA Act.*

6.1.1 Spatial and Temporal Boundaries

Spatial Boundaries

The spatial boundaries considered one or more of the following study areas:

- A Footprint Study Area made up of the area directly disturbed by the Project construction and cleanup activities, including associated physical works and activities (*i.e.,* permanent right-of-way, temporary construction workspace, temporary stockpile sites, temporary staging areas, and facility sites).

- An LSA consisting of the area which could potentially be affected by construction and reclamation activities as well as associated works and activities beyond the Footprint area. The local boundary varies with the discipline and issue being considered.

- An RSA consists of the area extending beyond the LSA boundary. The boundary for the RSA also varies with the discipline and the issue being considered (*e.g.,* for socio-economic analysis, regional boundaries include large communities that will be used as construction offices or regional municipal district boundaries).

The ecological boundary is described within the discussions of each element. Spatial ecological boundaries were determined by the distribution, movement patterns and potential zones of interaction between an element and the Project. The ecological boundary may be limited to the Footprint (*e.g.,* pipeline construction right-of-way) or extend beyond the physical boundaries of the area of the Project component since the distribution or movement of an element can be local, regional, provincial or transboundary in extent.

Temporal Boundaries

The time frames used in the assessment of the Project include the planning, construction, operations, and decommissioning and abandonment phases. The construction period for the pipelines (including; clearing, grading, trenching, testing and reclamation) is projected to occur between mid Q3 to late Q4 2012. A construction schedule for the Project is provided in Section 2.4.12 of this EA. The operations phase was considered to commence in late Q4 2012 following construction and extend an estimated 50+ years.

6.1.2 Biophysical and Socio-Economic Elements

Potential biophysical and socio-economic elements interacting with the Project were identified through the public and government consultation process, through experience gained during past construction programs, through experience gained during other construction programs in areas with similar conditions as well as the professional judgment of the assessment team. Key to determining element interactions with the Project was the identification of issues noted during public consultation with provincial and municipal government agencies, local industry people, interested stakeholders and the general public (Section 3.0 of this EA).

Biophysical and socio-economic elements potentially interacting with the Project include:

- physical elements such as physical environment, soil capability, water quality and quantity, GHG and air quality, and acoustic environment;
- biological elements such as fish and fish habitat, wetlands, vegetation, wildlife and wildlife habitat, and species at risk; and
- socio-economic elements such as human occupancy and resource use, heritage resources, traditional land and resource use, social and cultural well-being, human health, infrastructure and services, and employment and economy.

Effects arising from accidents and malfunctions, and effects of the environment on the Project were also considered.

6.1.3 Potential Environmental and Socio-Economic Effects

The potential environmental and socio-economic effects resulting from the Project were identified through the public and government consultation process, through experience gained during past construction programs, through experience gained during other construction programs in the area as well as in nearby areas with similar conditions, and most importantly, through the professional

judgment of the assessment team. The potential environmental and socio-economic effects arising from the construction and operation of the pipelines are identified in Section 6.2 of this EA.

6.1.4 Mitigative Measures

To ensure that potential environmental and socio-economic effects are minimized during pipeline and facility construction and operation, a number of general and site-specific mitigative measures have been proposed based upon current industry-accepted standards, consultation with government agencies and interested groups and individuals, and the professional judgment of the assessment team.

Site-specific mitigative measures are outlined in Sections 6.2, 6.3 and 6.4 of this EA. Various municipal and provincial government, and industry standards, guidelines, and (*e.g.,* Canadian Association of Petroleum Producers (CAPP) 1996, 1999, 2005, CAPP *et al*. 2005, Manitoba Natural Resources 1996) and previous EIA submissions to regulatory agencies have been taken into consideration in the EA.

Accompanying the EA are photomosaic maps and construction plans (see CD sleeve at back of the EA). Highly qualified Environmental Inspectors will be retained by EOG to ensure that the mitigative measures within the EA are properly implemented during construction. Environmental Inspection is further described in Section 8.0 of this EA.

6.1.5 Residual Effects

Residual effects are the net environmental and socio-economic effects remaining following the implementation of mitigative measures. In some situations, the recommended mitigative measures will completely mitigate the potential adverse effects while in other situations, the mitigative measures will lessen the effects, but not entirely eliminate them. Residual effects may also be induced effects (*e.g.,* the introduction of weeds through mitigative effects to control erosion). Potential impacts of an element for which no residual effects are predicted require no further analysis.

6.1.6 Significance Analysis of Residual Effects

Residual impacts were measured by evaluating certain criteria, and assigning each criterion a value according to an accepted scale. The criteria used to assess the potential environmental impacts related to the proposed project are: direction, severity (or magnitude), duration, occurrence and geographic extent of the effect.

In detail, these criteria are defined as the following:

a. **Direction** – the direction of the impact may be positive, neutral or negative with respect to the benefit or detriment of the environment that will result from the project going ahead.

b. **Severity** – a measure of the degree of change that will occur as the project proceeds and may be described as none, negligible (*i.e*., no measurable impact), minor, moderate or major.

c. **Duration** – refers to the length of time that the environmental effect occurs and whether the impact is reversible once the disturbance has been completed (*i.e*., reclamation of access trails and well pads). A short-term impact is defined herein as three years or less, a medium impact may last as long as the duration of the project (lifespan of the wells), and a long-term impact remains after the disturbance has been decommissioned.

d. **Geographic Extent** – refers to the area affected by the impact and is defined as site-specific (restricted to the individual well pad/pipeline), local (includes the access trails, pipelines, *etc*.), regional, and provincial/national.

e. **Occurrence** – refers to the frequency at which the impact occurs over the specified duration and is described as: none, infrequent, frequent, and continuous. Occurrence may also refer to the probability of occurrence (*i.e*., the risk of an event occurring) and is described as none, very unlikely, unlikely, likely and very likely. Occurrence is used in this latter (risk) context only in accident related activities (*i.e*., spills).

Estimating "Degrees of Severity" is complex because terms such as "minor", "moderate", or "major" are defined differently for different components within a project. Furthermore, within each component itself, there are varying degrees of magnitude for each potential impact. The following are general guidelines to the terms commonly used to quantify the degrees of severity associated with potential impacts:

1. **Major severity** – refers to an impact that affects a whole natural population or an entire biotic community in sufficient magnitude to cause a change that affects the integrity of the population.

2. **Moderate severity** – refers to an impact that affects a portion of a natural population and may bring about a change in abundance or distribution of that natural population; however, the change does not affect the integrity of the population as a whole.

3. **Minor severity** – refers to an impact that affects a specific group in a natural population but does not affect the population as a whole.

4. **Negligible severity** – refers to an impact that has no measurable effect on the natural population as a whole.

5. **None (no severity)** – that there is no interaction between the proposed project and the population or physical environment, or that the interaction has no effect.

The activities associated with the proposed project are first independently evaluated according to these criteria, then jointly to assess the overall or "cumulative" impact. Thus, the degree of impact measures the combined ecological and societal values (*i.e*., land use, aesthetics) for the area, and is defined as a function of the direction, severity, duration, occurrence and geographic extent of the impact.

The degree of impact can be described in general terms as:

1. **No impact** – refers to impacts that do not occur.

2. **Negligible impacts** – impacts that are not discernable above background or within the existing variance of the term being reported.

3. **Low impacts** – impacts that are minor in severity, short- or medium-term in duration and restricted to the project area.

4. **Moderate impacts** – impacts that are moderate in severity, or short-, medium- or long-term duration and do not extend beyond the regional area.

5. **High impacts** – refers to moderate or major impacts that are long-term in duration and/or extend beyond the regional area.

A summary of the significance evaluation for adverse residual effects arising from the construction and operation of the pipelines and associated pipeline facilities are identified in Section 6.2 of this EA, while the significance evaluation for adverse residual effects arising from temporary facilities for construction and pipeline abandonment are identified in Sections 6.3 and 6.4 of this EA.

6.2 Effects Assessment - Pipeline and Construction and Operation

Using the assessment methodology described in Section 6.1 of this EA, the following subsections evaluate the potential environmental and socio-economic effects associated with the construction and operation of the proposed pipelines.

Biophysical and socio-economic elements potentially interacting with the pipeline component of the proposed EOG Pipeline Project include:

- physical elements such as physical environment, soil capability, water quality and quantity, GHG and air quality, and acoustic environment;
- biological elements such as fish and fish habitat, wetlands, vegetation, wildlife and wildlife habitat, and species at risk;
- socio-economic elements such as human occupancy and resource use, heritage resources, traditional land and resource use, social and cultural well-being, human health, infrastructure and services, and employment and economy; and
- accidents and malfunctions.

The potential environmental and socio-economic effects associated with the pipelines as well as the accompanying proposed mitigative measures and resulting residual effects are presented in Table 6.1 located at the end of Section 6.0 of this EA.

A summary of the significance evaluation for adverse residual effects arising from the construction and operation of the pipelines and associated pipeline facilities is provided in Table 6.1 located at the end of Section 6.0 of this EA. The following subsections describe the evaluation of significance using the criteria presented in Table 6.1 for the adverse residual effects associated with the applicable biophysical and socio-economic elements.

6.2.1 Physical Environment

The potential residual effects (see Table 6.1 of this EA) associated with the construction and operation of the pipelines on the physical environment include:

- localized rill erosion could occur prior to the re-establishment of vegetation; and
- areas of minor instability may occur in fill materials as a result of terrain instabilities.

The potential effects of the environment on the Project (such as flooding, wildfires, climate change and severe weather) are discussed in Section 6.5 of this EA.

Localized Erosion

Rill erosion of topsoil could occur at localized areas prior to the re-establishment of vegetation. This residual effect is discussed in more detail in relation to Section 6.2.2, Soil Capability of this EA.

Minor Terrain and Fill Instabilities

During the construction of the pipelines, minor areas of terrain and fill instabilities may occur as a result of material slumping. These areas are largely confined to the slopes of the larger watercourses along the route.

Slope stability conditions along the proposed route are considered to be good, based on field observations. The pipelines were routed to avoid areas that may provide slope stability issues. Areas of potential terrain instability will be routinely monitored and promptly remediated, where warranted, to protect pipeline integrity. This residual effect is of low magnitude and reversible in the short-term. Effects of the environment on the Project (*i.e.*, slumping) are discussed in Section 6.5.1 of this EA.

Summary

Based on Table 6.1 of this EA, there are no situations where there is a high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically compensated. Consequently, it is concluded that the residual effects of pipeline construction and operation on the physical environment will be not significant.

6.2.2 Soil Capability

Most of the potential impacts on soil capability associated with the construction and operation of the pipelines are alleviated through the application of mitigative measures. The resulting residual effects associated with the construction and operation of the pipelines on soil capability may include:

- minor mixing of topsoil and subsoil will likely occur during topsoil salvage, storage and replacement activities, including those related to mitigating issues associated with trench instability, shallow topsoil depth, poor colour change, and compaction and rutting;
- some localized undesirable lower subsoils may be unexpectedly encountered and admixed with upper subsoil horizons;
- minor surface erosion of topsoil can be expected until a vegetative cover has been established;
- revegetation of soils saline to the surface may be difficult;
- stone picking may result in disposal issues and the use of sand as bedding and padding material can result in reduced capability of soils adjacent to the trench;
- pulverization resulting in fugitive dust and loss of soil structure can be expected during dry conditions; and
- minor trench subsidence may occur or a crown over the trench may remain.

Minor Topsoil / Subsoil Mixing

During the construction of the pipelines and, to a lesser extent, during maintenance activities, it is likely that a minor amount of topsoil and subsoil mixing will occur along all segments of the route. This residual effect is confined to the Footprint, reversible in the medium-term and of low magnitude.

Minor Undesirable Lower Subsoil / Upper Subsoil Mixing

Lower subsoils with a high salt or gravel content may be unexpectedly encountered within a localized area during construction activities and admixed with upper subsoil horizons exhibiting less salt or gravel content. The detailed soil survey will ensure that the three-lift soil handling technique (Appendix 6A) will be implemented at most locations to minimize the risk of mixing undesirable lower subsoils with topsoil, thereby maintaining the agricultural capability of the soil. This residual effect is confined to the Footprint and of low magnitude.

Minor Surface Erosion

Construction and maintenance activities which disturb the soil will likely result in some minor surface erosion of topsoil until a stable vegetative cover can be established, particularly on slopes which are more susceptible to water erosion. It is expected that a vegetative cover can be established on non-cultivated disturbed slopes within a year, with the application of a quick-catching cover crop in addition to the appropriate seed mix for the location. This residual effect is confined to the Footprint, reversible in the short to long-term and of low magnitude.

Revegetation of Soils Saline to the Surface

High salinity of surface soil may hinder revegetation efforts along the proposed route. The seeding of appropriate saline tolerant seed mix on non-cultivated lands will assist in revegetation of these areas. Post-construction monitoring of the route through these areas will ensure that any identified revegetation issues will be remediated in a timely manner. This residual effect is confined to the Footprint, reversible in the short-term and of low magnitude.

Stone Disposal

Picking of stones from the top of the backfilled subsoil and from the topsoil may result in disposal issues with landowners depending on the volume accumulated. In the event that sand to be used for bedding or padding in rocky areas is windrowed on unstripped topsoil, reduced soil capability could result. These residual effects are of low magnitude.

Pulverization in Dry Conditions

Construction activities during dry conditions may result in pulverization of soil and sod along the pipeline route which could lead to increased fugitive dust and loss of soil structure. The reversibility of this residual effect ranges from short to medium-term. This residual effect is confined to the Footprint and is of low magnitude.

Minor Trench Subsidence or Remnant Crown

Construction activities may result in localized areas of trench subsidence and/or a remnant crown over the trench along the route. This residual effect is confined to the Footprint, reversible in the short to medium-term and of low magnitude.

Summary

Based on Table 6.1 of this EA, there are no situations where there is a high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically compensated. Consequently, it is concluded that the residual effects of pipeline construction and operation on soil capability will be not significant.

6.2.3 Water Quality and Quantity

Potential issues related to aquifer contamination are discussed under Accidents and Malfunctions (see Section 6.2.17 of this EA). The resulting potential residual effects associated with the construction and operation of the pipelines on water quality and quantity include:

- minor localized alteration of natural drainage patterns until trench settlement is complete; and
- disruption of shallow groundwater flow where springs are encountered.

Minor Localized Alteration of Natural Drainage Patterns

With proper implementation of the mitigation measures proposed, disruption of surface flow patterns following construction is likely to be minor along the route. In the event that construction or maintenance activities result in changes in surface water regimes, corrective action in consultation with the appropriate authorities will be undertaken to resolve the issue. The residual effect is reversible in the short-term and of low to medium magnitude.

Reduction in Surface Water Quality

The selection of appropriate water body crossing techniques (i.e. boring of crossings) and implementation of surface erosion controls and riparian vegetation restoration are likely to substantially reduce the potential for adverse effects on surface water quality at watercourses crossed by the route. No sedimentation is anticipated during the pipeline crossing of a watercourse using a boring method since there is no instream construction associated with that method.

Disruption of Springs

If springs are encountered along the proposed route, disruption of shallow groundwater flow may occur during the short-term construction period. Monitoring of spring flow during construction will detect any disruption to flows and measures (*e.g.*, subdrains, trench breakers) will be implemented to restore groundwater flow regimes. Alternate water supplies for domestic or livestock use will be provided until the flow in the spring is restored. This residual effect is reversible in the short-term, of low magnitude and low probability.

Summary

Based on Table 6.1 of this EA, there are no situations where there is a high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically compensated. Consequently, it is concluded that the residual effects of pipeline construction and operation on water quality or quantity will be not significant.

6.2.4 Greenhouse Gases and Air Quality

The potential residual effects associated with the construction and operation of the Proposed EOG Pipeline contributing to GHG emissions and on air quality include:

- incremental increase in the GHG emissions associated with the EOG pipeline system will occur;
- increase in vehicle emissions from construction equipment will occur during pipeline construction;
- increase in dust arising from construction traffic on the right-of-way or access roads; and
- slight increase in vehicle emissions during maintenance activities.

Greenhouse Gas Emissions

Sources of GHG emissions identified as being associated with pipeline include:

- combustion of fossil fuels associated with pipeline construction activities; and

- emissions associated with the temporary and longer-term clearing of site vegetation (in particular, tree cover) and changes in land-use and vegetative cover.

An assessment of the direct and indirect incremental GHG emissions associated with the proposed pipeline project was not undertaken. No direct GHG emissions are anticipated to arise from the proposed operation of the pipelines.

Construction-related GHG emissions due to the construction of the pipelines were omitted from the assessment since these are a onetime occurrence. Nevertheless, the amount of GHG emissions associated with construction activities will be minimized by utilizing multi-passenger vehicles for the transport of crews to and from job sites to the extent practical. Similarly, the emissions associated with clearing of vegetation will be reduced since the proposed route largely traverses cleared lands thereby minimizing the amount of clearing required.

The residual effect of GHG emissions during pipeline construction is considered to be neutral and, consequently, does not require a further evaluation of significance.

Vehicle Equipment Emissions During Construction

Although nuisance emissions arising from construction equipment will occur along the entire route, the residual effect of an increase in vehicle emissions will be limited to areas in proximity to human receptors (*i.e.*, permanent residences). This residual effect is reversible in the short-term and, as a result of the proposed mitigation measures to minimize air emissions during construction, is of low magnitude.

Dust During Construction

Increased dust along the construction right-of-way and unpaved access roads is confined to those portions of the pipelines built during relatively dry non-frozen conditions. This residual effect is immediately reversible and, as a result of proposed mitigation measures to minimize dust during construction, is of low magnitude.

Air Emissions During Operations

The operation of the proposed pipelines will not result in any continuous air emissions. However, during periodic maintenance activities of immediate to short-term duration, emissions from equipment will occur and, depending on the location and season of the work, dust may result during the activity. Nevertheless, the residual effect of routine maintenance activities on air quality is anticipated to be of limited areal extent, reversible in the short-term and of negligible to low magnitude.

Summary

Based on Table 6.1 of this EA, there are no situations where there is a high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically compensated. Consequently, it is concluded that the residual effects of the proposed pipeline construction and operation on GHG and air quality will not be significant.

6.2.5 Acoustic Environment

The potential residual effects associated with the construction and operation of the pipelines on the acoustic environment include:

- increase in noise will occur during pipeline construction; and
- slight rise in noise levels will occur during site-specific maintenance activities.

Noise During Construction

Noise arising from construction activities is unavoidable and will occur over the entire route. However, the residual effect of a short-term increase in noise will be limited to areas in proximity to human receptors (*i.e.*, permanent residences, urban areas). The linear progression of pipeline construction results in approximately 1-2 weeks duration of concentrated construction activity at any given location. Confining pipeline activities to adhere to local noise by-laws will also reduce noise concerns in populated areas. The residual effect of construction noise on nearby residents is of low magnitude and immediately reversible.

The effect of construction noise on wildlife is discussed in Section 6.2.9 of this EA.

Noise During Operation

The operation of the pipelines will generally not result in an increase in noise levels over existing levels. However, during site-specific periodic maintenance activities of immediate to short-term duration, a slight rise in noise will likely occur from vehicles or equipment used during the activity. Nevertheless, the residual effect of routine maintenance activities on the acoustic environment is anticipated to be limited in aerial extent, immediately reversible and of negligible to low magnitude.

Summary

Based on Table 6.1 of this EA, there are no situations where there is a high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically compensated. Consequently, it is concluded that the residual effects of pipeline construction and operation on the acoustic environment will be not significant.

6.2.6 Fish and Fish Habitat

6.2.6.1 Ecological Context

Fish populations and aquatic habitat protection in Manitoba fall under the jurisdiction of the federal government through DFO and the *Fisheries Act*. Watercourses crossed by the proposed pipeline route are part of the Assiniboine River drainage basin. Eight drainages will be dry, open cut. The Souris River and Antler River will be bored and therefore no in-stream activities are proposed.

The watercourses that are crossed by the proposed pipelines are characterized by channels with typically shallow gradients, low to moderate water velocities and meandering course.

6.2.6.2 Significance

The river crossings will be bored during pipeline construction and therefore no environmental effects associated with the construction and operation of the pipelines on fish and fish habitat are expected.

Disturbance of Riparian Vegetation

No disturbance of riparian vegetation within the right-of-way will occur. Should disturbance occur during bellhole excavation for boring, disturbed areas will be seeded with the appropriate native seed mix along with a quick establishing cover crop.

There will be no residual effect as there will be no clearing of vegetation in riparian area.

Contamination from Spills

In the event of a large spill such as a fuel truck rollover in a stream, the adverse residual effects could be of high magnitude with long lasting ramifications to the health of the stream. Although spill contingency and clean-up measures would reduce the magnitude and reversibility of the residual effects, such an incident could be considered significant due to the adverse residual effects in a highly sensitive environment. Since events such as this rarely occur within the construction right-of-way and even more rarely occur instream, the probability of a significant adverse residual effect is low. See also Accidents and Malfunctions, Section 6.2.17 of this EA.

Summary

Based on Table 6.1 of this EA, there are no situations where there is a high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically compensated. Consequently, it is concluded that the residual effects of pipeline construction and operation on the fish and fish habitat will be not significant.

6.2.7 Wetlands

6.2.7.1 Ecological Context

The proposed pipeline route encounters wetland habitats within the Aspen Parkland and Grassland regions of the Continental Prairie Wetland Region. The greatest threat to the health of wetlands in this region results from agricultural practices of draining or altering prairie potholes. Agricultural conversion of wetlands has been a common practice in the prairies for the past century and it is estimated that only 40-50% of the original wetlands remain untouched (Leitch 1981).

The most common alterations of wetlands have been draining and filling of wetlands during subsequent agricultural practices and/or modification to the hydrologic regime.

6.2.7.2 Significance

The proposed pipeline route is designed to avoid impacts on wetlands to the maximum extent feasible. However, most of the potential effects associated with the construction and operation of the proposed pipelines on wetlands that cannot be avoided will be minimized through the application of mitigative measures. Potential residual effects associated with the construction of the pipelines include:

- alteration of wetland habitat function;
- alteration of hydrologic function of wetlands; and
- alteration of water quality function in wetlands.

Alteration of Wetland Habitat Function

Construction and maintenance activities within wetlands along the route will likely result in some minor disruption to the habitat function of wetlands. Examples of potential adverse environmental effects on wetland habitat function are: potential changes in species composition; stress on rare plant species; interruption of wildlife movements; and fragmentation of natural habitats. With proper construction and mitigative measures, these adverse effects can be successfully minimized.

For example, Zimmerman and Wilkey (1992) monitored wetlands for impacts to vegetation for 20-years post-disruption from pipeline construction. Findings of these long-term monitoring programs show that: adjacent natural wetland areas were not altered in type; no non-native plant species invaded natural areas; and the right-of-way increased diversity. Additional studies on wetland vegetation (Van dyke *et al.* 1994) record the following observations.

- Wetland community impacts: at most sites, many plants from adjacent natural areas re-establish themselves on the right-of-way; and properly constructed rights-of-way appear to have little impact on vegetation in the natural areas.
- Wetland species diversity: often, a greater number of wetland plants are observed on the right-of-way than in the adjacent natural area; and rights-of-way increase the number and types of habitats in the wetlands.
- Construction and management practices: vegetative cover on right-of-way sites in wetlands is generally well-established within 1-3 years after the pipeline construction. However, minor differences in the final right-of-way surface elevation can strongly influence the type of vegetation that reestablishes on the right-of-way.

The effects of construction of a pipeline right-of-way on wetland vegetation and bird communities were investigated up to two-years following construction by Santillo (1993). Results showed that: at two-years post-construction, wetlands were dominated by native hydrophytic graminoids; there was a fairly high similarity of species composition and structure among study wetlands at two-years post construction, regardless of wetland type, except for a wetland with standing water; and no new bird species were introduced as a result of the different habitat provided by the right-of-way.

Mitigative measures will be employed to minimize the residual effects on wetlands, depending on site-specific conditions and requirements. With the implementation of the proposed mitigation measures and in consideration of past monitoring programs, the potential disruption or alteration of wetland habitat function is considered to be reversible in the short-term and of low magnitude.

Alteration of Wetland Hydrologic Function

Potential changes to hydrologic flow (*i.e.,* surface or groundwater flow) of a wetland may include wetland drainage, water diversion and natural flow impedance. Excessive wetland drainage or diversion will result in an unnatural decrease to wetland area while flow impedance (*i.e.,* inadequate drainage) creates wetland habitat. However, each of these alterations is an interruption to the natural hydrologic regime and is considered an adverse environmental effect.

Among the most important considerations for limiting disturbances to hydrologic function is assuring that preconstruction elevations and contours are achieved (Gartman 1991) and that there will be no unnatural impedance to flow. Short-term disturbances to wetlands are expected during construction of the pipelines. If the right-of-way is restored to its preconstruction profile and the bed and bank of all channels are carefully reconstructed, then long-term impacts on wetland function are not expected.

Standard pipeline construction and operational activities are designed to avoid circumstances which result in drainage, diversion and/or unnatural retention of water. By utilizing the proven and effective mitigative measures from past projects in the area, it is anticipated that wetland hydrologic function along the pipeline route will be effectively restored within the short-term.

Consequently, the residual effect of the pipelines on wetland hydrology is reversible in the short-term and of low magnitude.

Alteration of Wetland Water Quality Function

Activity in or near wetlands during pipeline construction along the proposed route may result in an increased sediment supply and turbidity of surface waters thereby decreasing overall water quality function. Other possible impacts to water quality include the potential for loss of groundwater quality as a result of interference with shallow (within trench depth) groundwater movement, changes to nutrient levels due to flow impedance from an active river channel and, in the event of a major fuel spill from a piece of equipment or fuel truck, infiltration into surficial deposits and the near surface groundwater are probable.

Mitigative measures will be employed during construction and maintenance activities to ensure that all practical measures will be utilized to minimize impacts on water quality in wetlands. With the implementation of these measures, the residual effects of the pipelines on wetland water quality are considered to be of low magnitude and reversible in the short-term.

Summary

Based on Table 6.1 of this EA, there are no situations where there is a high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically compensated. Consequently, it is concluded that the residual effects of pipeline construction and operation on wetlands and wetland function will be not significant.

6.2.8 Vegetation

6.2.8.1 Ecological Context

Previous disturbances of native vegetation in the vicinity of the pipeline route have included clearing and breaking of native prairie and wooded areas for agricultural purposes since the late 1880s to present. Development of road and rail transportation networks from the late 1880s to present has also substantially affected native vegetation.

It has been estimated that 90% of the native landscapes on the Canadian prairies have been altered, primarily by agricultural activities (Grilz and Romo 1995). Native vegetation in the area is generally limited to wetlands, major river valleys, and stream channels as well as areas with soils or topography unsuitable for agricultural use. Improved pasture, which often contains elements of native plant communities, also forms a part of the landscape. The Aspen Parkland ecoregion contains very productive agricultural soils and native vegetation is generally limited to areas where topography is not favourable for cultivation.

The relationship of native vegetation with other ecosystem components is that it provides protection of: gene pools for future use; protection of native plant and wildlife species and their habitats; preservation of climax ecosystems and native biodiversity; and conservation of representative samples of different habitats characteristic of the region. Areas of remnant native vegetation are also economically important to the agricultural community since they provide grazing lands for livestock.

6.2.8.2 Significance

The potential residual effects on vegetation associated with construction and operation of the pipelines include:

- alteration of native vegetation;
- if mitigative measures do not completely protect the site, some loss or alteration of the local population of S1, S2 and/or S3 rare vascular plants may occur;

- transplanted or propagated rare vascular plant specimens may not survive;
- if the sensitive plant community cannot be avoided and access restrictions and temporarily covering the site do not completely protect the community, then a narrow strip of the community will be disturbed resulting in some loss or alteration of the community;
- alteration of approximately vegetation important to wildlife;
- weed introduction and spread may occur; and
- ornamental trees, wind breaks or shelterbelts may be removed as a result of construction activities.

Alteration of Native Vegetation

Disturbed areas through native vegetation segments will be seeded with the appropriate native seed mix. No locally or regionally adopted threshold or standard exists against which the incremental change in vegetation composition can be judged. This residual effect is limited to the Footprint, reversible in the medium to long-term and of low to medium magnitude.

Rare Vascular Plant Species of Concern

Protection measures and environmental management techniques for rare plants will be based on site-specific conditions and species sensitivity criteria. Final decisions on mitigative measures will be made by EOG in consultation with botanical experts and Manitoba Conservation. Mitigative measures for vascular plant species of concern are outlined in the Plant Species of Concern Discovery Contingency Plan (see Appendix 6B of this EA) and generally fall into categories of avoidance, minimizing disturbance and alternative reclamation techniques.

Minor re-routing of the pipeline route at the Souris River River crossing will avoid identified Buffalograss individuals. Based on the assessment of the rare vascular plants that may be encountered during construction, the proven mitigative measures described above are considered to be appropriate and applicable to the vascular species encountered by the pipeline route. However, if mitigative measures do not completely protect the site, a loss or alteration of a portion of the local population of S1, S2, and/or S3 rare vascular plants may occur. By basing mitigation on species ranking, abundance, growth habit and habitat, in addition to its location on the right-of-way, any loss or alteration of the local rare plant population, particularly S1 local populations, would be reduced to a level such that the local population is not placed at risk. Consequently, the residual effects of the construction of the pipelines on rare vascular plant species are reversible in the short to medium-term and of medium magnitude.

Sensitive Plant Communities

Protection measures and environmental management techniques for sensitive plant communities will be based on site-specific conditions and species sensitivity criteria. Final decisions on mitigative measures will be made by EOG in consultation with botanical experts and Manitoba Conservation. Mitigative measures for sensitive plant communities are outlined in the Plant Species of Concern Discovery Contingency Plan (see Appendix 6B of this EA).

The mitigative measures proposed are considered to be appropriate and applicable to the proposed pipelines. However, if the plant community cannot be avoided, then a narrowed strip of the S1, S2 or S3 community will be disturbed resulting in some loss or alteration of the community. In addition, temporarily covering of the site and implementing construction traffic restrictions may not completely protect the community. By basing mitigation on community ranking and abundance, in addition to its location on the right-of-way and the community type, any loss or alteration of the local community, particularly S1 local communities, will be reduced to a level such that the local community is not placed at risk. Consequently, the residual effects of

the pipelines on rare plant communities are confined to the Footprint or the LSA, are reversible in the medium to long-term and of medium magnitude.

Alteration of Vegetation Important to Wildlife

Disturbed areas through non-cultivated/native vegetation areas will be seeded with the appropriate native or agronomic seed mix unless otherwise requested by the landowner. No locally or regionally adopted threshold or standard exists against which the incremental change in vegetation composition can be judged. This residual effect is limited to the Footprint, reversible in the short to long-term and of low magnitude.

Weeds

A pre-construction weed survey was conducted in 2011 along the entire proposed pipeline route (see Section 5.0 of this EA). Mitigative measures outlined in this EA are proven and effective industry standard measures to minimize the introduction and spread of weeds. It is anticipated that weed introduction and spread arising from the construction of the pipelines will be limited in aerial extent, reversible in the short to medium-term and of low magnitude.

Ornamental Trees, Windbreaks and Shelterbelts

Where ornamental trees, windbreaks or shelterbelts are encountered along the route, the right-of-way will generally be narrowed to minimize the number of trees to be removed or the shelterbelt was bored. Landowners will be consulted with regard to ornamental trees, windbreaks and shelterbelts on their property potentially being affected by construction activities. Some of these features may be removed as a result of the construction of the pipelines. However, considering that such removal would have the approval of the landowner, this residual effect is considered to be neutral and, consequently, does not require an evaluation of significance.

Summary

Based on Table 6.1 of this EA, there are no situations where there is a high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically compensated. Consequently, it is concluded that the residual effects of pipeline construction and operation on vegetation will be not significant.

6.2.9 Wildlife

6.2.9.1 Ecological Context

The proposed pipeline route traverses habitats within the Aspen Parkland Ecoregion. Existing disturbances arising predominantly from agricultural activities within the local area have resulted in direct habitat losses and alterations in the past.

Habitat for many of the wildlife species in the vicinity of the pipeline route generally coincides with areas of native vegetation. The loss of native vegetation within the vicinity of the pipeline route directly affects use of native habitats by wildlife and the location, distribution, and viability of many species at risk. Some wildlife species have also adapted to, or acclimated to various levels of human activity.

6.2.9.2 Significance

The potential residual effects on wildlife and wildlife habitat associated with construction and operation of the pipelines include:

- alteration of wildlife habitat;
- displacement of wildlife away from the pipeline route during construction with resultant use of potentially suboptimal habitat during noncritical periods;
- potential for vehicle/wildlife collisions on access roads and along the right-of-way during construction; and
- potential for mortality due to the physical disturbance of undiscovered nests, burrows, dens or other localized habitat on the right-of-way.

Alteration of Wildlife Habitat

Disturbed areas through non-cultivated/native vegetation areas will be seeded with the appropriate native or agronomic seed mix unless otherwise requested by the landowner. No locally or regionally adopted threshold or standard exists against which the incremental change in vegetation composition can be judged. This residual effect is limited to the Footprint, reversible in the short to long-term and of low magnitude.

Sensory Disturbance of Wildlife

Noise arising during the construction of the pipelines may displace wildlife in the vicinity of the right-of-way. However, scheduling construction activities outside of the peak breeding season will substantially minimize the potential to disturb wildlife species during their sensitive life history phases. Due to the linear progression of pipeline construction, construction at any given location along the route will be limited to approximately one month and, therefore, is of short-term duration. This residual effect is of low magnitude and of short-term reversibility.

Wildlife Mortality

Although vehicle speed will be limited on the roads to the pipeline right-of-way as well as on the right-of-way (see Traffic Control Plan in Appendix 6B of this EA), a slight increase in potential for vehicle/wildlife collisions may occur during the construction and, to a lesser extent, during the operation of the pipelines. Consequently, the probability of such a collision is low.

Similarly, the application of mitigative measures outlined of this EA regarding pre-construction wildlife surveys and measures to be taken during construction to reduce the potential for wildlife mortality (*e.g.*, removing trapped animals from the trench) will substantially reduce the potential of wildlife mortality associated with the construction of the pipelines.

Summary

Based on Table 6.1 of this EA, there are no situations where there is a high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically compensated. Consequently, it is concluded that the residual effects of pipeline construction and operation on wildlife and wildlife habitat will be not significant.

6.2.10 Species at Risk

The potential residual effects on species at risk associated with construction and operation of the pipelines include:

- if mitigative measures do not completely protect the site, some loss or alteration of the local population of S1, S2 and/or S3 vascular plant species at risk may occur; and

- alteration of habitat used by wildlife species of concern, including burrowing owl, ferruginous hawk, loggerhead shrike and northern leopard frog as well as sensory disturbance and potential mortality during construction if mitigative measures cannot protect some individuals.

Vascular Plant Species at Risk

Although the pipeline route lies within the home range of five vascular plant species at risk (*i.e.*, buffalo grass, hairy prairie-clover, western spiderwort and small white lady's slipper), the majority of the proposed route is located on cultivated land. Minor re-routing of the pipeline route at the Souris River River crossing will avoid identified Buffalograss individuals. Should a vascular plant species at risk be discovered during construction, the implementation of contingency measures outlined in Appendix 6B of this EA will ensure that the residual effects on these species is reduced to a level such that local populations are not placed at risk.

Wildlife Species at Risk

Although the pipeline route lies within the known range of 14 wildlife species at risk, five of these species (*i.e.*, northern leopard frog, loggerhead shrike, ferruginous hawk and burrowing owl) have the potential to use habitat along the proposed route or have been previously recorded within the setback distance of the proposed route as per MB CDC records. Wildlife surveys conducted in June/July 2011 did not identify any conflicts with preferred habitat features (eg. dens, nests, etc.) for species at risk.

Northern leopard frogs are considered species of Special Concern under *SARA* in Manitoba. This species has been rated as S4 (apparently secure) in Manitoba. The population of northern leopard frogs is increasing and stable.

Should northern leopard frogs be identified during construction, the implementation of contingency measures will reduce the effects on this species to a level such that the local populations are not placed at risk. Consequently, the residual effects of the construction of the pipelines on northern leopard frogs are reversible in the short to medium-term and of low to medium magnitude.

Loggerhead shrikes are considered a Threatened species under *SARA* in Manitoba. This species has been rated as S3S4B (apparently secure to vulnerable) in Manitoba. The population of loggerhead shrikes has been declining, particularly in Saskatchewan and Manitoba.

Should loggerhead shrikes be identified during construction, the implementation of contingency measures will reduce the effects on this species to a level such that the local populations are not placed at risk. Consequently, the residual effects of the construction of the pipelines on loggerhead shrikes are reversible in the short to medium-term and of low to medium magnitude.

Should burrowing owls be identified during construction, the implementation of contingency measures would reduce the effects on these species to a level such that the local populations are not placed at risk. Consequently, the residual effects of the construction of the pipelines on burrowing owls are reversible in the short to medium-term and of medium magnitude.

Should other wildlife species of concern be identified during construction, the implementation of contingency measures will reduce the effects on the species to a level such that the local populations are not placed at risk. Consequently, the combined residual effects of the construction of the pipelines on wildlife species at risk are reversible in the short to medium-term and of low to medium magnitude.

Summary

Based on Table 6.1 of this EA, there are no situations where there is a high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically compensated. Consequently, it is concluded that the residual effects of pipeline construction and operation on species at risk will be not significant.

6.2.11 Human Occupancy and Resource Use

The potential residual effects on human occupancy and resource use associated with construction and operation of the pipelines includes:

- disruption of ranching and farming operations, including irrigation activities, may occur during pipeline construction;
- disruption of local hunting and guide outfitting activities may occur during pipeline construction; and
- a decrease in the quality of the outdoor recreation experience may occur at select locations during pipeline construction.

Disruption of Ranching and Farming Operations

Ranchers and farmers along the route may experience disruptions to their activities during the short-term duration of construction of the pipelines. Scheduling of the pipeline component outside of peak agricultural activity periods, including peak irrigation period, where feasible, will lessen the effects on ranchers and farmers. Furthermore, advanced notification of the pipeline activity schedule to all affected ranchers and farmers, and compensation for disrupted activities and crop loss will further minimize these effects. It is anticipated that the construction of the pipelines will not affect the sustainability of ranching and farming activities in the vicinity of the pipeline route nor the livelihood of the local rancher or farmer. The residual effect is reversible in the short-term and of low to medium magnitude.

Disturbance of Hunting and Guide Outfitting Activities

The proposed route is located in an agricultural setting on predominately private lands where hunting is only allowed with the permission of the landowner. The effect of the construction of the pipelines on hunting activities will be negligible for segments of the route constructed during winter and summer.

However, local hunters and guide outfitters may experience some minor disturbance of their activities along segments of the route constructed during autumn. The residual effect is reversible in the short-term and of negligible to low magnitude.

Outdoor Recreational Experiences

Outdoor recreational experiences such as wildlife viewing and fishing may be affected by noise and visual disturbances associated with the construction of the pipelines during nonfrozen conditions. The proposed mitigation measures will restrict the amount of dust and noise associated with the construction of the pipelines. This residual effect is of negligible to low magnitude and is immediately reversible.

Summary

Based on Table 6.1 of this EA, there are no situations where there is a high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically compensated. Consequently, it is concluded that the residual effects of pipeline construction and operation on human occupancy and resource use will be not significant.

6.2.12 Heritage Resources

The potential residual effects on heritage resources associated with construction and operation of the pipelines include:

- previously unidentified buried heritage resources may be disturbed during construction; and/or palaeontological resources may be disturbed as a result of construction activities.

Disturbance of Heritage Resource Sites

Heritage resources provide a window into past human experiences and by their very nature, are nonrenewable and once disturbed the resource may be altered or even lost. Consequently, the primary mitigative measure in protecting heritage resources is avoidance. Yet, to further the understanding of the past, disturbing the cultural resources through excavations is an acceptable practice for archaeologists and, in many cases, the only method to collect *in situ* information to add to the archaeological record. Regardless of whether the excavation of the site is for academic or development purposes, the loss of heritage resource sites is generally offset by the recovery of knowledge about the site gained through meticulous identifying, cataloguing, and preserving of artifacts and features.

No previously identified heritage resources have been identified in the vicinity of the proposed route and a heritage resource assessment will not be required.

Should any previously unidentified buried sites be encountered during construction of the pipelines, activity at that site will be stopped and contingency measures outlined in the Heritage Resource Discovery Contingency Plan (Appendix 6B of this EA) will be implemented. Since knowledge of the site will be recovered prior to resumption of construction activity, the addition of information to the archaeological record is viewed as generally compensating for the loss of heritage resources and magnitude is considered to be low.

Summary

Based on Table 6.1 of this EA, there are no situations where there is a high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically compensated. Consequently, it is concluded that the residual effects of pipeline construction and operation on heritage resources will be not significant.

6.2.13 Social and Cultural Well-Being

The potential residual effect associated with the construction and operation of the pipelines on social and cultural well-being is primarily a temporary increase in the local community population resulting from construction of the pipelines. Only those communities with sufficient services will be selected for locating temporary field offices and accommodating the anticipated 30 person workforce during construction.

The linear progression of pipeline construction results in activities occurring for a relatively short period in any given location along the route. Therefore, no impacts on social and cultural well-

being are anticipated as a result of the pipelines since construction activities occur too briefly to influence the well-being of communities along the pipeline route. Consequently, the residual effect of the construction of the pipelines on social and cultural well-being is anticipated to be neutral, and therefore, does not require an evaluation of significance.

6.2.14 Human Health

The potential residual effects on human health associated with construction and operation of the pipelines include:

- short-term increase in nuisance air emissions (*e.g.*, dust, vehicle exhaust, smoke) during construction; and
- short-term increase in nuisance noise during construction.

The evaluation of significance for nuisance air emissions is discussed in Section 6.2.4 of this EA under GHG and Air Quality while construction noise is evaluated in Section 6.2.5 of this EA under Acoustic Environment.

6.2.15 Infrastructure and Services

The potential residual effects on infrastructure and services associated with construction and operation of the pipelines includes:

- increased traffic on highways and local roads used to access the proposed pipeline right-of-way will occur during construction;
- temporary increase in waste flow to regional landfill sites will occur;
- some local or regional tourist accommodations will be temporarily occupied by Project workers, including those on the pipelines; and
- despite best intentions and work practices, incidents arising during construction may warrant the use of some emergency services.

Increased Traffic on Highways and Local Roads

Alteration of traffic patterns, movements and volumes during construction along major highways and local roads is an unavoidable residual effect. Through the implementation of such mitigative measures as using multi-passenger vehicles and obeying traffic, road-use and safety laws, the residual effect of construction activities on traffic movements is considered to be of low magnitude.

Temporary Increase in Waste Flow

EOG will reduce waste quantities to the lowest levels practical through Project design and the implementation of their Waste Management Plan during construction. All waste generated from the Project during construction will be hauled to the appropriate landfill sites in the region depending on the type of waste. Receptacles for recycling various products (*e.g.*, paper, cardboard, glass, tin, etc.) will be available at the construction offices and will be hauled to appropriate recycling depots. This residual effect is of immediate to short-term reversibility and of low to medium magnitude.

Use of Regional Tourist Accommodations

EOG or its contractor(s) are not planning to install a temporary construction camp. If however, due to limited available accommodation in the regional area a camp may be considered. This

construction camp will be used to house pipeline construction personnel. The use of a construction camp by Project personnel may alleviate the strain on local and regional accommodation in the area, thereby minimizing the displacement of tourists, especially during the peak tourist season.

Summary

Based on Table 6.1 of this EA, there are no situations where there is a high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically compensated. Consequently, it is concluded that the residual effects of pipeline construction and operation on infrastructure and services will be not significant.

6.2.16 Employment and Economy

The potential residual effects associated with the construction and operation of the Project, including pipeline construction activities on employment and economy include:

- local businesses and residents will benefit from the Project through employment opportunities; and
- the Project will generate revenue for municipal, provincial and federal governments.

Approximately 30 workers will spend about $100/day on food and accommodations over the course of the 30-day project. This will result in over $90,000 being injected directly into the local economy.

Construction expenditures for the Project expenditures are estimated to total $15 million, excluding provincial sales taxes. It is projected that the entire estimated amount will be spent in Canada on goods and services.

Summary

Construction of the Project is estimated to result in expenditures on goods and services of approximately $15 million. The effects of the Project on output, employment, labour income and tax revenues, all of which are considered to be positive residual effects on employment and economy, and, consequently, do not require a further evaluation of significance.

6.2.17 Accidents and Malfunctions

The following potential residual effects could occur as a result of accidental events during construction of the pipelines:

- spot spills, once remediated, will have little adverse residual effect, although other resources could be affected or lost as a result of the accident;
- despite vigilance, fires may adversely affect adjacent vegetation and, in very rare situations, affect wildlife and adjacent property;
- rupture of water, sewage or gas lines could lead to interruption of services, contamination of soil and water depending on the location and severity of the rupture, and fires in the case of gas while cable damage can lead to interrupted service of the utility to communities and local residences;
- release of drilling mud on land, once cleaned-up and reclaimed, will have little residual effect;
- depending on the volume and location of the release, a release of drilling mud into a watercourse may affect aquatic ecosystems in the short to medium-term; and

- a pipeline failure may adversely affect adjacent soils, vegetation, wildlife habitat and aquatic ecosystems, including aquifers.

While substantial adverse effects could occur as a result of an accident during the construction of the pipelines, EOG will implement the best available technology and safety measures to minimize the probability of accidents occurring. Therefore, the potential is low for an accident to occur during construction that would have substantial adverse effects.

Spills of Hazardous Materials During Construction

Terrestrial spills during construction will generally be very small and localized within the Footprint. Since light hydrocarbons (*i.e.,* diesel and hydraulic oils) tend to disperse readily and break down, the potential adverse residual effects are reversible in the short-term.

In the event of a large spill such as a fuel truck rollover in a stream, the adverse residual effects could be of high magnitude with long lasting ramifications to the health of the stream. Although spill contingency and clean-up measures would reduce the magnitude and reversibility of the residual effects, such an incident could be considered significant due to the adverse residual effects in a highly sensitive environment. Since events such as this rarely occur within the construction right-of-way and even more rarely occur instream, the probability of a significant adverse residual effect is low.

Fire During Construction

The significance of a fire will depend greatly on the size and what it consumes. Since small fires within the Footprint and off of the Footprint are of minor and moderate concern respectively, and can be extinguished quickly, they are not likely to cause a significant adverse residual effect. Large fires that spread off the Footprint and result in loss of resources and property are likely to be considered a significant adverse residual effect. The likelihood of large fires developing is extremely low since the construction crews will have firefighting equipment and training, and most of the pipeline route lies in close proximity to fire fighting services.

Rupture of or Damage to Foreign Lines, EOG Pipelines and Cables During Construction

Rupture of a water line, buried cable or telephone line along the route may be inconvenient but the adverse residual effects would likely be of low magnitude, and reversible in the immediate to short-term since repair would be relatively easy. Rupture of a sewer line would firstly, be an inconvenience and secondly, could contaminate the soils and trench in the vicinity of the rupture. Contamination of the soils and trench could be remedied relatively quickly with minimal to no residual effect.

In the event of a rupture of a high-pressure gas line, the risk of explosion and risk to human health could be considered significant. Since high pressure pipelines are easily located (as opposed to some low pressure plastic distribution lines) and are of sufficient size and strength that rupture is extremely unlikely, the probability of a significant adverse effect resulting from an explosion of existing gas pipelines is low.

The rupture of an existing EOG or foreign pipeline during construction of the pipelines resulting in severe contamination to lands or water could be considered a significant adverse effect. Since EOG will be adhering to industry standards, regulatory regulations and company protocols, the probability of a significant adverse effect resulting from working in the vicinity of the existing EOG pipelines and foreign pipelines is low.

Release of Drilling Mud During Boring

The release of drilling mud during boring of a watercourse is not uncommon and, in most cases, is relatively benign since the mud is inert and can often be cleaned-up and the areas reclaimed. The introduction of a clay-based drilling mud into the environment will have variable effects depending on the location, volume released and the level of clean-up that is appropriate. Monitoring programs throughout a boring program allow a release of drilling mud to be detected soon after a release occurs. The ability to stop the flow of mud quickly also aids in limiting the total volume of drilling mud. Since the total volumes of drilling mud released during an inadvertent release are generally limited, drilling mud released into a watercourse will be dissipated into a watercourse in a short period. Schmidt *et al.* (2001) evaluated the effect of a release of mud during HDD on wetlands at five sites and determined that none displayed significant long-term impacts as a result of bentonite discharge and further noted that the level of observed impact was in part related to the nature of clean-up procedures. The reversibility of the adverse residual effect on the riparian area will depend on the length of time it takes for vegetation to recolonize the area disturbed by the mud and clean-up activities but is likely to be short to medium-term.

Pipeline Failure During Operations

Pipelines are the safest and most efficient method of transporting large volumes of crude oil and other liquid petroleum products over long distances. The significance of a failure of the pipeline system will depend greatly on the type of product spilled, volume of product spilled and sensitivity of location of the failure. For example, if the incident was contained within a bermed pump station, the residual effect of the release would likely be considered not significant whereas, if the released product affected important wildlife habitat during critical life stages, sensitive aquatic ecosystems (including aquifers) or downstream municipal water intakes, the residual effect would likely be considered significant.

EOG and its predecessors have operated their existing pipelines with diligence over the past 10 years. EOG is committed to maintaining the pipeline right-of-way and operating the pipelines and associated facilities with a continuing high standard of excellence. The following mitigation and operational risk management practices are currently utilized by EOG pipeline operations and will be utilized on the proposed pipelines;

- The pipelines will be operated and maintained as per CSA standards;
- The external portion of pipe will be covered with yellow jacket coating and utilize cathodic protection;
- Internal protection of the pipe will consist of cathodic protection and chemicals to prevent corrosion

Through such programs as pipeline integrity management and emergency response, the risk of a spill resulting in a significant adverse effect is low.

Summary

Based on Table 6.1 of this EA, there are no situations where there is a high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically compensated. Consequently, it is concluded that the residual effects arising from an accident or malfunction during construction and operation for the pipelines will be not significant.

6.3 Effects Assessment - Temporary Facilities for Construction

The following subsection evaluates the potential environmental and socio-economic effects associated with the installation and operation of temporary facilities associated with the construction of the EOG Pipeline Project.

Temporary Facilities for Pipeline Construction

Other temporary facilities which may be required prior to or during pipeline construction of the EOG Pipeline Project include:

- shoo-flies / temporary access roads;
- equipment storage sites (marshalling yards);
- pipe stockpile sites and associated bone yards; and
- construction office sites.

The need for and the respective general location of these sites are the responsibility of the pipeline construction contractor. However, all temporary facility site locations will require the approval of EOG's Project Engineer or designate.

The evaluation of potential temporary facility sites will be conducted as far in advance of its intended use as practical in order to allow an adequate time to chose and evaluate any alternate sites. In the event that specific mitigation is warranted for the site, the measures developed will be documented in the Environmental As-built Report (see Section 8.4.4 of this EA). Mitigative measures to be used at temporary facility sites will be as described in Section 6.2 of this EA. All applicable landowner as well as municipal, provincial and federal government approvals for the temporary facility site will be acquired prior to use of the site or area. The level of mitigation applied will ensure that any adverse residual environmental effects associated with the temporary facilities for construction are reduced to a level that is not significant.

6.4 Effects Assessment - Decommissioning and Abandonment

This subsection describes the decommissioning and abandonment phase where decommissioning means the permanent cessation of the operation of a pipeline without discontinuance of service and abandonment means the permanent cessation of the operation of a pipeline which results in the discontinuance of service.

At the time of decommissioning and/or abandonment of the EOG Pipeline Project, EOG will review and consider current options, issues, and regulatory requirements of the day. The decommissioning and/or abandonment plan will comply with the acceptable regulatory standards of the day, and will be developed in consultation with stakeholders holding an interest in the proposed decommissioning or abandonment work.

Abandonment will most likely consist of abandonment-in-place where the pipeline is purged, cathodic protection of the pipelines is discontinued and measures (*e.g.*, insertion of concrete, foam or other materials) are taken to maintain the structural integrity of the abandoned pipelines at specific locations such as rail, road and water crossings; surface appurtenances are removed and the right-of-way restored to as close to pre-disturbance condition as is practical.

Activities associated with the abandonment of the pipelines are anticipated to include dismantling and removing surface facilities, and reclaiming of the sites to as close to pre-disturbance condition as is practical. Consequently, the biophysical and socioeconomic elements interacting with the EOG Pipeline Project would likely include:

- physical elements such as physical environment (surface erosion), soil capability (admixing of topsoil/subsoil), water quality and quantity (sedimentation), air quality (nuisance health effect – dust, vehicle emissions), and acoustic environment (nuisance health effect – noise);
- biological elements such as fish and fish habitat (alteration of habitat, sedimentation), wetlands (alteration of habitat function), vegetation (weed introduction), wildlife (auditory disturbance), species at risk (auditory disturbance); and
- socio-economic elements such as human occupancy and resource use (disruption of ranching and farming activities), infrastructure and services (transport of workers and supplies); and accidents and malfunctions.

Upon implementation of standard mitigation of the day, it is anticipated that any adverse residual effects would be of similar or lesser magnitude to those which are described above for construction of the pipelines or facility.

6.5 Effects of the Environment on the Project

The following environmental conditions were considered to have the potential to adversely affect the EOG Pipeline Project either during construction or operations or both:

- slumping;
- flooding;
- wildfires;
- changing climatic conditions; and
- severe weather including high wind speeds, heavy/persistent precipitation or extreme temperatures and temperature inversions.

6.5.1 Slumping

Engineering and design of the pipelines has taken into consideration the potential slumping along the proposed pipeline route. Areas of potential terrain instability will be monitored during regular aerial patrols during operations and remedial action will be promptly undertaken where warranted. Mitigative measures will be implemented where the potential for localized terrain instability is encountered (see Section 6.2.1 of this EA). Consequently, slumping events are unlikely to affect the integrity of the buried pipelines. Aboveground facilities such as valves have been located in areas with low potential for slumping. Therefore, the probability of a significant adverse environmental effect on the pipelines resulting from slumping is low.

6.5.2 Flooding

An extreme flood event, either during construction or operations, could result in a loss of cover over the pipelines along floodplains and in watercourses along the pipeline route. The potential effects of flooding and associated mitigation vary depending upon the timing of the event.

The pipelines will be buried deep enough to minimize the potential effects of flooding as well as associated erosion and scouring. Nevertheless, line patrols during operations will pay particular attention to the bed and banks of watercourse crossings following floods to further ensure the integrity of the pipelines and minimize impacts on the aquatic environment. Remedial measures will be taken immediately, where warranted, following receipt of applicable approvals. Consequently, the probability of a flood resulting in a significant adverse environmental effect is low.

6.5.3 Wildfires

A wildfire in the immediate vicinity of the pipelines during the construction phase, although unlikely, could delay construction activities along bush/wooded areas of the proposed route. Construction activities and/or construction-related traffic would be suspended if conditions were considered to be unsafe by EOG's Chief Inspector or if requested by the appropriate authority (*e.g.*, Manitoba Conservation). The short delay of construction activities due to wildfire would generally be considered as having a minor affect on the pipeline component.

During the operations phase, fires are unlikely to adversely affect the buried pipelines. The proposed route traverses predominantly cleared, cultivated lands, thereby minimizing the potential for adverse effects as a result of a wildfire.

An assessment of the effects arising from construction activities is provided in Sections 6.2, 6.3 and 6.4 of this EA while contingency measures identified in the Fire Contingency Plan (Appendix 6B of this EA) have been prepared to ensure that appropriate and effective procedures and materials are in place in the event of a fire accidentally caused during construction of the EOG Pipeline Project. As described in Section 6.2.17 of this EA, the probability of a fire resulting in a significant adverse environmental effect is low.

6.5.4 Climate Change

Changes to climatic conditions during operation of the EOG Pipeline Project may manifest in several ways. Increases in snow pack in winter and warmer temperatures during spring may extend and intensify runoff and alter hydrologic regimes within watercourses including timing and duration of peak flows.

Changes in summer temperatures and rainfall patterns could lead to an increase in wildfires. During operations of the pipelines, EOG will be adaptive in their management of the pipelines and schedule maintenance activities to suit local environmental conditions so as to minimize the potential environmental impact. By utilizing adaptive management practices which are responsive to changing conditions, the effects of climate change on the project are anticipated to be neutral and, consequently, do not require an evaluation of significance.

6.5.5 Severe Weather

<u>High Winds</u>

High winds could result in the suspension of some construction activities along the pipeline route such as topsoil handling, clearing and welding. The buried pipelines will not be adversely affected by high winds.

<u>Inclement Weather</u>

Heavy or persistent precipitation could result in the delay of the construction of the pipelines if topsoil salvage activities have not been completed or if wet soil conditions create safety or trafficability problems. High water tables will not affect the minimum depth of cover.

During the operations phase, heavy or persistent precipitation or extreme temperatures are not anticipated to adversely affect the pipelines (when buried) or aboveground facilities. As a result, no adverse effects on the EOG Pipeline Project are anticipated to result from inclement weather.

6.6 Summary of Environmental and Socio-Economic Effects Assessment

6.6.1 Summary of the Assessment of Potential Effects of the Project on the Environment

The environmental and socio-economic effects associated with the construction and operation of the EOG Pipeline Project (*i.e.*, pipelines and temporary facilities for construction) are not unlike those routinely encountered during pipeline and associated facility construction in an agricultural setting.

Numerous potential environmental and socio-economic effects associated with the EOG Pipeline Project were identified through: consultation with the provincial government representatives, other stakeholders and the general public; review of existing literature; field studies; and the professional judgment of the assessment team. These potential effects were related to biophysical and socio-economic elements including:

- physical elements such as physical environment, soil capability, water quality and quantity, GHG and air quality, and acoustic environment;
- biological elements such as fish and fish habitat, wetlands, vegetation, wildlife and wildlife habitat, and species at risk;
- socio-economic elements such as human occupancy and resource use; heritage resources; traditional land and resource use; social and cultural well-being; human health; infrastructure and services; employment and economy; and
- accidents and malfunctions.

Most potential effects arising from the EOG Pipeline Project are associated with the construction of the pipelines.

Several mitigative strategies have been employed to avoid or minimize the impacts of the EOG Pipeline Project including: avoidance through pipeline route selection; scheduling of activities to avoid sensitive periods; development of detailed, practical and effective mitigative measures to address numerous site specific and general issues; inspection during construction to ensure that planned mitigation is implemented and effective; and conducting the maintenance and operation of the pipeline system with a high standard of environmental excellence.

Given the mitigative measures identified above, the residual effect of the construction and operation of the pipelines on species at risk is considered to be of low magnitude and not significant.

Through the implementation of the mitigative strategies, the residual effects associated with the construction and operation of the EOG Pipeline Project on the other biophysical and socio-economic elements were considered to be not significant.

6.6.2 Summary of the Assessment of Potential Effects of the Environment on the Project

Environmental conditions such as slumping; flooding; wildfires; changing climatic conditions; and severe weather including high wind speeds, heavy/persistent precipitation or extreme temperatures were considered to have the potential to adversely affect the EOG Pipeline Project either during construction or operations or both. However, through routing of the pipelines, implementation of contingency plans, and burial of the pipe, the potential impacts of the environment on the construction or operation of the EOG Pipeline Project will be minimized and are considered to be not significant.

6.7 References

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TABLE 6-1 SUMMARY OF RESIDUAL IMAPCTS OF THE PROPOSED WASKADA PIPELINE PROJECT

Phase	Area of Impact	Severity	Duration	Occurrence	Geographic Extent	Degree of Impact
Pipeline						
Construction	Physical Environment & Soils	Moderate	Short-term	Infrequent	Local	Low – Not Significant
	Water Quality & Quantity	Minor	Short-term	Infrequent	Local	Low – Not Significant
	Native Vegetation	Minor	Short-term	Infrequent	Local	Low – Not Significant
	GHG & Air Quality	Minor	Short-term	Infrequent	Local	Low – Not Significant
	Water Resources	Minor	Short-term	Infrequent	Local	Low – Not Significant
	Acoustic Environment	Minor	Short-term	Infrequent	Local	Low – Not Significant
	Fish & Fish Habitat	None	N/A	N/A	N/A	Low – Not Significant
	Wetlands	Minor	Short-term	Infrequent	Local	Low – Not Significant
	Vegetation	Minor	Short-term	Infrequent	Local	Low – Not Significant
	Wildlife	Minor	Short-term	Infrequent	Local	Low – Not Significant
	Species At Risk	Minor	Short-term	Infrequent	Local	Low – Not Significant
	Heritage Resources	Minor	Short-term	Infrequent	Local	Low – Not Significant
	Infrastructure & Services	Minor	Short-term	Infrequent	Local	Low – Not Significant
	Employment	Minor	Short-term	Infrequent	Local	N/A
Operation and Maintenance	Physical Environment & Soils	Negligible	Short-term	Infrequent	Local	Low – Not Significant
	Water Quality & Quantity	Negligible	Short-term	Infrequent	Local	Low – Not Significant
	Native Vegetation	Negligible	Short-term	Infrequent	Local	Low – Not Significant
	GHG & Air Quality	Negligible	Short-term	Infrequent	Local	Low – Not Significant
	Water Resources	Minor	Short-term	Infrequent	Local	Low – Not Significant
	Acoustic Environment	None	N/A	N/A	N/A	N/A
	Fish & Fish Habitat	None	N/A	None	Local	Low – Not Significant
	Wetlands	Minor	Short-term	Very unlikely	Local	Low – Not Significant
	Vegetation	Minor	Short-term	Infrequent	Local	Low – Not Significant
	Wildlife	Minor	Short-term	Infrequent	Local	Low – Not Significant
	Species At Risk	Minor	Medium-term	Infrequent	Local	Low – Not Significant
	Heritage Resources	Negligible	Medium-term	Very unlikely	Local	Low – Not Significant
	Infrastructure & Services	Minor	Medium-term	Infrequent	Local	Low – Not Significant
	Employment	Minor	Medium-term	Infrequent	Local	N/A